Regional applied general equilibrium modelling: the case of South Africa's North West Province

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Thesis submitted for the degree

Philosophiae Doctor in Economics

in the

School of Economics

at

North-West University (Potchefstroom Campus)

Promoter: Prof. W.A. Naudé

Potchefstroom

November 2007

ACKNOWLEDGEMENTS

The completion of this thesis required the assistance of a number of friends, colleagues and acquaintances. It is therefore a pleasant aspect that I now have the opportunity to express my gratitude to all of them.

First and foremost, a very (very) special thanks goes to my wife, Stephanié, who is the sole reason why I embarked on this journey. If not for her love and wonderful words of encouragement I would never have succeeded in my endeavours. I will never be able to repay her and I will always try. Stephanié, thank you for all you have done and thank you for all that you are.

Second, I would like to thank my supervisor, Professor Wim Naudé for his guidance, supervision, patience, and mentorship throughout the growth of my thesis. History has shown that a long distance (working) relationship almost never works, but ours did. He has the deepest well of knowledge and I thank him for sharing it with me.

Thanks to the WorkWell *Research Unit for People, Policy and Performance* and all the institutions that generously supplied the information, models, software, facilities, infrastructure, guidance and assistance that I required. Also, I am pleased to acknowledge the financial support that this thesis received from the National Research Foundation (Grant number FA2005041500003) and the North West Provincial Government.

The work here would also not have been possible if it were not for the support of Martin Cameron and Professor Waldo Krugell. They graciously provided of their time and knowledge on the subject and were always available when needed.

Much of my appreciation must go to people I know and love outside the academic environment. First, a debt of gratitude is owed to my family for being so supportive over the eight (count'em, eight) years I spent in Potchefstroom getting my four degrees. Knowing you are all there means everything.

I would also like to extend my gratitude to those people who made my life miserable, which was the catalyst of me finishing up faster.

Last, but surely not least, I would like to thank the Lord for giving me the knowledge, opportunities, ability and strength, without which I would not have been able to achieve anything.

The language editing was done by Mossie Kroep; printing was done by Xerox Printing; and binding was done by the North-West University library (Potchefstroom Campus).

Riaan Rossouw

Potchefstroom, November 2007.

ABSTRACT

South Africa's North West Province is dependent on gold and platinum exports for its economic growth and employment. Whether this specialisation is optimal from an economic growth, employment creation and welfare point of view, or whether greater export diversification should be encouraged, can most appropriately be evaluated using a general equilibrium framework. Moreover, the answer of whether such specialisation or rather diversification is appropriate may differ depending on the spatial level of analysis that is taken. For instance, export diversification or specialisation on a national level might differ from export diversification or specialisation on sub-national (e.g. provincial) level. A general equilibrium framework is most appropriate for investigating the potential differences between these levels as it takes into consideration a region's economic structure, and the economy-wide linkages between demand, supply, production structure and income distribution.

In this light this thesis proposes a regional applied general equilibrium (RAGE) model for the North West Province to address these issues. The question asked is, how can a RAGE model be formulated and implemented for the North West Province of South Africa in order to study the differential impacts of greater export specialisation versus greater export diversification? In answering this question this thesis provides policy makers at regional/provincial level with access to a potentially useful modelling tool, to analyse regional economic issues; it contributes to better understanding the spatial concentration and spatial dynamics of economic activity in the North West Province; and contributes toward the practical policy debate in South Africa.

This thesis reviews the literature on export diversification and specialisation, by investigating the extent of export diversification and specialisation in the North West Province over the period 1995-2006 and its relationship to GDP per capita, and using a RAGE model to investigate the economy-wide impacts of greater export diversification versus greater export specialisation. These **results are contrasted** by investigating the economy-wide impacts of greater export diversification versus greater export specialisation on the national level, using a country-wide applied general equilibrium (AGE) model for South Africa. It is found that greater export diversification results in a more substantial increase in exports

(of between 0.95 and 1.73 per cent) than in the case of greater export specialisation. In fact it was found that if the North West Province were to specialise in mining exports, such exports would need to grow or increase from the base year by approximately 78 per cent (with no increase in the export demand for other sectors) to result in the same level of growth of total export volumes as is found under export diversification.

Avenues for further research are identified. These are a need for more research on elasticities and parameters at regional level, an expansion of the transport services sector in the model, incorporating Tourism Satellite Accounts, BEE and SMME aspects into the model, etc.

In conclusion, the thesis implemented the first provincial regional applied general equilibrium model for South Africa, and illustrated that it can make an important contribution to the policy debate on a provincial level in South Africa. The construction of Social Accounting Matrices (SAMs) for all of South Africa's provinces, and the maintenance of these provincial databases could therefore make further contributions to the quantitative assessment of policy options facing government on both the national and provincial level.

Key words: Regional applied general equilibrium modelling, computable general equilibrium modelling, social accounting matrices, development, South Africa, North West Province

OPSOMMING

Suid-Afrika se Noordwes Provinsie is afhanklik van goud en platinum uitvoer vir sy ekonomiese groei en indiensname. Of hierdie spesialisasie optimaal is vanuit 'n ekonomiese groei-, werkskepping- en welvaartsoogpunt, en of groter uitvoer-diversifikasie aangemoedig behoort te word, kan alleen beoordeel word deur gebruik te maak van 'n algemene ewewigsraamwerk. Daarby, die antwoord of sulke spesialisasie of eerder diversifikasie toepaslik is mag verskil afhangende van die geografiese vlak van analise wat onderneem word. Byvoorbeeld, uitvoer-diversifikasie of -spesialisasie op nasionale vlak mag verskil van uitvoer-diversifikasie of -spesialisasie op sub-nasionale (bv. Provinsiale) vlak. 'n Algemene ewewigsraamwerk is die mees geskikte middel om die potensiële verskille tussen hierdie vlakke te ondersoek aangesien dit 'n streek se ekonomiese struktuur, en die ekonomie-wye koppelings tussen vraag, aanbod, die produksiestruktuur en inkomsteverdeling in ag neem.

In hierdie lig stel hierdie verhandeling 'n streeks-toegepaste algemene ewewigsmodel (STAE) vir die Noordwes Provinsie voor om hierdie probleme te beantwoord. Die vraag wat gevra is, is hoe kan 'n streeks-toegepaste algemene ewewigsmodel vir die Noordwes Provinsie van Suid-Afrika geformuleer en geïmplementeer word ten einde die verskillende invloede van groter uitvoer-diversifikasie teenoor groter uitvoer-spesialisasie te bestudeer? Deur die beantwoording van hierdie vraag voorsien hierdie tesis/proefskrif beleidmakers op streeks/provinsiale vlak met toegang tot 'n potensiële bruikbare modelleringsinstrument, om streekekonomiese probleme te analiseer; dit dra by tot 'n beter begrip van die geografiese konsentrasie en dinamiek van ekonomiese aktiwiteit in die Noordwes Provinsie; en dra by tot die praktiese beleidsdebat in Suid-Afrika.

Hierdie proefskrif hersien die uitvoer-diversifikasie en –spesialisasie literatuur, deur ondersoek in te stel na die mate van uitvoer-diversifikasie en -spesialisasie in die Noordwes Provinsie oor die periode 1995-2006 en sy verhouding tot per capita BBP, deur gebruik te maak van 'n streeks-toegepaste algemene ewewigsmodel om ondersoek in te stel na die ekonomie-wye invloed van groter uitvoer-diversifikasie teenoor groter uitvoer-spesialisasie. Hierdie **resultate word weerspieël** deur die ekonomie-wye invloede van groter uitvoer-diversifikasie teenoor groter uitvoer-spesialisasie op nasionale vlak, deur gebruik te maak

van 'n landwye toegepaste algemene ewewigsmodel van Suid-Afrika. Dit is bevind dat groter uitvoer-diversifikasie 'n meer substansiële toename in uitvoer tot gevolg het (van tussen 0.95 en 1.73 persent) as in die geval groter uitvoer-spesialisasie. Dit is bevind dat indien die Noordwes Provinsie in mynbou-uitvoer sou spesialiseer, sulke uitvoer sou moet toeneem of groei vanaf die basisjaar met ongeveer 78% (met geen toename in die vraag na uitvoer van ander sektore nie) om dieselfde vlak van groei in totale uitvoer volumes tot gevolg te hê.

Gebiede vir verdere navorsing word geïdentifiseer. Dit sluit in 'n behoefte aan meer navorsing rakende elastisiteite en parameters op streeksvlak, 'n uitbreiding van die vervoerdienste sektor in die model, inkorporering van die Toerisme Satelliet Rekeninge, BEE en SMME aspekte in die model, ens.

Ter afsluiting, het hierdie verhandeling die eerste Provinsiale streeks-toegepaste algemene ewewigsmodel vir Suid-Afrika geïmplementeer, en geïllustreer dat dit 'n belangrike bydrae tot die beleidsdebat op 'n provinsiale vlak in Suid-Afrika kan maak. Die konstruksie van die Sosiaal Rekeningkundige Matrikse (SRM) vir al Suid-Afrika se Provinsies, en die handhawing van hierdie provinsiale databasisse kan voortdurende bydraes maak tot die kwantitatiewe assessering van beleidsopsies wat die regering op beide nasionale en provinsiale vlak ervaar.

Sleutelwoorde: Streeks toegepaste algemene ewewigsmodelle, berekenbare algemene ewewigsmodelle, sosiaal rekeningkundige matrikse, ontwikkeling, Suid-Afrika, Noordwes Provinsie

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ABBREVIATIONS

AGE	Applied General Equilibrium
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
GAMS	General Algebraic Modelling System
GEM	General Equilibrium Model
GEMPACK	General Equilibrium Modelling PACKage
GDP	Gross Domestic Product
GOS	Gross Operating Surplus
GTAP	Global Trade Analysis Project
IFPRI	International Food Policy Research Institute
IDC	Industrial Development Corporation
I-O Table	Input-Output Table
LED	Local Economic Development
LPs	Linear Programming models
NAM	National Accounting Matrix
NEG	New Economic Geography
NWPGEM	North West Province General Equilibrium Model
MAC	Manufacturing Advice Centres
MSG	Multi-Sectoral Growth
RAGE	Regional Applied General Equilibrium
RAS	A method for balancing matrices
RSA	Republic of South Africa
SAM	Social Accounting Matrix
SCGE	Spatial Computable General Equilibrium
SDIs	Spatial Development Initiatives
StatsSA	Statistics South Africa
SNA	System of National Accounts
SU-Tables	Supply and Use Table
SIC	Standard Industries Classification
VAT	Value Added Tax

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Poverty, income disparities, high levels of unemployment and low economic growth are realities within the South African economy (Krugell, 2005:11). It is therefore no surprise that these have been the main focus areas in development economics in South Africa. With much of this work, though, the focus is only on the level of the national economy. Moreover, with these socio-economic challenges becoming increasingly complex and interrelated the need for policy makers to have adequate tools to support the evaluation of development policies on all levels of government becomes evident (Pedercini, 2003:1).

The diversity within sub-national regions (provinces, municipalities, cities) within South Africa in terms of population, natural resource endowments and socio-economic structures is likely to result in different impacts of international events and national policy changes on regions' economic development. The intuition is that economic activity is largely based on location-dependent capital and labour, implying that economic activity is firmly linked to a "place" so that international events and national policies will have a differential impact depending on the characteristics, including the economic structure, of the regional environment within which sub-national places, whether it be provinces or municipalities, are located (see e.g. New Zealand Ministry of Economic Development, 2007). South Africa is a pertinent case in point for the need to understand the differential sub-national impacts of international events and national policies better. The country is an open economy, and has been re-integrated into the global economy since 1994, through an extensive trade liberalisation programme. At the same time, the national government has implemented a number of nationally-based macro-economic strategies to address unemployment and poverty, such as the Growth, Employment and Redistribution (GEAR) strategy[1] and

[1] The South African Government introduced the GEAR strategy in 1996. The long term vision of GEAR was to create a competitive fast-growing economy; sufficient jobs for all job seekers; to redistribute income; to provide health, education and other services, to all; to secure the home environment; and to create a productive place to work (see e.g. Department of Finance, 1996).

more recently the Accelerated and Shared Growth Initiative for South Africa (ASGISA)[2]. Concerns that the greater openness and export orientation of the South African economy, coupled with the potential differential provincial impact of macro-economic strategies might exacerbate spatial disparities in incomes and unemployment has been voiced (see e.g. Naudé and Krugell, 2003). It is appropriate that sub-national levels of government be concerned about this possibility, as these levels of government have been assigned significant responsibilities for economic development in terms of the country's constitution (Jansen van Rensburg and Naudé, 2007).

To date however, methods or tools to assess the sub-national regional impacts of international events and national policies have been lacking. One reason is that economic data, which allows quantitative simulation of policy impacts, is much richer at the national level. As a result top-down approaches are often used to estimate the impact of national policies and global trends on South Africa's provinces. This however ignores many regional level factors such as the effect of the local environment on economic activity, the proximity of firms from distinctive resources (clusters), and the quality of the regional labour market (Wing and Anderson, 2004).

This thesis aims to alleviate the lack of quantitative tools to assess the regional impact of national policies and international events by developing a regional applied general equilibrium (RAGE) model for a sub-national region of a developing economy to identify and develop capabilities to enhance the region's economic potential. In this case, the RAGE model will be applied to South Africa's North West Province. This province is significantly dependent on the export of minerals and is therefore sensitive as to both national policies (such as those that influence the value of the exchange rate and the costs of labour) and the situation in global markets.

This chapter provides some background on RAGE modelling (section 1.2), sets out the problem statement (1.3) and motivates this thesis (1.4), including the focus on the North West Province of South Africa. The research question is stated in section 1.5, followed by a description of the primary and secondary objectives of this thesis (1.6). In section 1.7 this thesis' central working hypothesis is described

[2] The South African Government introduced the ASGISA strategy in 2004 to become a national shared growth initiative. The core objective of this strategy is to halve poverty and unemployment by 2014, through the achievement of an average Gross Domestic Product (GDP) growth rate of 6% or more (see e.g. Office of the Presidency, 2006).

and section 1.8 explains the methodology, including a glossary of the concepts and terms, as well as the data used repeatedly throughout this thesis. The chapter concludes by providing a layout of the remainder of this thesis.

1.2 BACKGROUND

Numerical simulation models of the real world are regularly used to inform policy decisions (Giordano, Weir and William, 2003:1). They are useful where analytic solutions are either not attainable or do not provide sufficient information. When compared to analytic models, "... *it is clear that the numerical approach aids the analysis of intricate economic interactions and the impact assessment of structural policy changes*" (Böehringer, Rutherford and Wiegard, 2003:1).

Applied general equilibrium (AGE) models are particular numerical simulations that merge the abstract general equilibrium structure formalised by Arrow and Debreu (1954) with economic data on the equilibrium across a specified set of markets.[3] This makes them a standard tool of empirical analysis (Wing, 2003). Since 1991, the significance of AGE modelling in academic research has been recognised with *the Journal of Economic Literature* listing a separate classification number for this type of analysis (D 58: Computable and other applied general equilibrium models). In South Africa, AGE models have been implemented in various fields of study, including areas as diverse as development planning (e.g., Naudé, Coetzee and Gwarada, 1997; McDonald, Reynolds and Van Schoor, 2006; Pauw and Edwards, 2006), international trade (e.g., Devarajan and Lewis, 2000; Thurlow, 2003; Naudé and Coetzee, 2004), social issues (e.g., Humphreys, 2000; Arndt and Lewis, 2000), and increasingly, environmental regulation (e.g., De Wet and Van Heerden, 2002; Van Heerden *et al.*, 2006).[4] Based upon microeconomics, AGE models provide an important tool for answering complex questions about the interactions within an economic system in a coherent and consistent way. Also, AGE models are very effective at describing market inefficiencies and the burdens caused by price distorting measures. Moreover, AGE models can be used to

[3] For more detail see Arrow and Debreu (1954), Arrow (1951; 1953), Debreu and Scarf (1963), and Hahn (1973).

[4] For a summary on the main AGE applications in South Africa to date see Chapter 4 as well as Appendix A.

describe the economy at a disaggregated level by detailing many different sectors and markets (Bovenberg and Goulder, 1991:201). Rutten (1991:143) has described AGE models as reflecting "*the heart of economic science*".

RAGE models, however, differ from their national counterparts in that regions are perceived as being relatively more open economies compared to nations (Partridge and Rickman, 2007). In RAGE models, the openness of regions highlights the importance of commodity trade and resource migration (Vargas and Schreiner, 1999a). These models also capture the effects of economic issues that cannot be adequately addressed at national level. Moreover, RAGE models are particularly useful to model the impacts of international trade on sub-national economies. This is an issue that has been receiving increasing attention in recent years, in particular in the New Economic Geography (NEG) literature, where it is increasingly realised that a country's participation in world trade, and integration into world markets, may have differential effects on sub-national regions (see e.g. arguments in Gries and Naudé, 2008).

One common feature of both RAGE and AGE models is that each requires a micro-consistent benchmark dataset for development (Partridge and Rickman, 2007). This is provided in the form of a Social Accounting Matrix (SAM). A SAM combines data from input-output tables, national income statistics, and household income and expenditure statistics. The SAM provides a logical arrangement of statistical information, concerning income flows in a country/region's economy within a particular time period (usually a year) (Cameron, 2003).

Why then use RAGE models? Although RAGE models have grown in popularity in recent years as an alternative method for examining regional economies and policy issues, their contribution is yet to be assessed. Partridge and Rickman (2007) present an extensive review of literature related to RAGE modelling and conclude that RAGE models, though still with unclear conclusions on issues of quantitative accuracy, represent a significant advancement in regional economic analysis.[5] Another important contribution of this modelling technique can be to bring out clearly the contingent nature of a lot of the modeller or policy maker's knowledge, or otherwise, as stated by O'Rourke (1995:1) "... *solidly grounded uncertainty can be preferable to ignorant certainty.*"

[5] For more detail on RAGE modelling see Partridge and Rickman (2007).

Currently, policy makers at regional/provincial level in South Africa have only limited access to the most basic modelling tools, such as econometric forecasting models, fixed price input-output multi-sector models and SAMs, to analyse economic issues specific to their regions. A case in point is South Africa's North West Province, which faces numerous and diverse challenges specific to the region/province. In particular this province faces significant implications from foreign trade and the greater openness of the South African economy since 1994 (see Naudé and Coetzee, 2004 for a discussion of trade liberalisation and its effects on the South African economy since 1994). The North West Province is the location of significant gold and platinum mining which forms the bulk of its employment and exports. These are however subject to international commodity prices, the Rand exchange rate, which created important uncertainties in its international trade and growth. In addition, developments in mining exports impact on manufacturing development through for instance 'Dutch Disease' type of effects. As a result, exports and the growth base in the province are also highly specialised and dominated by mining, due to the province's endowments of platinum, gold, diamonds and other commodities. Long term growth strategies for the province should address the specialised nature of exports, and consider the relative merits of export specialisation versus greater export diversification. Using a RAGE model is one method to investigate these relative merits and derive a set of consistent policies to maximise household welfare in the province.

1.3 PROBLEM STATEMENT

South Africa's North West Province is significantly dependent on gold and platinum exports for its economic growth and employment. Whether this specialisation is optimal from an economic growth, employment creation and welfare point of view, or whether greater export diversification should be encouraged, can only be judged using a general equilibrium framework. Until now, such a general equilibrium framework that could be used to support numerical simulation of policy options have lacked in the province, making decisions on the impact of trade strategy on the province difficult.

This thesis proposes a RAGE model for the North West Province to address these issues. This model is called NWPGEM and will be used in this thesis to illustrate the differences between export

specialisation and export diversification for the province, as well as the differences between the national impacts of export diversification and its provincial impacts. It shows that perhaps counter-intuitive result that whereas export diversification may have net positive effects on the national level, its provincial impacts may under particular conditions, be negative.

1.4 MOTIVATION

The contribution of this thesis may be threefold:

First, it provides policy makers at regional/provincial level with access to an advanced modelling tool, through the RAGE model, to analyse regional economic issues. Through the use and implementation of this tool, a region can identify and develop policies and development programmes to enhance the region's economic potential.

Second, it contributes to better understanding the spatial concentration and spatial dynamics of economic activity at regional level in South Africa, more specifically in the North West Province. Here, Storper (2006) pointed out that with significant changes in the world economy, conditions for economic growth at regional, national, and international levels have been distorted. This has brought about the need to re-examine theories and models of the location of economic activity and the growth of territorial economies. This thesis investigates the extent of export diversification and specialisation in the North West Province of South Africa over the period 1995-2006 and its relationship to GDP per capita, and implements a RAGE and AGE model to investigate the economy-wide impacts of greater export diversification versus greater export specialisation on the North West Province and South African economies. In this province, exports have been dominated by mining. In contrast, the province has yet to increase its non-traditional exports, such as those of manufactured goods. By focusing on the North West Province, this thesis contributes towards understanding better the export dynamics of this region, which has not been able to significantly generate export-led growth nor substantially diversify its range of manufactured exports (Hausmann and Klinger, 2006). Moreover, the necessity of RAGE modelling in South Africa can be illustrated through a comparison of the varying economy-wide effects of policy/strategies at both national and regional/provincial level. It is illustrated in this thesis, through the

use of a RAGE model, that the national and provincial impacts of trade policies (such as attempts to diversify the export base) may under particular circumstances be quite different. Policy makers would not have been aware of this were it not possible to build a RAGE model for the province.

Finally, this thesis contributes toward the practical policy debate in South Africa. Sustaining decentralisation and creating a more equitable spatial economy may benefit from policies that are better informed and more region specific, in particular the ways in which specific regional qualities impact on their growth performance. The export success of the Asian "*tiger economics*", for example has been attributed to the active role played by their governments in the form of designing incentive programs for the promotion of specific domestic sectors (Glenday and Ndii, 2000). Moreover, according to Perobelli and Haddad (2004:1) with the world economy continually changing, issues of globalisation receiving more attention and with the inherent assumption "*that a region's economic future is inextricably tied with its ability to compete in the international export market*", international trade has become a necessity for both regional analysts and policy makers alike as a means of achieving and sustaining long term economic growth. With the recent expansion in world trade bringing about significant growth in countries/regions across the globe, other regions may be able to benefit from this expansion by means of greater diversification of their non-traditional exports (Osakwe, 2007).

1.5 RESEARCH QUESTION

The research question to be addressed in this thesis is how can a regional applied general equilibrium (RAGE) model be formulated and implemented for the North West Province of South Africa in order to study the differential impacts of greater export specialisation versus greater export diversification?

1.6 OBJECTIVES

The primary objectives are (a) to formulate and implement a RAGE model for the North West Province of South Africa and (b) use this model to evaluate export specialisation versus export diversification as a trade and development strategy for the province.

The secondary objectives are to:

- Provide a discussion on the theoretical understanding of the relationship between international trade and regional development;
- Provide and assessment of the quantitative tools available to conduct assessments of regional policy issues;
- Identify the key sectors in the North West Province for export promotion;
- Determine whether the province can achieve export-led economic growth through either greater diversification or greater specialisation of manufacturing (non-traditional) exports;
- **Compare the simulation results** of the **RAGE** and **AGE** models in order to highlight the differences in impacts of policy/strategies on the national and regional/provincial economies; and
- Determine the likely impact of an exchange rate appreciation/depreciation on the exports of the North West Province.

1.7 HYPOTHESIS

The hypothesis underlying this thesis is that a RAGE model can be usefully formulated and implemented for the North West Province of South Africa in order to distinguish between the optimal export strategies for the province.

1.8 METHODOLOGY

To achieve the objectives as set out in Section 1.6 requires a literature review, data, empirical analysis, and modelling of sub-national development issues.

The literature review presents an overview of the salient knowledge in regional and local economic development theories, and how this has influenced the development of quantitative assessment tools.

The literature overview further provides a theoretical overview of the development of applied general equilibrium modelling in general with a specific focus on RAGE modelling, which is then extended

to the South African national and sub-national context. The purpose of this background is to show that a gap exists in South Africa as far as the available tools for quantitatively assessing regional and local policy impacts are concerned.

The data analysis is closely linked to the empirical analysis. This thesis will investigate the extent of export diversification and specialisation at sub-national level, specifically in South Africa's North West Province over the period 1995-2006 and its relationship to GDP per capita, and a RAGE model is used to investigate the economy-wide impacts of greater export diversification versus greater export specialisation, and the effects of an exchange rate depreciation/appreciation on the regions exports. The methods are explained in greater detail in Chapters 4, 5 and 6.

1.8.1 Concepts and definitions

For purposes of clarity, a number of concepts applied throughout this thesis are defined below.

According to Cameron (2003), **input-output** analysis has the fundamental purpose of examining the interdependence of industries in an economy. An input-output model in its most basic form consists of a system of linear equations, each one of which describes the distribution of an industry's product throughout the economy.

Social Accounting Matrices (SAMs) extend the input-output concept from production to income distribution and include both social and economic data for an economy (Raa and Sahoo, 2005). A SAM consists of data from input-output tables, national income statistics, and household income and expenditure statistics. Contrary to national accounts, "... *a SAM attempts to classify various institutions to their socio-economic backgrounds instead of their economic or functional activities*" (Chowdhury and Kirkpatrick, 1994:58).

General Equilibrium refers to a state of an economy where the needs of all participants in this economy are satisfied. This implies that there exists no excess demand for, or supply of, any goods or services traded in the relevant economy (Rumler, 1999). A **general equilibrium model** extends the general equilibrium theory to a model of an economy that portrays the operation of many markets simultaneously (Vargas *et al.*, 1999b).

An **Applied General Equilibrium** (AGE) model is a model of the economy which recognises that the economy is a complete system of interdependent components. Economic shocks impacting on any one component can have repercussions throughout the economic system. An AGE refers to the theoretical model (Shoven and Whalley, 1984). When an AGE model is applied to practical data, the term **Computable General Equilibrium** (CGE) is used. In this thesis AGE and CGE are one and the same.

A CGE model is "*an economy-wide model that includes feedback between demand, income and production structure, and where all prices adjust until decisions made in production are consistent with decisions made in demand*" (Dervis, *et al.*, 1985:132).

Regional Applied General Equilibrium Modelling has "... *typically been patterned after those used in national and international studies*" (Partridge and Rickman, 1998:2). RAGE models are thus based on the same basic structures, and apply similar assumptions and naming systems as the more geographically-aggregated models. As a result, RAGE models implement the same external substitution elasticities as used in national or international models.

According to Siksamat (1998:1-2), **Interregional AGE** models can be divided into three categories: top-down, hybrid, and bottoms-up models. With the top-down model aggregate national results are aggregated proportionally across regions according to known regional economic statistics, such as employment by industry (Shoven and Whalley, 1984). In theory, the hybrid and top-down models are the same with the difference lying in the fact that the hybrid model makes use of regional data at the national level. With the bottoms-up approach each region is modelled as a mini-economy with government budget and intra-region, inter-region and international trade flows separately specified.

Spatial CGE (SCGE) models, which form part of the school of new economic geography (Krugman, 1991a; Fujita *et al.*, 2000), are comparative static microeconomic models with a strong focus on interregional trade and location. Similar to most comparative static models, SCGE models make use of utility and production functions with substitution between inputs (Tavasszy, 2003:3). Due to their comparative static nature, these types of models are ideally suited for transport appraisals.

The **GTAP** (Global Trade Analysis Project) model is an AGE based model developed mainly for analysing the effect of global trade on individual countries across the world. The latest version (Database

Version 6)[6], is based on an international input-output table comprising 87 countries/regions and 57 sectors. The ORANI model, which forms the basis for the GTAP model, is a single-region model, whereas GTAP is a global model. Both use the same software and basic structure, with a few exceptions.

Exports refer to the selling of goods or services by a firm or individual located in a particular country to a firm or individual located in another country as part of trade, and where payment would result in the exporter (the firm exporting the good or service) receiving foreign currency (Naudé, 2006a:9). Therefore, for purposes of this thesis, exports are strictly seen as trade with economic agents located abroad. Trade with the rest of South Africa is not defined as exports.

In the North West Province, **traditional exports** consists of mining products (platinum, gold, diamonds and other minerals) and agricultural products (maize, sunflowers, groundnuts and others).

Non-traditional exports are defined as exports of goods and services other than that from mining and agriculture. In particular, for purposes of this thesis, non-traditional exports will refer to the exports of manufactured goods.

1.8.2 Data and reliability

Currently, there are only two comprehensive databases containing regional data for South Africa's nine provinces. The first of these is a system of integrated databases known as the **Regional Economic Focus** (REF) that provides information for each province over the period 1996-2006. The REF is compiled by Global Insight Southern Africa and draws together many different sources of sub-national economic information from Statistics South Africa, government departments, development agencies and Regional Services Councils (Krugell, 2005). The data components are internally consistent and add up to national totals. A number of indicators of the economies and people of the nine provinces are used in this thesis.

For economic activity, Gross Domestic Product (GDP) by region is used. The GDP statistics differ from Gross Value Added (GVA) in that it includes "*Other taxes on products*" and "*Other subsidies on products*", which is broken down to specific regions from the Supply and Use tables published by Statistics

[6] For further details, see Hertel (1997).

South Africa (StatsSA, 2002). Other REF indicators used in this thesis include population size, poverty rate, unemployment rate and exports.

The GVA and export data used in Chapter 5 comes from outside Global Insight's Regional Economic Focus and was obtained from a different consultancy, called Quantec. Quantec's **Regional Market Indicators** provide a unique, disaggregated and consistent view of South Africa's socio-economic structure and market potential on a regional basis. The data is compiled by "*combining a regional demographic and industry framework, spanning more than three decades, with a comprehensive set of census, survey and time-series indicator data*" (Quantec Research, 2007:1). The result is a systematic and up-to-date set of actual and standardised regional indicators for the South African regions.

Primary data sources include: Statistics South Africa's Population Censuses from 1970 to the present, Industry Censuses and Surveys, Household Surveys including Income and Expenditure Surveys since 1990, Labour Force Surveys since 1999, AMPS (All Media and Product Survey) Household Surveys since 1992, and Quantec Research's Standardised Industry Database.

Given the research question (objective) and intended use of the data, the REF and Quantec databases should be sufficiently reliable for engagement purposes and the use of the data should not lead to an incorrect or unintentional message.

The empirical work in which the data are used is explained in Chapter 2 and 6. The North West Province SAM used for data input in the RAGE model is discussed, in detail, in Chapter 4.

1.9 OUTLINE

This thesis is structured as follows: Chapter 1 presents the introduction. Chapter 2 provides a brief overview of the economic theories of regional economic development. National as well as international policies have impacts at the provincial level. The aim is therefore to link the theory of regional economic development with the problems they are supposed to address. Chapter 3 provides an overview of the economic development policy of the North West Province and discusses the context for export promotion. Chapter 4 provides an overview of the tools used for regional policy assessment. The aim is to provide an intuitive explanation of the spatial concentration and spatial dynamics of economic activity, and

to point out the need for RAGE modelling in South Africa. Chapter 5 provides an overview of the RAGE model with particular reference to the data used in the model and structural features imposed to ensure adequate representation of the North West Province economy. The chapter is further extended to provide a description of the model closure and parameter estimates of the RAGE model. Chapter 6 reviews the North West Province economy, discussing the challenges and opportunities for development. The chapter also provides a brief overview of the theoretical understanding of export diversification and specialisation, and discusses the various ways in which the degree of diversification (both vertical and horizontal diversification) can be measured. The chapter also discusses the current state of export diversification and specialisation in the North West Province, and tests for the relationship between export diversification and economic growth. In Chapter 7 the data used in the RAGE model are outlined and **the results of various simulations at both national and provincial level are compared** in a comparative static fashion and discussed. A summary, conclusion and avenues for further research are presented in Chapter 8.

CHAPTER 2: REGIONAL ECONOMIC DEVELOPMENT

2.1 INTRODUCTION

In Chapter 1 it was emphasised that the impact of national policy aimed at addressing unemployment, poverty, and insufficient growth, may vary between regions. It was also emphasised that policy makers and governments responsible for promoting economic development at sub-national/regional level are in need of tools and methods to quantitatively evaluate the impacts of policies and international events on the regional level (Storper, 2006:1). It is therefore necessary to understand the link between the theories on regional economic development and the problems they are meant to address.

There exists a large literature on regional economic development and a complete assessment of this broad literature falls outside the scope of this thesis. The essence of regional development theories in economics is to explain the spatial concentration and spatial dynamics of economic activity, including the trade patterns within and between regions. This field has always been driven by the practical policy needs of governments and businesses, with a need to identify those policies that would stimulate regional and local economic development.

The primary purpose of this chapter is to provide an overview of the salient knowledge in regional and local economic development theories. This will be done in section 2.2. Finally, the chapter converges on the case of South Africa (2.3), by providing a short overview of the state of regional economic development and thinking in South Africa. Chapter 3 will provide an overview of economic development policy in the North West Province and provide some insight into the working of the provincial economy. Section 2.4 concludes.

2.2 DETERMINANTS OF REGIONAL ECONOMIC DEVELOPMENT

A substantial literature deals with the determinants of regional development (Krugman, 1995; Martin and Sunley, 1996; Fujita *et al.*, 2000; Brakman *et al.*, 2001; Harrison and Todes, 2001; Du Pisanie, 2002; Henderson and Thisse, 2004). An exhaustive overview falls outside the scope of this thesis. However,

given the growing importance of trade and integration into the world economy for a growing number of countries, in particular South Africa, this section focuses on the theoretical understanding of the relationship between international trade and regional development. This focus will be informed from three strands of theoretical literature: Regional Science, Local Economic Development and the New Economic Geography (geographical economics) (NEG).

2.2.1 Regional Economics

Regional and urban economics might be perceived as focussing on the same strand of literature but regional economics enables theorists to answer the questions pertaining to the specific location of cities/places as well as the nature of their spatial relationship to each others. Isard (1956) was the first to adapt this original German seminal writing to English and he called this new field "*regional science*".

Considering the economy of a region, it is expected to think of that region's economic activities as being divided into two different types. First, there are those activities that satisfy demands from outside the region: the region's so-called "*export base*", second are the activities that mainly supply products/goods and services to the local population. The base-multiplier analysis uses these economic activities and states that a region's export activities can be referred to as its "*economic base*" and its local activities its "*nonbase*" and that the "*nonbase*" activities can be derived from its "*economic base*" and thus will contract or grow depending on the "*economic base's*" performance. Pred (1966) stated that because of this base-multiplier the share of income spent locally in a particular region is not a constant but rather depends on the size of the local market. In other words, as the size of the regional economy grows, it becomes profitable to produce a wider range of products/goods and services locally, because the market becomes large enough to support an efficient range of firms. Pred (1966) then went on to argue that this relationship could set in motion a cumulative process of regional growth.

According to Tiebout (1956) the regional "*economic base*" can be seen as a key factor in explaining regional economic growth. A regions' economic growth is dependent on the degree of success of its exports. This can be achieved through either an increase in existing exports, or through the expansion of new exports. A better explanation can be found by closely examining the impact of the location of a region

on changes in its export basket. Tiebout (1956) went on further to explain that the "*export base*" is but one characteristic impacting on regional growth. In larger regions, numerous other variables may affect exports as well, such as the optimised use of factors between exports and local market outputs.

Fujita *et al.* (2000) took the base-multiplier and formalised the extension of it, as calculated by Pred (1966) and found that although the model tended to be inadequate in some ways it presented four functional insights into the workings of regional economics: (i) the interaction between economies of scale and endogenous market size can lead to a cumulative process of agglomeration; (ii) it is important to note that one should not only study static equilibria but also, at least in an elementary way, dynamics, because dynamics play an essential simplifying role, limiting the number of possible outcomes; (iii) the dynamics of economies in which scale economies and market size interact typically involve the possibility of discontinuous change: a cumulative process begins when underlying parameters cross some critical value; finally, (iv) the critical value of change in one direction is usually not the same as the critical value for change in the other.

As was argued by Fujita *et al.* (2000), although regional economics can be seen as a very useful measure in investigating regional differences it is not without its shortcomings. The extemporised nature of its models, their lack of closure and the general sense of loose ends left hanging has prevented it from becoming a well-incorporated part of mainstream economics. What it has become is a strand of theory which is used by regional planners, transportation departments etc. for its practical analysis in helping to guide policy changes.

2.2.2 Local Economic Development

According to Nel (2001) the economic development strategy known as Local Economic Development (LED) has been widely used in the Northern hemisphere countries for the past few decades. This particular strategy seems to be somewhat of a fairly recent occurrence when one considers the Southern hemisphere countries, which in an era of economic crisis needs to be evaluated in terms of its potential to help address the challenges of poverty and unemployment alike and to concurrently encourage economic growth. The fundamental nature of LED can not only be measured in terms of actions taken by local

government, but it should also incorporate the various activities of central governments who seek to find a medium through which growth at the local level can be achieved. The activities of various community development organisations motivated to improve economic and social conditions within specific regions must also be considered (Nel, 2001).

Schuurman (1993) argues that LED can be seen as a response to what he calls the "development impasse" and states that it is analogous with the anti-development argument about the need to focus on innovative grassroots movement.

All theories of LED emphasise the economic base of a locality, as well as the importance of market size and market access. Through a development of exports, local economic development in a region will be assisted by expanding the markets available to producers in each locality. Helmsing (2001:3) argues that globalisation places a huge premium on the competitiveness of a particular location, which highlights the increasing importance of locality as the globalisation of the world economy continues. Approaches focusing on generating externalities, creating a learning region and establishing good governance as indispensable for sustainable LED are also identified.

According to Taylor and Mackenzie (1992:21) reasons why Southern hemisphere countries are gradually adapting to the concept of LED include; "*the debt crisis, the effective incapacity of many states to intercede at the local level, imposed structural adjustment, massive currency devaluation and the series of natural and political shocks which continually shake the region.*" As stated by Rogerson (1997) evaluations of the status of LED within local government areas in the Southern hemisphere show that formal LED, as opposed to community-based variations, is still in its infancy and few local governments or other agencies can be said to be actively engaged in LED at present. The process of democratisation in the Southern hemisphere, moves to decentralise control and the state's attempts to bring about development not so much through direct intervention, but rather through facilitation of the private sector, are all gaining in importance and will assist the LED process (Nel, 2001).

As South Africa shares similarities with both the Northern and the Southern hemisphere countries' economies, it is to be expected that LED is experienced in forms ranging from urban entrepreneurialism to rural survival strategies. However, in many cases, LED is in its early stages as central

and local governments are often still in the first phases of policy development and application and it would be difficult to claim that significant, concrete results have been achieved to date (Nel, 2001). For a detailed overview of LED in South African towns and cities see Nel (2001).

2.2.3 New Economic Geography

In order to comprehend the role of the NEG theory, one must first consider the neo-classical growth theory in order to identify the gaps which exist because of its assumptions. In the traditional neo-classical growth theory, geography is not seen as being relevant. It stated that in the short-run a positive growth rate of output per capita is possible by means of capital accumulation or technological progress. Since capital accumulation is subject to the law of diminishing returns, it is only through technological progress that a positive growth rate of output per capita can be sustained in the long-run. Seeing as technological progress is viewed as being exogenous, it can be argued that in the end, it leaves the growth of output per capita unexplained. Cross-country differences in the level of output per capita are thought to be temporary. Assuming that countries have access to the same technology and are equal in all other (structural or institutional) respects, the neo-classical theory predicts that countries will converge to the same level of output per capita in the long-run. The capital stock per capita will be low for initially poor countries, which implies a high return on investment – capital accumulation – and this fosters the convergence process (Brakman *et al.*, 2001).

The neo-classical growth theory thus implicitly predicts absolute convergence: countries will end up at the same equilibrium level of output and capital per capita. Even though convergence might be perceived as being slow, the theory states that the poor countries will catch up and that the actual differences in growth rates are best thought of as reflecting this process of convergence. In such a world the spatial agglomeration of high or low growth rates of GDP per capita does not warrant much attention. One criticism of this theory is the hard time it has explaining the stylised facts of growth which could mean that either convergence is extremely slow or its main prediction of absolute convergence is flawed (Brakman *et al.*, 2001).

Seeing as the neo-classical growth theory cannot explain economic growth as such, one might argue that this can be a potential gap which could be filled through the inclusion of geography. As stated by Behrens and Thisse (2006:5) NEG is the "*first successful attempt made to explain why a priori similar regions do not experience the same level of economic development*". NEG has connections with several branches of modern economics, including industrial organisation and urban economics, but also with the new theories of growth and development. In particular, NEG and endogenous growth theory (which contributes the differences between countries' level of development to technological spillovers, research and development, unskilled labour, factor endowments and the degree and extent of international trade) share the same framework, using monopolistic competition, increasing returns and spillovers. The NEG models typically rest on very specific models of monopolistic competition, mainly the one by Dixit and Stiglitz (1977). Therefore it might be argued that the NEG lacks the level of generality that characterises standard general equilibrium theory (Behrens and Thisse, 2006).

The NEG builds on the foundation which was laid out by Marshall (1920). He suggested a threefold classification to be used when modelling the returns to spatial concentration, i.e. why regions/countries experience differences in their economic growth. He focuses on the fact that industrial districts come to pass because of knowledge spillover (the so-called spillover effect), the advantages of substantial markets for specialised skills as well the backward and forward linkages associated with large local markets. For the purposes of this thesis only the last classification will be discussed. The essence of linkage effects starts with producers who will first and foremost choose a region which will provide them with the largest possible access to markets as well as the various products/goods they or their workers might need. If, for some reason a concentration of producers already exist in a specific region it can be argued that the potential producer will have better access to a larger market as well as a bigger variety of products/goods to choose from if it decided to settle in that specific region. In this region there now exists backward and forward linkages. It is because of these linkages that a spatial concentration of production, once established, may tend to endure, and a small difference in the primary economic size of two otherwise equivalent locations may grow over time (Marshall, 1920).

Since the mid-1990s, there has been a significant increase in the amount of research done pertaining to economic geography. Reasons for this occurrence include the lack of previous analytical models (which has since been provided through the contributions of theorists such as Krugman (1987; 1991c; 1995) and Venables (1996; 1998) and according to Fujita *et al.* (2000) the so-called 'real-world' problems. For instance, as already mentioned above, one might ask why certain sub-national differences (whether in economic growth rates or poverty, etc.) occur within a country. Fujita *et al.* (2000) argues that one of the main pillars in previous studies done on regional development is its assumption of increasing returns although it poses much intricacy to economic theorists. If one assumes that an economy operates on constant-returns, understanding why households do not produce most of the items for themselves – seeing as they should be driven by "*backyard capitalism*" – becomes difficult.

Although one might argue that there could be a disproportion in the various regions' population density or in the fertility etc. of the natural environment which could contribute to the differences between regions, the striking spatial disproportion of the 'real economy' could not be the result of intrinsic differences among regions, but because of some set of cumulative processes (Fujita *et al.*, 2000).

To add to this, Brakman *et al.* (2001) points out that in the field of NEG little attention has been given to the link between spatial concentration, spatial dynamics and international trade flows. As a point of departure, when looking at a two-country/region model (better known as the core model of geographical economics, with two products, food and manufactures) with economic activity evenly distributed, international trade of food will not occur, leaving only inter-industry trade of manufactures to take place between the two countries/regions. On the other hand, with complete concentration in manufacturing activity, complete inter-industry trade between the two countries/regions of food for manufactures will take place.

Brakman *et al.* (2001) attempted to bridge this gap in the literature, identified by Ohlin (1933), by creating a theory of location for a theory of international trade to be based upon. To achieve this, the core model (mentioned above) was used.

According to Krugman and Venables (1995), what differentiates international economics from regional economics, is that labour is mobile within the spatial economy. This is contrary to the assumption made in international economics, where labour is assumed to be mobile between countries/regions.

When one talks about defining issues of economic geography it is necessary to explain concentrations in certain regions, for example, economic activity. Every single concentration cluster is formed and thus survives because of some form of agglomeration economies, in which spatial concentration itself creates the complimentary economic environment that supports further or continued concentration. It is not sufficient to only hypothesise about the existence of these agglomeration economies but the self-reinforcing character of spatial concentrations should be derived from a more essential viewpoint. In other words, by modelling the sources of increasing returns to spatial concentration the behaviour of when and how these sources might change together with its influence on the economy could be predicted (Fujita *et al.*, 2000).

2.3 REGIONAL ECONOMIC DEVELOPMENT IN SOUTH AFRICA

Since democratisation in 1994 there has been an upsurge in sub-national economic development policy making and practice in South Africa. At both regional and local levels, more participants in public, private and community sectors are now engaged in creating policy guidelines, designing practical activities, and starting to implement them. These new players are all increasingly concerned with more than just the nature of economic development policy. Nowadays, there is a stronger interest in its substance, "*that is, on how policy can be implemented with specific instruments, with impacts that are visible, demonstrable, and sustainable*" (Bloch, 1999:3).

The efforts of government departments at national, provincial and local levels, private sector think tanks, various foundations and planning consultants have produced a range of policy guidelines as well as economic development strategies for individual places. "*This policy work has catalysed activity broadly aimed at attempting to boost the employment, investment, and economic growth performances and prospects of localities*" (Bloch, 1999:4). However, uninformed and unguided policy formulation will result in economic development

initiatives that will increasingly take on a useless quality, a lack of seriousness, substance, and, ultimately, effect.

The following section will provide an overview of the regional economic development profile of South Africa whereupon a short discussion will follow on selected stylised facts pertaining to the economic growth and development of all nine provinces.

2.3.1 Profile of regional economic development in South Africa

The current situation with respect to regional/spatial economic development in South Africa is a topic that has received much attention in recent years.[7] According to Naudé and Krugell (2003:3) "*an explanation of spatial economic inequality in South Africa should be an explanation of the self-reinforcing development of cities and towns.*" South Africa is marred by a poor distribution of its economic activity across space, with 70 per cent of the country's GDP being produced in only 20 per cent of places (Krugell, 2005). Furthermore, local governments have received the tall order of improving and developing regional economic growth to ultimately address the spatial inequalities facing the country.

Naudé and Krugell (2003) advocate three reasons for the failure of government to address the issue of spatial inequality in South Africa: a lack of convergence between cities and towns; South Africa's metropolitan areas not being of optimal size; and a lack of education and training.

"*The provisions of South Africa's new Constitution, adopted in 1996, establish sub-national economic development as a responsibility for national, provincial and local levels of government*" (Bloch, 1999:5). In line with the principal of cooperative government which guides the Constitution, provincial and local governments have been granted restricted powers with regard to economic development.

Moreover, these place-based responsibilities appear to have been constrained by the Constitution in terms of the national interest. A factor in establishing such limits was an awareness of the potential dangers of competition between places for investment. In other societies what has often resulted are destructive bidding wars in which provinces (or cities and towns) try to lure new investors, typically by

[7] This section draws on the work of Bos and Drewes (1995), Suleman (1998), Rogerson (2001a), Bek *et al.* (2005) and Naudé and Krugell (2003, 2006).

subsidising the costs of their inputs with the indiscriminate use of either tax incentives (e.g., exemptions, reductions, credits, accelerated depreciation of industrial plant and equipment) or non-tax incentives (e.g., grants, loans, skills training) (Bloch, 1999). As investors play off one place against another in what can turn out to be a "race to the bottom," costs to the public can rise significantly. "*Limited administrative capacities, a lack of experience in economic development, and the fiscal constraints affecting sub-national governments such as limited revenue raising powers were also factors, as was, arguably, a centralist political tradition in South Africa*" (Bloch, 1999:5).

Focussing on manufacturing at sub-national level, Suleman (1998) found that the basic metals and fabricated metal products are concentrated in the Gauteng Province, paper and chemicals in the KwaZulu-Natal Province and food processing and textiles in the Western Cape Province. The unequal development determined by trade and extraction was reinforced by climate and culture. Rogerson (2001b), on the other hand, wrote of challenges facing the manufacturing sector resulting from globalisation, a changing policy environment and the trade system. He identified two factors that may improve the performance and competitiveness of manufacturing SMMEs that is an improved support framework and manufacturing advice or support system. An example of such a system is the Manufacturing Advice Centres (MAC) programme. He further stressed a need for intervention to boost industrial and organisational structures.

Finally, Bos and Drewes (1995) question the implementation of a uniform set of strategies to address spatial inequalities. They found, however, the uniform approach to be justified, because of it being an improvement on the previous regional industrial development strategy and owing to it being unbiased. Bos and Drewes (1995:268) conclude by indicating that the choice between a spatially uniform or selective approach for regional development policy will depend on the development status of the country or region.

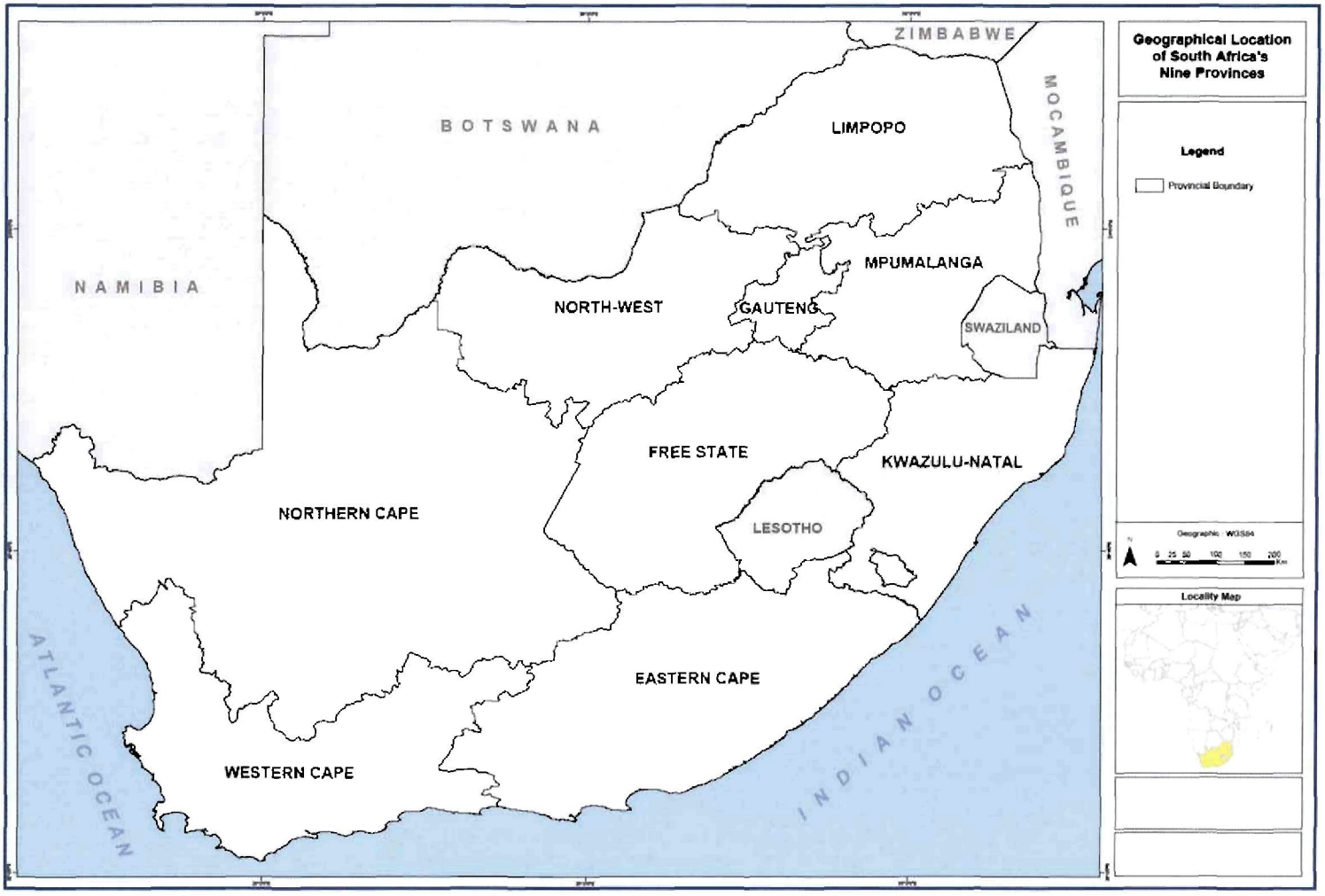
Local government in South Africa came into being much later than the national and provincial spheres of government (Department of Provincial and Local Government, 2007). Incorporating this sphere into the system of co-operative governance has proved complex, due to scarcity of required skills, lack of local capacity, as well as uncertainty regarding the responsibilities of local government and municipalities, regardless of the new opportunities for more responsive and efficient governance that have been generated through this process.

The absence of a definite policy on provincial and local government has generated uncertainty about the role of these spheres in economic and social policy making. This is of particular importance as spatial concentration and spatial dynamics play a key role in improving regional economic development and growth. More recently, attempts have been made to bring practice in line with policy. An example of this includes Project Consolidate, which has shown that hands-on support to municipalities has resulted in improved service delivery (Department of Provincial and Local Government, 2007).

The map in Figure 2.1 below shows the location of South Africa's nine provinces (white shading). This is followed by Table 2.1, which shows the Gross Domestic Product (GDP) per capita, GDP size, as well as the population size, economic growth rate, exports as percentage of GDP, regional share of exports in the total economy, main SIC export sector, poverty rate and unemployment rate for each of the nine provinces.

From Table 2.1, one can see that Gauteng, followed closely by the Western Cape, has the highest levels of GDP per capita, GDP size, and economic growth. Gauteng's main SIC export sector is basic non-ferrous metals whereas the Western Cape's main SIC export sector is agriculture, forestry and fishing. At the other end of the spectrum, Limpopo and the Northern Cape experienced the lowest levels. It is surprising that Limpopo experiences such low levels compared to the other eight provinces seeing as its main SIC export sector is basic iron and steel. The Eastern Cape and North West Province are the poorest performers with regards to poverty, unemployment and low economic growth. In the North West Province only 16 per cent of value added in 2006 came from exports. The main SIC export sector for the North West Province is basic non-ferrous metals.

Figure 2.1: Geographical location of South Africa's nine provinces



(Source: Map drawn for this chapter by Giscoe (Pty) Ltd, Potchefstroom)

Table 2.1: Main economic differences between South Africa's nine provinces, 2006

Economic Measures						
Place	**GDP pc (Rands)**	**GDP size (R 1000)**	**Population**	**Economic growth (%)**	**Poverty rate (%)**	**Unemployment rate (%)**
Western Cape	43,621	202,819,345	4,649,600	3.40	18.90	22.10
Eastern Cape	10,688	76,883,519	7,193,594	2.70	60.50	51.70
Northern Cape	21,701	20,440,332	941,898	2.70	41.40	35.80
Free State	17,555	53,130,894	3,026,471	1.50	49.40	37.70
KwaZulu-Natal	17,708	177,910,042	10,047,150	3.30	48.20	43.20
North West	18,534	73,379,729	3,959,106	2.70	52.00	43.60
Gauteng	47,834	439,739,363	9,193,030	4.20	25.20	31.70
Mpumalanga	22,409	77,388,291	3,453,514	3.00	44.00	34.30
Limpopo	8,518	49,674,473	5,831,757	2.20	56.10	44.00
South Africa (National total)	24,254	1,171,365,988	48,296,119	3.40	43.70	37.70

Economic Measures				
Place	**Exports (R 1000)**	**Exports as % of GDP**	**Regional share (%)**	**Main SIC export sector**
Western Cape	43,917,199	14.90	10.10	Agriculture, forestry & fishing (11-13)
Eastern Cape	30,766,899	27.10	7.10	Motor vehicles, parts & accessories (381-383)
Northern Cape	8,420,771	26.70	1.90	Other mining (22, 24, 25, 29, 39)
Free State	2,639,507	3.30	0.60	Basic non-ferrous metals (352)
KwaZulu-Natal	54,666,382	21.00	12.60	Basic non-ferrous metals (352)
North West	19,746,976	16.70	4.50	Basic non-ferrous metals (352)
Gauteng	260,484,814	40.60	60.00	Basic non-ferrous metals (352)
Mpumalanga	6,349,328	5.80	1.50	Basic non-ferrous metals (352)
Limpopo	7,010,121	9.20	1.60	Basic iron & steel (351)
South Africa (National total)	434,001,999	25.10	100.00	Basic non-ferrous metals (352)

(Source of data: Global Insight Southern Africa, Regional Economic Explorer, 2007)

On the local economic development front, a want for a clear LED policy format, has resulted in the objectives of economic development policy becoming obscured or disappearing altogether. As a consequence sub-national economic development policy becomes a broad remedial approach to solving almost any problem of place-based social or economic development (Bloch, 1999). Currently, a broad policy position on LED still applies. LED has therefore become a blended solution to localised development problems (Nel, 2001). Within this, national, regional, and local participants and institutions will have to craft strategic approaches to further policy making and implementation.

Regional development, on the other hand, is a well-defined policy field. Markusen's (1996:49) definition is a useful one: "*Regional policies are designed to moderate regional growth rate differentials, ameliorate regional differences in per capita income, integrate stalled regions into the national economy, and spread urbanization from a single metropolis to multiple sites.*"

There are several government initiatives and programmes which aim at dealing with regional disparities. Nationally-raised revenues are transferred to provinces to provide education and health services according to a Fiscal and Financial Commission formula which favours poorer provinces (Markusen, 1996). Eskom's electrification programme privileges rural areas. Telkom's telephone roll-out targets rural villages and schools. And other programmes – defence spending, welfare – have implicit spatial effects.

Several of the DTI's programmes and schemes also have spatially-distinctive impacts, even if they are not couched specifically in regional policy terms. The DTI's key investment support programme, the Tax Holiday Scheme, has a spatial dimension (Bloch, 1999). The scheme, which replaced the 1991 Regional Industrial Development Programme, contains a two year tax holiday component awarded according to the location of new investment in specified places across the country. The cluster initiatives, although typically conducted at national rather than regional level, also have spatial implications. But of such efforts, it is undoubtedly the DTI-led spatial development initiatives (SDIs) which have captured most public and policy attention as "*part of a national programme for regional development*" (Platsky, 1995:14).

Economic development at the regional level is currently starting to be propelled by explicit regional policy objectives backed by theory, whereas, in the past it was driven by the programmatic activities already underway. Sub-national economic policy making and practice is then moving from an

intermediate to a more advanced stage. This is a good place to be. By and large, economic development actors are not at the beginning, casting around for first principles (Rorty, 1998). The recent experience of implementation can now be drawn upon to craft better policy and strategy (and implementation experience is much-required in an arena in which apparent boundless confidence often masks insecurity stemming precisely from inexperience) (Bloch, 1999).

However, without better answers to policy questions and a lack of useful policy assessment tools, sub-national economic development policy might remain a series of good, if often general ideas, disengaged from or lagging behind practice (Bloch, 1999). Distinguishing between the available instruments to meet specific objectives or to carry out tasks will also remain difficult for many.

2.3.2 Approaches to provincial economic development

This section will begin by briefly discussing the history of regional development in South Africa. This will then be followed by new strategies (such as spatial development initiatives) of regional development currently implemented and lastly an overview of the Provincial Growth and Development Strategy will be provided.

In South Africa, the concept of decentralisation was always an important aspect on the spatial economic development agenda. Regional industrial development policy officially began in South Africa with the introduction of a decentralisation policy in 1960. Decentralisation is associated with problems of uneven growth of regions, and deconcentration with the problems experienced in the metropolitan areas. Decentralisation mainly focuses on industrial development and can refer to the moving of industries into other areas, a greater balance in the distribution of industries between regions; or a shift of industries from large cities to the suburbs (Kleynhans, 2003).

According to Lighthelm and Wilsenach (1991), from its inauguration in 1982, it was predicted that the regional industrial development programme (RIDP) would be evaluated on a regular basis to assess its success in accomplishing its overall objectives, and that alteration and corrective actions would have to be undertaken when necessary. From an evaluation of the RIDP by an independent panel of experts, certain structural shortcomings were identified which eventually led to the development and implementation of

the new RIDP in 1991. These shortcomings included firstly, the fact that too many development points had been selected, with the result that there was a lack of concentrated regional industrial establishment at a number of the development points. Secondly, several of the development points had been incorrectly established in terms of their spatial location in relation to comparative cost benefits, so that there was a lack of self-sustaining industrial development. Most importantly, it was said that the relative success that had been achieved to date at certain development points could be attributed to the very attractive financial incentives of the programme, which resulted in cost disadvantages being compensated for, rather than economic viability being promoted (Bos and Drewes, 1995).

In 1991, the emphasis was placed on the development of an "*integrated Southern African economy together with the promotion of regional development*" as an objective in its own right. Other principals of importance were "*the promotion of regional development in such a way as to contribute to the improvement of the performance of the Southern African economy, with emphasis on the development of the less developed areas; a market-oriented development approach; free flow of production factors; a multi-sector development approach, backed by the regional development strategies and based on comparative cost advantages; and a market-oriented profit/output-based incentive scheme*" (Bos and Drewes, 1995:248).

Case studies done on the regional economic development in South Africa have been limited to much of the Western and Eastern regions seeing as regional development has been closely associated with spatial development initiatives (SDIs) which require dividends from the various projects in order to be sustainable. Much focus has been placed on the aforementioned two regions seeing as popular belief is that these regions might be the most profitable and thus could contribute the most to economic growth as a whole. The North West region also has a SDI but unfortunately this region has not yet benefited from this particular SDI and thus it can be concluded that it has not been the success story everyone has hoped for. Three SDIs namely; the West Coast Investment Initiative, the Maputo Development Corridor and the Platinum Highway will now be discussed in brief.

The South African Government's response to severe problems such as spatial inequality has been to adopt a neoliberal macroeconomic framework in the expectation that a stable economic environment will generate investment, regional development, economic growth as well as widespread job creation.

According to Jourdan *et al.* (1997) neoliberal policy found expression in the formulation of a regional development programme that was announced in 1995, whereby a number of specific regions with 'untapped economic potential' became the focus of endeavours to engage with global flows of trade and investment. Between 1997 and 2001 the South African Government invested considerable financial and human resources in these regions, known as SDIs, which had been the showpiece of the GEAR macroeconomic strategy since its launch in 1995, but the programme has not been particularly successful in meeting its key objective of attracting significant flows of investment (Bek, 2003).

The SDI programme has been administered at the national level by the Department of Trade and Industry's (DTI) 'Special Projects Directorate', the Department of Transport (DoT) and the Development Bank of Southern Africa (DBSA). According to Rogerson (2002) SDI's status as a supporting pillar of GEAR reflects the Southern Africa Government's faith in the neoliberal ideology, and as such can be understood as an element in South Africa's response to globalisation and represents a further variant of essentially top-down spatial planning. Bek *et al.* (2005) argues that SDIs have been conceptualised as short-term fast track interventions acting as catalysts for long-term growth.

Bek *et al.* (2005) investigated policy actions to facilitate institutional and regional development within the West Coast region of South Africa, which was done under the guidance of the Southern African Government's flagship industrialisation programme, the SDIs. This particular region's SDI was named the West Coast Investment Initiative (WCII). In Bek *et al.* (2005:2) the main focus of their study was to *"consider the validity of claims by SDI planners that dividends have been achieved on the 'process side', and to question the ability of the regionalist paradigm to deliver the kinds of socioeconomic dividends that South Africa so desperately needs"*. They found some advantages for the region which could be directly linked to the WCII. These include; upgrading of the local institutional infrastructure, networks of diverse actors which had been drawn together and the density of multi-scalar institutional activities which increased substantially. It is important to note that while some tensions still prevail, there are signs that more progressive actors are starting to control development processes in the Western Coast region. Awareness of this region's economic potential has been increased and the resolve of dynamic, outward looking private sector actors has been hardened. While claims that the local institutional setting has improved substantially in recent years have some

reliability, it must be noted that the reported beneficial catalytic effects are yet to be associated with a step change in the region's density and quality of economic activity.

In May 1996 a SDI was launched known as the Maputo development corridor (MDC) with the focal endeavour to create a development alliance between the Maputo port and the Gauteng region. The economic logic behind this SDI lies in the certainty that this is the shortest route to an export harbour for South Africa's industrial nucleus. This MDC was established with the following objectives in mind: "*rehabilitation of the primary infrastructure along the corridor using the private sector; encouraging private investment in the inherent potential of the corridor and in the opportunities afforded by rebuilding infrastructure; and to safeguard development and employment creation through growth*" (Bek and Taylor, 2001:3). In broad, this means that the economic objectives entail stimulating foreign investment, export earnings and the generation of regional growth and development in this specific region.

This particular SDI has attracted criticism seeing as the quality and nature of the proposed 35 000 new job opportunities are considered to be problematic, if the expressed public aims of the SDI methodology are taken seriously. With a low skills base, opportunities for most of the local work force are likely to be casual, low paid and short-term, with minimal skills transferral of any apparent sort. Another criticism of the MDC is the fact of misalignment. The industrial focus on minerals and metals and slightly processed goods seems ill-suited to a spatial area where agriculture is dominant and where investment in relatively low skills based agricultural processing and other spin-offs would be more suitable (Bek and Taylor, 2001).

There currently exist three SDIs and corridors which have been planned for the North West Province. Most noteworthy of these three is the Platinum SDI / Highway (which was introduced in 1996). One of the key objectives for this regional development initiative is economic growth which is theoretically to be stimulated through increased local, regional and international trade. The Platinum SDI can be seen as a transport route that acts as an economic 'artery' linking the North West Province with the economic hub of South Africa, the Gauteng Province, as well as providing additional linkages with other transport corridors (Tladi and Tlhomelang, 2002). The Platinum SDI links the North West Province to the rest of the country and with neighbouring countries such as Mozambique (to the east) and Botswana (to the

north-west). Initial impact studies estimated that the Platinum regional development initiative would stimulate the North West Province's industrial sector as well as trade, business and financial services, and food and construction industries. It was also expected that this SDI would lead to a decrease in unemployment seeing as an estimated 14 000 jobs should have been created (7000 of them in the vicinity of the corridor). The personal income for South Africa as a whole should have been increased with R 1,8 billion of which an estimated percentage of 18,7 was destined for lower income households (Tladi and Tlhomelang, 2002).

Unfortunately, as argued by Kleynhans (2006), ten years later, in which much was spent on research and planning there is still nothing tangible to show and nothing to indicate that the initial key objective of regional economic development and growth, poverty alleviation, skills development and increased personal income will be reached in the future.

The Provincial Growth and Development Strategy was formulated in 2004 after President Mbeki challenged provincial and local structures to align their growth and development strategies/programmes with the national priority objectives. The North West Province adopted a Growth and Development Strategy (PGDS) at a Summit in August 2004. The main objectives of the PGDS are to halve poverty and unemployment by 2014 by achieving growth rates of at least 6.6% per annum. A number of growth and economic development pillars were identified for strategy formulation at the Summit, of which included: growth and investment, agricultural and rural development, manufacturing and trade, etc.

However, the objectives and policy implications of the PGDS are not the result of or based on any quantitative analyses and are therefore neither accurate, nor consistent. To bridge this gap in the current planning structure, government needs to analyse and quantify the relationships at sectoral level, in particular their effect on the potential for growth and employment creation, and the sectoral investment needs in the North West Province.

2.4 SUMMARY

The purpose of this chapter was to briefly review the literature on regional economic development in order to better understand the factors that drive regional growth and that should be captured in quantitative

tools for policy assessment. As a consequence the focus was specifically on New Economic Geography, Regional Economics and Local Economic Development. Section 2.3 reviewed the state of regional economic development and thinking in South Africa.

A number of conclusions can be drawn from the literature assessment. The first is that although sub-national economic policy making and practice is at a more advanced stage, there is still some room for improvement to provide better answers to policy questions. Distinguishing between the available instruments to meet specific objectives or to carry out tasks was shown to remain a problem for many. Furthermore, it was shown that to bridge the gap in current provincial planning structures, government needs to analyse and quantify the relationships at sectoral level, in particular their effect on the potential for growth and employment creation, and the sectoral investment needs at provincial/regional level.

Finally, critics caution that empirical analysis and policy applications should aim to take account of history and institutions when explaining the spatial structure of economic activity and determinants of spatial economic growth.

Following the starting point provided in Chapter 2, the following chapter will provide a discussion on the economic development policy of the North West Province as well as provide some motivation for regional growth and development through export promotion.

CHAPTER 3: ECONOMIC DEVELOPMENT POLICY OF THE NORTH WEST PROVINCE

3.1 INTRODUCTION

Chapter 2 presented a theoretical overview of the leading knowledge in regional and local economic development theories and concluded by identifying a need for improved planning structures and methods to quantify the impacts of policies and international events at the regional level, to ultimately assist in or drive policy formulation. Government's vision of a development path through the ASGISA strategy incorporates "*a vigorous and inclusive economy, where the output of production is diverse, where more value is added to products and services, where costs of production and distribution are reduced, where labour is readily absorbed into sustainable employment, and where new businesses are encouraged to proliferate and expand*" (Conningarth Consultants, 2006:3). In response, the North West Province has formulated its own Provincial Growth and Development Strategy to put in place a structure that will also in the longer term ensure alignment between the provincial growth strategy and the national ASGISA programme. Moreover, the challenge for the North West Province is to adapt its own growth and development strategy to reflect the six initiatives identified in ASGISA. Poverty alleviation, the issue of unemployment, and improving the level of expertise and skills are all immediate and long term challenges.

Specific aspects that will be addressed in this chapter include the current state of economic development policy in the North West Province, which will inform the need for boosting economic growth in the province through, for example, stimulating non-traditional (such as manufacturing) exports. Finally, a foundation will be laid for the promotion of export-led growth later on in this thesis through either export diversification or specialisation of the province's current export basket. The focus of this thesis is on the development and implementation of a RAGE model at provincial level in order to determine the region specific effects of policy changes. Consequently, this thesis will now focus on the regional level, i.e. provincial level. This leaves room for improvement and for the development of AGE at municipal level. However, this is left as an area for future research.

This chapter is structured as follows: Section 3.2 provides a brief overview of the current state of economic development policy in the North West Province. Section 3.3 then sets out the context for export promotion. The focus is on the importance of exports for growth and development in the province. Section 3.4 concludes.

3.2 REGIONAL ECONOMIC DEVELOPMENT POLICY

The South African Government's progress in meeting its socio-economic commitments has raised sharp debate as sluggish progress distances the country from broad development targets set for 2014. Although the South African economy is growing at higher levels than in previous decades, it is still slow to share the benefits of growth to rich and poor alike. Hence the confirmation at the recent ANC policy conference for a 'developmental' state; that is, "*a state that is more interventionist in its approach than at present in fast tracking economic development and transformation*" (Western Cape Provincial Treasury, 2007:1).

Drawing lessons from East Asia where significant inroads into poverty were achieved through investments in equity, particularly with regard to education and health, the South African variation demands a particular mix of strategic, organisational and technical capacity that will ensure higher levels of broad-based economic growth and social inclusion (World Bank, 2006). Key is an appropriate governance model for provincial and local government that is optimum for leading economic development and service delivery. This is necessary, given the South African government's imperative to improve both the pace and quality of service delivery if targets are to be achieved.

Unlike many other countries, South Africa's mode of decentralisation did not evolve out of socio-economic considerations, but is rather the outcome of historical factors and a negotiated political settlement in the early 1990s. "*This does not mean that decentralisation has not borne socio-economic benefits over the past 13 years; rather, that the primary rationale for decentralisation, particularly at the provincial level, was based on political imperatives in the negotiation to democratic transition. Socio-economic considerations were secondary concerns at the time*" (Momoniat, 2002:23).

After more than a decade of practice, the system surely does demand review to examine whether it is necessarily appropriate, even pragmatic in optimising the South African Government's stated economic

growth and social inclusion imperatives and targets for 2014 and beyond (Western Cape Provincial Treasury, 2007). This is not to say that the system has been static. Rather, the intergovernmental landscape has gained its own dynamism, evolving in response to local needs and circumstances. However, development has been uneven and asymmetric. "*Kaleidoscopic fragmentation has impeded coordinated and coherent progress and delivery*" (Western Cape Provincial Treasury, 2007:2).

This fluid environment makes policy, strategy and budgetary decisions highly complex, most particularly at the provincial level (Momoniat, 2002). In what manner should a provincial government engage in developing long-term strategic vision, designing appropriate policy interventions, making complementary budgetary decisions and cohering with local government actions all while appreciating and anticipating significant institutional reform to its powers and functions?

Answers are not self-evident. Nevertheless, the business of governing must carry on even at a time that government reviews its very mode of governance itself. The North West Province has charted a unique course in this respect. Its Provincial Growth and Development Strategy is a broad-based strategy aimed towards shifting the province onto a higher shared growth and integrated development path (Conningarth Consultants, 2006).

While the broader South African economy's fortunes are reliant on rich commodity resources, and associated industries and services, the North West Province's weak economic performance has been based on a less diverse array of construction, wholesale and retail, financial and business services, niche manufacturing activities as well as property development and tourism (Conningarth Consultants, 2006). The Province's unique economic structure calls for a particular blend of industrial policy under the broader national scope.

While provincial unemployment is lower than the national rate, it has also risen sharply over the past five years due to natural population growth and in-migration. Similar to the national picture, unemployment is particularly stark among the youth, contributing to fragmented social capital (Momoniat, 2002). Unemployment rates also continue to be higher among women than men. Furthermore, structural shifts in the economy have contributed to a deepening mismatch between labour supply at the lower to medium skill levels and labour demand at the higher skill level, heightening the importance of investment

in education and training among the youth. Bolstering the above are interventions aimed at unblocking binding constraints to enhanced regional growth and development. Key among these are the 2010 Soccer World Cup; energy and water (including sanitation) infrastructure projects; and scarce skills development.

The North West Provincial Government has been making a concerted effort to quantify the impact on a number of strategic macroeconomic variables as prerequisites for attaining accelerated growth rates in the provincial economy. This has, however been done in a very short time without the benefit of customised econometric models that have been fitted to the North West Province economy and properly linked to the economy of the rest of South Africa (Conningarth Consultants, 2006).

3.3 THE CONTEXT FOR EXPORT PROMOTION

In today's globalised world exports are critical for economic growth and development at both national and sub-national level. Export-led growth is more likely to take place in an economy where institutions and government manage to shift resources from declining to rising activities.

The North West Province is an independent self-governing region. It therefore represents the limiting case of what is effectively a regional economy with full fiscal autonomy and considerable latitude to pursue its own local economic development policies. Moreover, the current policy climate in the North West Province exhibits the wider emphasis on the local, as opposed to national/global, perspective to exports that characterises most small economies (Learmonth *et al.*, 2007). The North West Province economy is distinctive in that it has a labour market that is not very tight – with an unemployment rate of more than 43% – and also unusually weakly integrated with other regional labour markets. This, taken with a lack of diversity in the structure of the economy, means that the policy response to the issue of 'exports' is of particular interest.

This thesis uses the North West Province economy to illustrate the importance of the local/regional dimension of economic growth and development. The choice of the North West Province is partly motivated by the availability of a comprehensive region-specific, economic database that is at present unique within South Africa. However, there are also specific characteristics of the North West Province economy which make it of particular interest.

This is a key reason why it is important to discuss export-led economic growth in the North West Province through an assessment of sectoral dynamics. Since the provincial government is responsible for a particular geographic space that can be distinguished from higher (national) and lower (local) levels of aggregation, it is necessary first to place the above discussion in its proper spatial context (Learmonth *et al.*, 2007).

3.3.1 National economic development objectives

The main emphasis of the ASGISA initiative is on faster and shared growth. It is recognized in the ASGISA strategy that if South Africa is to halve unemployment and poverty by 2014 (as the country intends to do and as is contained in the country's subscription to the Millennium Development Goals) economic growth needs to exceed at least 5% per annum. Over the past decades, the South African economy rarely, if ever, achieved such rates. The North West Province, in particular, has managed economic growth rates much less than this. For instance, South Africa's average annual growth rate was 3.1% per annum over the period 1995 to 2005, and the North West Province's average annual growth rate was 2.4% during this same period (Naudé, 2006a).

Whilst ASGISA contains a number of specific initiatives that will be mentioned, the overall approach of ASGISA as set out by the Deputy President is of a philosophy to remove or alleviate the obstacles that stand in the way of the country (and its provinces) of obtaining sufficiently high economic growth rates. In the North West Province, the ASGISA approach would mean identification of the reasons (obstacles) why the province cannot break into growth beyond the 3.1% average experienced over the past 10 years (Naudé, 2006a). One of these obstacles is the relative isolation of the provincial economy from international markets, in particular, the lack of sufficient exports of non-traditional products such as manufactured goods.

The main current emphasis in the ASGISA strategy for overcoming growth obstacles is in provision of infrastructure, and certain national strategic projects, such as bio-diesel. Generally, the ASGISA interventions comprise of the following categories (in each of these, export promotion in the North West Province can contribute) (Naudé, 2006a): First – macroeconomic issues. These are important

for export growth in that South Africa needs to maintain a competitive exchange rate regime. Second – infrastructure programmes. To the extent that these improve transport costs, and lower the general costs of doing business, it will improve the competitiveness of the economy, and thus will be good for exports. Any export strategy for the North West Province must consider that the province is "landlocked" and that transport (logistical) costs are bound to create a serious barrier to exporting. Third – sector investment strategies (or industrial strategies). For the North West Province to benefit from these, it is imperative to identify sectors from where the potential exists to supply international markets. Fourth – skills and education initiatives. There is ample evidence that the knowledge, expertise and meeting of international standards are a significant fixed cost (or barrier to entry) to be overcome before a firm can export. Assisting firms in identifying opportunities and assisting them in making use of these opportunities are an important part of any export promotion strategy. Fifth – second economy intervention. Most firms in the North West Province are small, medium and micro-enterprises (SMMEs). These firms face particular constraints in exporting, and international experience would suggest greater assistance and co-ordination to ensure export success by smaller firms. Finally – public administration issues. Until now, the North West Provincial government has done relatively little to promote exports and support export-oriented firms. By adopting an export strategy based on a sound knowledge of the profile and opportunities for exporting will assist in greater government support.

It is thus clear that in all of the ASGISA categories, an export promotion initiative can make a useful contribution.

3.3.2 The national export strategy and practice in South Africa

Within the context of globalization, it is crucial for a government (at the national and local or provincial level) to have a clear, implementable and measurable export strategy, including the funding of effective export promotion activities. More than a decade ago the South African government committed itself to an outward-oriented growth strategy that aims to not only increase the level of exports, but also diversify the range of commodities exported from the country's shores. This is crucial as the economy still relies heavily

on primary and semi-processed commodity exports, which by their very nature are characterised by declining terms of trade, price instability and low income elasticity of demand (NES, 2005:16).

The recently published National Export Strategy (NES) of the DTI is an important part of the government's strategy to transform the South African economy (NES, 2005:4). The NES also acts as an important link between the DTI and the stakeholders (both public and private) involved in exports and export promotion and development (Naudé, 2006a).

The DTI's mandate is to increase both the value of South Africa's exports and the number of exporters, with a specific focus on Small, Medium and Micro Enterprises (SMMEs) and Black Economic Empowerment (BEE) enterprises (NES, 2005:10).

Within this context, the purpose of the NES is to (NES, 2005:11):

- Align the relevant divisions of the DTI around the key objectives and strategic interventions;
- Ensure policy coherence within the DTI and between the DTI and the rest of the government, especially those departments represented in the economic cluster;
- Build consensus amongst external stakeholders within government;
- Provide clients with a clear understanding of the strategic interventions of the DTI, including priorities with export promotion and development;
- Provide clients with a clear understanding of the service offerings available to exporters and prospective exporters; and
- Ultimately to increase exports, increase the number of exporters, with specific focus on SMMEs and BEE enterprises.

At the core of the NES are nine strategic themes or components, namely:

- Creating a domestic economic environment that enables enhanced global competitiveness of South African exporters (NES, 2005:25). Inefficiencies as a result of decades of inward focused policies, together with the new challenges imposed by globalisation, make interventions aimed at increasing the competitiveness of companies in South Africa an integral part of the NES.

- Implementing Customised Sector Programmes (CSP) aimed at improving the competitiveness and level of employment within priority sectors in South Africa (NES, 2005:37). The CSP's are located within Trade and Investment South Africa and one exists for each of the 11 priority sectors, i.e. agro-processing, automotives, chemical and allied industries, clothing, textiles, leather and footwear, cultural industries, business processing outsourcing, electro-technical (information and communication technologies and electronics), mining and metals, capital equipment, tourism and transport industries (aerospace, marine and rail).
- Improving the South Africa's supply chain, comprising the national road, rail, sea and air transport infrastructure and networks (NES, 2005:43). The efficient functioning of the national export supply chain is critical to export competitiveness and hence export growth. The NES includes two action initiatives aimed at improving the supply chain, i.e.:
    - Implementation of National Logistics Platform Initiative (NES, 2005:45), and
    - Implementation of National Corridor Performance Management (NCPM) system. The DTI is planning to start role out of the NCPM on key national corridors in priority sectors, i.e. Durban-Gauteng container corridor, automotive, metals, iron and steel, chemicals and agriculture.
- Creating a country and product information system matrix that informs the DTI's strategy, resource deployment and activities in the area of export promotion and development (NES, 2005:49). To ensure effective intervention of the DTI, a decision-making tool is currently being developed to identify key export markets for prioritized export products. This tool will provide a scientific base for funding of export promotion activities and take into account new export opportunities in unexploited markets or opportunities for new products in existing markets.
- Ensuring that South Africa gains maximum access to foreign markets through a sustained and pro-active market access programme to integrate the South African economy into the global economy (NES, 2005:59). A coherent international trade strategy with the aim of achieving strategic integration into the global economy is crucial within the context of globalisation. This

entails programmes at the multilateral (e.g. participation within the World Trade Organisation) and bilateral level (e.g. negotiating free trade agreements with targeted economies).

- Implementing a National Trade Information System (NTIS) that serves as the information support link between domestic suppliers and international buyers (NES, 2005:68). According to the NES, the NTIS is "envisaged to function both proactively and reactively, obtaining and disseminating important trade-related information, as well as passing trade leads on to domestic suppliers and assisting them with market information and to make informed and effective export decisions" (NES, 2005:68).
- Establishing a national small exporter development programme (NES, 2005:77). Small and medium enterprises in South Africa generally are not able to evolve into exporters. A systematic set of interventions are therefore necessary in support of such enterprises if the country is to grow its number of exporters. The Small Enterprise Development Agency (SEDA) has been mandated with the responsibility of developing and implementing the national exporter development strategy.
- Developing co-ordinated export promotion mechanisms (NES, 2005:86). In line with international best practice, the DTI adopted a sector approach to export promotion during the mid-nineties. However, the successful implementation of the NES ultimately hinges on the efficiency and effectiveness with which the three central delivery mechanisms, i.e. the export promotion cluster desks of Trade and Investment South Africa, the export councils and the foreign offices, can execute export promotion activities.
- Providing appropriate export incentives and financing products as a component of an effective NES (NES, 2005:99). The government has set as a major challenge to increase the number of exporting SMMEs and BEE enterprises and to increase the geographic spread of these exporters through the provision of appropriate export financial incentive schemes. The following product offerings are currently available:
    - Export Marketing and Investment Assistance Scheme (EMIA);
    - Industrial Development Corporation (IDC) export finance schemes;

- Export Credit Insurance Corporation (ECIC) export insurance schemes; and
- Consultancy Trust Funds to the World Bank and the International Finance Corporation.
- However, if government is to achieve the above challenge, these product offerings as well as their administration need to be continuously improved.

Growing and diversifying the export base of the country will depend on the successful implementation and continuous monitoring and evaluation of the above components of the NES. Success at the national level can only be achieved if the strategy is also filtered through at the provincial level. It is therefore important for the North West Provincial government to align their own export strategy with the national export strategy (Naudé, 2006a). The North West Province is even more reliant on commodity exports than the national economy and the challenge for the province is therefore to move towards higher value-added manufactures and manufactured exports in an attempt to address the economic challenges facing the economy.

From the above can also be concluded that South Africa's current export promotion activities rely on historical export performance trends (NES, 2005:47). Little, if any, scientific justification could be given for the current funding of export promotion activities and it does not take consideration of new export opportunities in unexploited markets or opportunities for new products in existing markets.

3.3.3 Provincial economic development objectives

The North West Province adopted a Provincial Growth and Development Strategy (PGDS) at a Summit in August 2004. The main objectives of the PGDS are to halve poverty and unemployment by 2014 by achieving growth rates of at least 6.6% per annum. The following growth and economic development pillars were identified for strategy formulation at the Summit:

- Growth and Investment,
- Agricultural and Rural Development,
- Mining and Energy,
- Manufacturing and trade

- Tourism,
- Construction and Infrastructure,
- SMME, and
- Training and Skills Development.

By promoting non-traditional exports, the provincial government can make a contribution towards strengthening each of these pillars. Table 3.1 below describes the broad contribution of greater exports to the various economic development pillars of the PGDS.

Table 3.1: Contribution of export promotion to the PGDS

Pillar	Contribution of accelerated exports
Growth and investment	There is a large empirical literature that documents the positive relationship between exports and economic growth.
Agriculture and rural development	By focusing on the exports of agro-processed goods, e.g. processed foods, beverages, bio-diesel, etc. a contribution can be made to agriculture and rural development.
Mining and energy	Most of mining's products are already exported, but mostly in raw format. Beneficiation of mining products may be promoted if sufficient external and international markets for such products can be established.
Manufacturing and trade	Export promotion initiatives, such as this profile report, can identify possible opportunities for manufacturing exports. Currently, North West Province's manufacturing exports are relatively small in volume, and come from a narrow range of products / sectors.
Tourism	Tourism can be seen as a non-traditional export, since it generates foreign exchange for the country. It can also generate international demand for cultural goods and arts and crafts from the province. Conversely, exports of North West Province made products can act as advertisement for the province abroad.
Construction and infrastructure	Physical infrastructure such as roads, airports, harbours, storage facilities, etc. are required to ensure the efficient and cheap production and transportation of goods from North West Province to international markets. By strengthening linkages to international markets through export promotion, the provision of such infrastructure may be supported.
SMME development	Most firms in the North West Province are small and medium enterprises. Export promotion will therefore primarily be interested in how these firms can be made to export more. As such the development and upgrading of this sector and the integration of the first and second economies will be facilitated.
Training and skills development	To make use of the export opportunities identified in this report will require firms that are "export ready". This necessitates creating greater export awareness amongst the North West Province business sector, and the provision of training and assistance in the export process.

(Source: Naudé, 2006a:27)

3.3.4 Local economic development in the North West Province and the North West Spatial Development Framework

Assisting firms in finding export markets, and supporting firms to exploit the opportunities identified in this report, will make an important contribution towards local economic development in the province.

There are many definitions of LED. A popular definition sees LED as a process in which partnerships between local governments, community-based groups and the private sector are established to manage existing resources to create jobs and stimulate the economy of a well-defined area (Helmsing, 2001a:1). The key words in this definition, consistent with a human rights approach are "partnerships" and "management of existing resources". As far as LED as a process by partners are concerned, Helmsing (2001b:301) considers LED to be a suitable instrument for advancing human rights since "*In stark contrast to past practices at national level, local governments generally realise that they are but one of many players involved in local economic development*".

All theories of LED emphasise the economic base of a locality, as well as the importance of market size and market access. In The North West, the implications, as noted in the North West Spatial Development Framework (NW-SDF, 2004) is that most local markets are small; that transport distances to markets tend to be high, and that the resource base of most localities depend significantly on mining and agriculture (primary commodities).

Developing exports will therefore assist local economic development in the province by expanding the markets available to producers in each locality. In following such a strategy, the following challenges need to be addressed.

Firstly, local development becomes more difficult to achieve due to its complex external environment. The word or concept of globalisation has become very relevant on a local level. Globalisation is due to two major factors namely so-called "space-reducing" technologies (Dicken, 1998) in ITC (information technology and communication) and transport and the growing volume of people, capital and firms that are mobile across the globe (Helmsing, 2001a:3). Globalisation puts a huge premium on the competitiveness of a particular location. This is why many commentators are stating that locality has become *more* (not less) important as the globalisation of the world economy proceeds. Pressures towards competitiveness are often understand to mean lower relative wages, lower transport costs, faster transit

times, compliance to environmental protection (e.g. ISO), high skilled and highly productive workers and the meeting of high consumer standards.

Secondly, because of the huge increases in the flows of foreign direct investment (FDI) across the globe in recent times, many cities, towns and regions have identified efforts to attract foreign investment. As identified by Helmsing (2001a:3) "*...getting a small share of a large volume of internationally mobile investment may make a big contribution to local employment and income...and may assist in bridging the local-global gap*".

Thirdly, although local government has an important role to play in LED they are not in the driving seat when it comes to local economic development. Indeed this limitation is accentuated by the huge internal challenges of transformation that local government is currently facing in South Africa. The type of partnerships that may facilitate LED when local governments are confronted with such transformation challenges and globalisation pressures has been described by Helmsing (2001b:302-303) as "regional innovation systems". He states that "*In many countries there has been a veritable explosion of differently constituted local economic development agencies, for a, platforms, commissions, and so on, that play a role in co-ordination, promotion and support... the broadening of the local institutional base is one of the central messages on local economic development*".

Helmsing (2001b) contains an excellent overview of the current state of the art with respect to how LED strategies ought to be designed in the complex environment that most local governments are facing. He identifies approaches focusing on generating externalities, creating a learning region and establishing good governance as indispensable for sustainable LED. There is increasingly consensus in the LED literature that the formation of clusters and networks. has significant advantages for LED – see in particular Camagni (1991) who argues that in a complex and globalising environment firms need to manage a wide range of uncertainties, and that they do so best through their milieu and their networks. Within the milieu (or local environment) he states that "*synergy effects stem from a common cultural and similar psychological and often political background*" (Camagni, 1991:133). The implication is that a clustering approach towards export development could be appropriate for North West Province – both in terms of supporting the development of appropriate manufacturing clusters in the province but also in that export training is best done for the various clusters.

3.3.5 The need for export promotion in the North West Province

The export success of the Asian "tiger economics" has been attributed to the active role played by their governments in the form of designing incentive programs for the promotion of specific domestic sectors (Glenday and Ndii, 2000).

Many authors agree that it is no longer "'if" governments should be involved in the allocation of resources and encouragement of trade. The principal questions are: "how much?" and "what kind of?" government involvement there should be (During 1997; Shankarmahesh, *et al.*, 2005). However national resources are scarce and therefore great selectivity is required in developing and implementing export promotion strategies and activities (Cuyvers, 2004). Therefore a nation waiting to stimulate economic growth through export promotion must distinguish between limited alternatives (Jaffe, Salazar, & Brambila, 1996). The challenge faced by governments, therefore, lie in the necessity to choose specific sectors for export promotion and allocate their limited resources among these sectors (Shankarmahesh, *et al.*, 2005). This selectivity should be based in a thorough analysis of potential export opportunities.

The development of manufacturing through the promotion of exports can be important for economic development and growth. Manufacturing development through exporting can make important contributions to the North West Province's economic development since:

- Manufacturing creates added value to primary production. In the North West Province, the most significant natural assets are land and minerals. To these, manufacturing can add significant value.
- Manufacturing provides for higher quality employment than is normally the case in primary sectors. Most workers in manufacturing require some form of schooling, and on-the-job training also adds to the stock of human capital.
- Manufacturing wages are generally higher than wages in primary sector employment.
- Manufacturing is less subject to adverse external shocks (such as changes in the weather and commodity prices) than primary production.
- Manufactured goods are often easier (and less costly) to export than primary commodities.

3.4 SUMMARY

The purpose of this chapter was to briefly review economic development policy in the North West Province and to provide some insight into the working of the provincial economy. This was done to better understand the region specific factors that drive growth in the North West Province and that should be captured in quantitative tools for policy assessment. Section 3.2 reviewed the provincial and national policies, their focus and the alignment between these policies. Following that, some evidence and motivation were provided to stress the importance of exports for improved growth and development in the province in Section 3.3.

A number of conclusions can be drawn from the literature assessment. The first is that given the unique economic structure of the North West Province, a particular blend of industrial policy under the broader national scope is required to assist the province in breaking into growth beyond the 3.1% average experienced over the past 10 years. A way in which to do this is through the stimulation of non-traditional (such as manufacturing) exports. Whether governments should be involved in the allocation of resources and encouragement of trade is no longer the main question, but rather how much and what kind of assistance is required. It was also emphasised that the development of manufacturing through the promotion of exports can be important for economic development and growth. Manufacturing can make important contributions to the North West Province's economic development through added value to primary production, higher quality employment (schooling and on-the-job training adds to the stock of human capital), higher wages, and a smaller exposure to adverse external shocks.

The following chapter will provide an empirical literature review of the quantitative tools available for the assessment of regional policy impacts, with a specific focus on regional applied general equilibrium modelling. This discussion will inform the model specification in Chapter 5.

CHAPTER 4: ASSESSMENT OF REGIONAL POLICY IMPACTS

4.1 INTRODUCTION

Chapter 3 provided a discussion on economic development policy in the North West Province and highlighted the need for boosting economic growth in the province through stimulating non-traditional (such as manufacturing) exports. This emphasises that policy makers and governments responsible for promoting economic development at sub-national/regional level are in need of tools and methods to quantitatively evaluate the impacts of policies and international events on the regional level (Storper, 2006:1). It is therefore necessary to understand the link between the theories on regional economic development and the problems they are meant to address.

The interactions between theorists and policy makers have led to the development of quantitative modelling tools to assist in identifying the magnitudes of policy impacts on local and regional economies. Economic modelling is therefore a critical tool in government policy, planning and budgeting processes at both national and regional level, and regional models have been developed specifically to increase understanding of the impact of changes, such as shifts in government policy or chance events, on a specific region. These tools include (but is not limited too) applied general equilibrium modelling.

The primary purpose of this chapter is to discuss how regional and local economic development theories have influenced the development of quantitative assessment tools. This will be done in sections 2 and 3. The secondary purpose, to be reached in sections 4 and 5, is to provide a theoretical overview of the development of applied general equilibrium modelling in general with a focus on RAGE modelling. Finally, the chapter converges on the case of South Africa, by providing a short overview of the way in which AGE modelling has developed in the country.

It is pointed out that despite the usefulness of AGE modelling (notwithstanding its shortcomings) the approach is not yet used in South Africa, and thus a gap exists as far as the available tools for quantitatively assessing regional and local policy impacts are concerned. In the next chapter this thesis will start to make an attempt in addressing this shortcoming.

4.2 TOOLS FOR REGIONAL POLICY ASSESSMENT

According to Dervis *et al.* (1992:131) "*there is no doubt that the techniques of development planning have acquired a wide field of potential real-world application.*" Over the years, policy planning, formulation and assessment has been done by relying on unassisted intuition (Jerome, 2004). However, more recently, policy makers have started to integrate the use of quantitative modelling tools in the policy formulation process, in order to account for the 'real-world' effects of their policies. Jerome (2004:2) argued that "*models provide a logical abstract template to sort out complicated chains of cause and effect, and influence between the numerous interacting variables in an economy.*" Because economic models have a logically consistent framework, the policy maker has been provided with a valuable tool, representative of the economic sector with which ideas and policy proposals can be tested (Hazel and Norton, 1986). Economic models have added significant value through qualitative assessments, since they include more structural and institutional features of the economy, and are useful to measure the size of the response to policy initiatives (Jerome, 2004).

Economic models are divided into two broad categories. First, there are the macroeconomic models, which are mostly utilised by central banks that capture variations in an economy. The second type, known as applied general equilibrium (AGE) models, take into account the feedback effects between role players in an economy and are used mainly to conduct economy-wide impact analyses of changes in policy and economic structures.

Models of the first type (macroeconomic models) follow the pioneering works of Klein (1950) and Klein and Goldberger (1955). These models flourished in the 1960s and 1970s and because they have a Keynesian foundation, most of the models in this class were demand-driven. Thus, the crucial closure rule of the macroeconomic type models is that supply adapts itself to demand and prices do not play an integral role in short-run adjustments to imbalances (Soludo, 2002).

Models of the second type (input-output, multiplier and AGE) originated with Leontief (1936). In a restricted sense, it constitutes a general equilibrium analysis to the extent that it analyses the structural interdependence among productive activities in the different sectors in an economy. The scope of its application includes checking for internal consistency; analysing the interdependence of the different sectors in an economy; estimation of resource requirements; and forecasting (Olofin, *et al.* 1993). The first

model of this type (developed in the 1930s) is the input-output model. In input-output models the interdependencies between industries are traced, analytical methods of calculating inverses are used and multipliers exist (Jerome, 2004). The model has a fixed-coefficient technology and no price changes and therefore represents a pure quantity approach.

The evolutionary product and empirical counterpart of general equilibrium is known as the AGE modelling approach. The aim of AGE modelling, according to Bandara (1991:9), "*is to convert the abstract representation of an economy into realistic, solvable models of actual economies.*" One of the major features of AGE modelling is its attempt to combine theory and policy in such a way that the analytic foundations of policy evaluation work are improved (Bandara, 1991).

A short description of the advantages and disadvantages of quantitative modelling tools is shown in Table 4.1.

Table 4.1: Approaches to quantitative modelling in economics

Model types	Advantages	Disadvantages
Fixed ratio	Easy to implement, requires relatively little data	Too simplistic Very little economic theory No dynamics
Econometric	Relatively easy to construct and run High frequency of data and forecasts possible	Relatively data-intensive and need "add factors" in forecasting due to stochastic nature. (Lucas critique). Thin on economic theory (best forecasting models are pure time-series models).
AGE	The "workhorse" for policy analysis Allows all dimensions of economy to be studied simultaneously (macro, meso/sectoral, micro e.g. households)	Very intensive in terms of time and data Not strong on generating dynamic forecasts or analysing monetary phenomena Micro behaviour limited
Microsimulation	Allows for more accurate "behavioural" rules and characteristics of economic agents Typically uses snapshot data e.g. household surveys	Very *ad hoc* – no standard theory Difficult to judge the reliability of results/predictions Can be very complex to implement

(Source: Naudé, 2006b:x)

4.3 APPLIED GENERAL EQUILIBRIUM MODELLING

According to Borges (1986) applied general equilibrium modelling is one of the most actively participated fields of research in economics. It is viewed by policy makers, economists, and analysts alike as a

methodology that can provide coherent answers to complicated 'real-world' questions in a systematic way. The value of AGE models is undeniable for addressing certain types of issues, but is still viewed with suspicion by many, mainly due to a lack of understanding of the underlying modelling framework. Another reason advocated for the negativity towards AGEs stems from the fact that the first initial applications were meticulously chosen and implemented, which delivered ideal results thus proving advantages and possibilities of AGE models. However, as new applications and extensions are proposed, "*it becomes clear that the results obtained are not always in line with the expectations, and that the approach has some limitations which must not be overlooked*" (Borges, 1986:15).

The formalisation of the concept of general equilibrium is due to Walras (1874). By using a mathematical system of simultaneous equations to describe the interaction between all participants in an economy, Walras attempted to prove the existence of a vector of prices that would allow the system to solve, but was unable to do so.

Herbert Scarf (1969) developed an algorithm, which made it possible to calculate a solution of the general equilibrium problem. Shoven and Whalley (1984) were the first to implement the AGE model to address policy issues in the areas of tax reform and international trade. However, recently AGE models have been applied more frequently and in areas, including fiscal reform and development planning (e.g. Perry, Whalley and Mcmahon, 2001; Gunning and Keyzer, 1995), international trade (e.g. Shields and Francois, 1994; Martin and Winters, 1996; Harrison, Rutherford and Tarr, 1997), and more recently, environmental regulation (e.g. Weyant, 1999; Bovenberg and Goulder, 1996; Goulder, 2002).

More recently, various studies have attempted to combine and integrate the various strands of modelling (macroeconomic, AGE and Microsimulation) to capture both the macro- and microeconomic effects of policy changes on the economy as well as on the various role players in the economy (Davies, 2004).

The advantages of AGE models include: the fact that the methodology of AGE models have a solid microeconomic foundation; the issue of internal consistency; the flexibility of the solution algorithms; extensions of the models to national and sub-national levels through the bottoms-up and top-down approaches; the level of disaggregation that is possible in the models; and the most important one

pertaining to this thesis; the possibility of deriving better measures of the welfare gain or loss associated with a new policy (Borges, 1986).

There also exist some weaknesses which are associated with AGE models, these include: the lack of empirical validation; the number of assumptions and estimates on which the models are based; the comparative static nature of the majority of the models as opposed to the more scarce dynamic models; and in particular the inadequate treatment of the foreign sector through the treatment of net trade flows (Borges, 1986).

Robinson (1989:907) states that, "*in trying to understand AGE models, it is useful to establish a standard approach to describing the features of a general equilibrium model.*"

In the following subsections the approach is therefore to examine AGE models by looking at the three types of information that they embody: analytical, functional, and numerical. The analytical structure is the background theoretical material, which identifies the variables of interest and posits their causal relations. The functional structure of the model is the mathematical representation of the analytical material and consists of the algebraic equations, which make up the actual model. The numerical structure consists of the signs and magnitudes of the coefficients in the equations which form the functional structure (Rossouw, 2004). First, the analytical structure is considered.

4.3.1 Analytical

AGE models simulate the functioning of an economy by explicitly capturing the behaviour of the various agents (households, firms, government, rest of the world), the institutional framework (fiscal system and transfer mechanisms), and the market clearing processes (price and quantity). As a result, they can be considered "structural" as opposed to "reduced form" models.

"*The structure of AGE models is Walrasian in spirit, stressing interaction among economic agents and the workings of market clearing processes. At the same time, these models can formally incorporate rigidities and distortions that are particularly strong in developing economies*" (Robinson, 1989:907). The treatment of foreign trade, for example, can substantially differ from a standard neoclassical story through the introduction of various foreign exchange rationing schemes or through quantitative import restrictions.

According to Ginsburgh and Robinson (1984), an AGE model can be usefully described in terms of a number of components.

4.3.1.1 The basic components: agents, rules, signals and institutional structure[8]

First, it is important to specify the economic actors or agents whose behaviour is to be analysed. A simple Walrasian model includes only producers and households. Most AGE models add other actors or additional institutions in the SAM framework, such as government and the 'rest of the world'. Second, behaviour rules must be specified for these actors. Thus, producers are typically assumed to maximise profits subject to technological constraints and households to maximise utility subject to income constraints. Third, agents decide according to signals they observe. In a Walrasian model prices are the only signals agents need to know. Fourth, one must specify the institutional structure of the economy, i.e. the "rules of the game" according to which agents interact (Robinson, 1989). When the assumption is made that perfect competition implies that each agent is a price taker and that prices are flexible – markets exist and work perfectly.

A close connection exists between the specifications of the institutional structure and of the signals that agents observe and react to. For example, "*market equilibrium in a competitive model is defined as a set of prices and associated quantities such that excess demand on all markets is zero*" (Robinson, 1989:910). In a model with some fixed prices, agents will be subject to rationing and one must specify their behaviour in this situation. This might include the rationing rules and resulting spillover effects.

With the specification of the agents, their motivation, and the institutional constraints under which they interact, a general equilibrium model is still not completely determined. So-called "equilibrium conditions" also have to be defined. These are "system constraints" that must be satisfied, but that are not taken into account by any agent in making his decisions. Formally, equilibrium can be defined as "*a set of signals such that the resulting decisions of all agents jointly satisfy the system constraints*" (Ginsburgh and Waelbroeck, 1981:86). The signals represent the variables of the model that are in equilibrium. For example, market

[8] This discussion draws on Robinson (1989).

equilibrium in a competitive model is defined as a set of prices and associated quantities such that all excess demands are zero. In a market economy, prices are the equilibrating variables that vary to achieve market clearing.

A model's fundamental property lies in the definition of equilibrium conditions. The specification of variables in equilibrium and of system constraints that characterise equilibrium can be seen as a simplifying device that provides a way to describe the results of the working of an actual economy. For example, instead of specifying prices as variables that are in equilibrium to achieve market clearing, one could instead try to model price determination explicitly, specifying "disequilibrium" price adjustment rules to describe how prices change over time. Such a specification is theoretically very difficult to implement and completely unnecessary if one is willing to accept the market-clearing system constraints under flexible prices as a reasonable description of the final result of such a process within the time period described by the model (Robinson, 1989).

Times exist, however, when certain market-clearing assumptions are not reasonable. For example, in the AGE models of developed countries it is usually assumed that capital is mobile across sectors and is allocated in order to compare sectoral rental rates – an equilibrium condition that is consistent with an assumption of perfect capital markets. Such a specification obviates the need to describe exactly how the capital market functions – modellers are only interested in the result (Robinson, 1989). The assumption of sectoral capital mobility in models of developing countries is, however, rarely if ever reasonable. Instead, modellers have tended to assume that sectoral capital stocks are fixed within a period and, since sectoral rental rates are not equal across sectors, they have had to specify explicitly how the sectoral allocation of investment is determined from period to period (Bandara, 1991).

Once the basic components are set out, AGE models should also be described in terms of closure, treatment of time and level of spatial detail.

4.3.1.2 Closure of the model

AGE models usually have more variables than equations, which means that the user must specify the values of some variables. This set of user-specified exogenous variables is referred to as the model's closure (Naudé and Brixen, 1993).

Besides being used as a mathematical tool to help solve the model, the closure serves three fundamental purposes. First, the closure specifies some variables as exogenous to reflect various assumptions regarding the way in which economic agents behave, as well as any economy-wide constraints, for example, the government budget deficit, capital formation, wages, foreign currency prices, and so on. Secondly, the closure helps determine the run of the model. Various closures are possible and have been discussed at length elsewhere (see Dewatripont and Michel, 1987). Thirdly, a key part of the closure is the setting or specification of the shocks the user wishes to apply to particular variables, and these shocks are derived from the topic of the study (Dixon and Parmenter, 1996).

Thus it is clear that there are various types of AGE models and one way in which they can be distinguished further is according to their treatment of time.

4.3.1.3 Treatment of time

Some AGE models run static simulations from a projected future equilibrium. A comparative static model, for example, compares the economy at two distinct points in time, without modelling any explicit time periods or time path. Typically, the two states compared are the state of the economy with a given policy change and the state of the economy without the policy change. Consequently, this method of analysis does not provide any details of the adjustment path of the economy between the two points in time. A broad timeframe for these simulations, e.g. short run or long run, is specified by the closure (Ginsburgh and Keyzer, 1997). A time element can be introduced by solving the model sequentially, updating the capital stock to simulate investment and depreciation, the labour stock to simulate population growth, and productivity parameters to simulate advances in technology. Such models are known as recursive dynamic models (Robinson, 1989).

A final analytical area in which AGE models can be distinguished is according to their level of spatial detail.

4.3.1.4 Level of spatial detail

An AGE model could, for example, be a national, multi-region, or single-region model. The level of disaggregation generally depends on user preference and the availability of suitable data.

Within the category of multi-region AGE models, a further distinction can be drawn as to how each region is modelled (Shoven and Whalley, 1984). One method is to use a top-down procedure that allocates the aggregate national results proportionally across regions according to known regional economic statistics, such as employment by industry. A major disadvantage of this approach is that it assumes that the cost and sales structures for a given industry, in each region, is the same as the national industry structure. On the other hand, providing the input-output data is available, each region can be modelled according to a bottom-up procedure. Under this procedure each region is modelled as a mini-economy with government budget and intra-region, inter-region and international trade flows separately specified. The major advantage of this procedure when using a multi-region model, as opposed to the top-down procedure, is that each region has separately specified supply constraints. Therefore, the bottom-up procedure, as opposed to the top-down procedure, is ideally suited to determining the impact of region-specific economic shocks (Shoven and Whalley, 1984).

AGE models are therefore basically simulation models, designed to investigate the impact of policies that work through the market system, such as taxes, tariffs or subsidy changes, or to analyse the impact of direct government intervention in the economy, such as the profile and composition of a public investment program, pricing policies or import restrictions. Next, the models are characterised in terms of functional structure.

4.3.2 Functional

AGE models are essentially numerical models based on general equilibrium theory, which are put into practice in the form of a computer programme. From the perspective of the functional information embodied in an AGE model, its basic structure can be described as follows (see Gilbert and Wahl, 2000:3): Take a global economy consisting of M regions indexed by r. Let V^r be a vector (length F) of factor endowments in each region r, and P^r be a vector (length N) of prices in each region r. The GNP functions for each region can then be defined as $G^r(V^r,Y^r) = \max\{P^r \cdot V^r : P^r\}$, and similarly the expenditure functions as $E^r(P^r,U^r) = \min\{P^r \cdot D^r : U^r\}$, where U^r is aggregate utility in region r. The aggregate budget constraints are then:

$$S^r(P^r,V^r,U^r) = G(P^r,V^r) - E^r(P^r,U^r) = 0 \qquad r = 1,\ldots,M \tag{4.1}$$

From the first order conditions to the GNP maximisation problem one obtains sectoral supply functions by Hotelling's lemma, and Hicksian demand functions follow similarly from the derivative properties of the expenditure function, hence:

$$S_i^r(P^r,V^r,U^r) = D_i^r(P^r,U^r) - Y_i^r(P^r,V^r) = 0 \qquad i = 1,\ldots,N;\ r = 1,\ldots,M \tag{4.2}$$

define Hicksian net exports. With trade there can be only one price vector, which is denoted P. International equilibrium then requires:

$$\sum_{r=1}^{M} S_i^r(P^r,V^r,U^r) = 0 \qquad i = 1,\ldots,N \tag{4.3}$$

By Walras' law these equilibrium conditions are not independent, and any one of them can be dropped. Hence, one element of P (say P_1) must be declared a numeraire price. The solution to the system of equations defined by (4.1) to (4.3) then yields a relative price vector, aggregate utility levels, and net exports. One can subsequently derive factor prices from the GNP function:

$$W_j^r = W_j^r(P, V^r) \qquad j = 1,\ldots,F;\ r = 1,\ldots,M \qquad (4.4)$$

Finally, since each sector is a price-taker in factor markets, from the first-order conditions of sectoral cost minimisation $C_i^r(W^r, Y_i^r) = \min\{W^r \cdot X^r : Y_i^r\}$ one obtains factor demands:

$$X_{ij}^r = X_{ij}^r(W, Y_i^r) \qquad i = 1,\ldots,N; j = 1,\ldots,F;\ r = 1,\ldots,M \qquad (4.5)$$

In this simple model there are $M+MN+N+2MF+MFN-1$ variables, but we have only $M+MN+N+MF+MFN-1$ independent equations. In a neoclassical model the V^r are declared exogenous, enabling the system to be solved (Gilbert and Wahl, 2000).

While the framework previously described is very simple, the important features of AGE models discussed earlier are clearly illustrated. First, the utility maximisation and profit maximisation conditions underlying the expenditure function and the cost and GNP functions respectively, clearly shows that optimising behaviour is explicitly built into the model. Second, as reflected by the conditions underlying the GNP and expenditure functions, economy-wide constraints are enforced. Finally, it can be seen how such a closed system explicitly captures the relationships between sectors.

Within the above framework specific functional forms must be employed to define the substitution relationships of an AGE model (most commonly CES or Cobb-Douglas functions in value-added and Armington, Leontief in intermediate use, and Stone-Geary, Cobb-Douglas or CRESH in household demand – even though other functional forms exist and are used). After deciding on which functional forms will be implemented, the required free parameters (e.g., elasticities of substitution for CES production functions, income elasticities of demand and the Frisch parameter for Stone-Geary utility functions) are determined either by econometric estimation or literature searches. "*Through a process called calibration, the assumption is made that profit and utility maximising conditions will hold in the base year allowing the remaining parameters to be determined from the base data*" (Gilbert and Wahl, 2000:5).

The typical applied model retains the basic framework described by equations (4.1)-(4.5) despite adding some complexity. In AGE models of a single economy, prices are given exogenously, or are based on partial rest-of-the-world demand functions (Gilbert and Wahl, 2000).

Two methods are normally used for solving models once they have been constructed, of which the first method is a linear approximation, which has the advantage of computational simplicity. The second method includes the implementation of the model in levels form, and the use of non-linear solution methods, which has the advantages of producing accurate results for large-scale changes and reproducing the benchmark data, through which error checking is made automatic (Horridge *et al.*,1993). Bandara (1991) noted that the institution with which the researcher is associated often reflects the choice of solution method. Moreover, by breaking the simulation into smaller parts and solving sequentially, it is possible for the solution of a linearised model to approach to the solution of a non-linear model to an arbitrary degree of accuracy (Gilbert and Wahl, 2000). Since many packages automate this procedure, the differentiation of models on the basis of solution method has become less important.

Finally, it is possible to describe the models in terms of the numerical information that they contain.

4.3.3 Numerical

An AGE model is a mathematical representation of an economy (Arrow and Debreu, 1954). The previous sections have shown that at the core of the model is a set of equations describing the behaviour of various economic agents (for example, industries, households and governments) when faced with changes in key economic variables, for example, and most importantly, relative prices. This theoretical structure is usually derived from neoclassical microeconomics. Typically, households maximise utility subject to a budget constraint, and industries minimise costs subject to production functions. The core behavioural equations are supplemented with market clearing equations, which compare supply and demand in all commodity and factor markets. Such a model is calibrated from a numerical database, the central part of which is a set of input-output accounts showing, for a given year, the flows of commodities and primary factors between groups of economic agents (Dixon and Parmenter, 1996). Input-output or SAM accounts provide the underlying data framework for AGE models, with an income-expenditure account for each actor in the model. This data represents the state of the economy in question at one point in time – the base year. In order to obtain a solution to the model, the model's equations are solved simultaneously.

The procedure involved in choosing values for models' parameters is known as 'calibration' in the AGE literature (Mansur and Whalley, 1984). In general, for a given economy, an equilibrium situation is assumed that is known as 'benchmark' equilibrium. The values of the parameters of the models are chosen such that the model can replicate the benchmark data set. In general the benchmark data set is from national accounts (including input-output data) and government data sources. In practice the calibration procedure involves only a set of data for a particular year. This is known as base year data. Sometimes a 'typical year' data base is used as an average over a number of years (Higgs, 1986). An important factor in models' calibration is that it completely depends on a single set of data as a benchmark data set.

To calibrate an AGE model two broad categories of data are required: firstly input-output and national accounts data and secondly various elasticity estimates. The SAM (containing mostly input-output data) provides a snapshot of the economy at a single point in time and each cell records the value of each transaction (i.e. the product of prices and quantities) (Cameron, 2003). When subject to change, from an exogenous shock or an endogenous change in demand or supply, how much of the change will be represented by a change in price and how much a change in quantities will depend on the structure of the model. Since in the SAM there is no automatic partition of the transactions value into price and quantity, one must be chosen. In practice one would start by normalising all (domestic) prices to unity in the base (Robinson, 1989). How the cell then evolves is determined by the choice of values for key behavioural parameters.

The aforementioned thus portrays the way in which one can describe AGE models, while the next section analyses the extension of AGE modelling to the regional level.

4.4 REGIONAL APPLIED GENERAL EQUILIBRIUM MODELLING

Regional economic modelling has evolved from simple input-output models with fixed relative prices to the more complex RAGE models that allow for flexible relative prices. More recent developments of input-output models also include the construction of models that integrate econometric and input-output approaches (Western Cape Provincial Treasury, 2007).

The evaluation of economic policy requires that information on both the regional and economy-wide effects of policy changes be available to the policy maker (Higgs *et al.*, 1988). Such information can be obtained through the implementation of one of three modelling approaches. First, the top-down method models economic behaviour at the economy-wide level after which the economy-wide effects are disaggregated to a regional level without any feedback from the regions. Second, the bottom-up approach applies the behavioural theory at the regional level, with feedback from regions taken into account and derived as explicit aggregates of the regional results (Higgs *et al.*, 1988:317).

A third approach involves combining the top-down and bottom-up approaches to make a hybrid framework (Ahmed and O'Donoghue, 2006). The hybrid (top-down and bottom-up) approach is usually used to disaggregate the model framework beyond the broader regions i.e. hybrid models capture details of sub-regions/sub-provinces (Coady and Lee Harris, 2001). In the first step, making use of a bottom-up AGE model, one obtains the usual results explained above and in the second step a top-bottom approach is used to split the regional results into sub-regional details. As these steps indicate hybrid models are computationally more intricate than the bottom-up models and pose serious consistency problems depending upon the quality of sub-regional input-output database quality (Ahmed and O'Donoghue, 2006). For most occasions formalised I-O tables are not available for sub-regions and one has to make use of only trifle details such as sub-regional factor employment and produced outputs. Even the household incomes have to be captured through some form of assumptions derived from household income and expenditure surveys.

Both direct and indirect effects are relevant in the context of RAGE models and it is the capturing of indirect, or secondary, effects that makes RAGE modelling a powerful planning tool, distinguishing it from other analytical techniques. RAGE modelling also allows for insight into the socio-economic impacts, including income, welfare, and employment, of policy decisions and economic shocks. These are particularly important when assessing the impact of policy decisions on different communities in the economy (Western Cape Provincial Treasury, 2007).

RAGE or impact-modelling exercises usually only simulate one or two policy changes simultaneously. When too many changes are incorporated into one simulation, the effects become

intertwined and the model loses its power to extract from reality to improve the understanding of the economy. RAGE modelling therefore has a macro-economic focus, making its applicability more suited to economy-wide analysis rather than detailed impact analysis where there are limited linkages (PROVIDE, 2005c). Despite such limitations, RAGE modelling has been carried out at various levels of the economy, from national, to regional or provincial level, as well as town level. RAGE models are very similar in design to national models, but exhibit major differences in certain key assumptions.

According to Partridge and Rickman (1998:205) RAGE models "*have grown in popularity in recent years as an alternative method to examine regional economies and regional policy issues*". The problems faced by RAGE models are inherent in all empirical regional modelling. Due to the regional economies being more open compared to their national counterparts, it is necessary to account for these differences in the structure of the model. Some models have, through an adjustment in their structure, attempted to encapsulate these differences, whereas others have followed the national structure. These initiatives, however, were mostly determined by the type of question being modelled (Partridge and Rickman, 1998).

The number of issues modelled through RAGE models increased significantly in the late 1980s and early 1990s. There are an ever increasing number of topics being covered by RAGE models. RAGE modelling "*has provided unique insights into key regional economic issues, becoming an additional tool available to those studying regional economies*" (Partridge and Rickman, 1998:226-227).

The most significant shortcoming of the RAGE modelling approach to date is a lack of useful and accurate regional data. Also, SCGEs, which are developed for sub-national regions are more ideally suited for application in the transport sector due to its comparative static nature (Tavasszy *et al.*, 2001).

4.5 APPLIED GENERAL EQUILIBRIUM MODELLING IN SOUTH AFRICA[9]

Since the 1990s, there has been a considerable increase in the use of AGE models in South Africa to study a variety of policy issues. The advantages of AGE models for policy analyses, compared to traditional macroeconomic models, are now widely acknowledged. General equilibrium models allow for consistent

[9] For a detailed list of CGE modelling efforts and work in South Africa, see Appendix A.

comparative analysis of policy scenarios and they incorporate microeconomic mechanisms and institutional features within a consistent macroeconomic framework, and avoid the representation of behaviour in reduced form (Zalai, 1982). This allows analysis of structural change under a variety of assumptions.

Since the 1990s there has, however, been a major shift both in the questions to be addressed by the models and in the types of models used in South Africa. The early AGE models were used to examine the issues of the day such as macroeconomic stability and the opening up of the economy. Currently the challenges have shifted to the labour market, environmental, social (HIV/Aids) questions and sub-national issues.

Earlier efforts started in 1993 with a small multi-sector model of Naudé and Brixen (1993) and concluded with the implementation of the Industrial Development Corporation's IDCGEM (see Joubert, 1994; Horridge *et al.*, 1995; 1996). The IDCGEM is the largest and most disaggregated AGE model in South Africa and has been used, amongst other applications, to inform South Africa's GATT negotiations.

Since 2000 there has been an upsurge in interest in AGE modelling in South Africa. This has been led by international researchers from the World Bank and the International Food Policy Research Institute (IFPRI), but local modellers have also been playing an active role in building new models in response to new policy challenges. Naudé and Coetzee (2004) were the first to extend the modelling approach in South Africa by incorporating dynamics in a comparative static AGE model. McDonald and Punt (2001) used a RAGE model to analyse the impact of increased agricultural export opportunities upon the economy of the Western Cape. Specifically, the focus was on grape and deciduous fruit production that had achieved appreciable productivity growth. The model was calibrated with a SAM for the Western Cape in 1993, in which agriculture (24 commodities and 9 agronomic activities/regions) and labour (11 skill classes and 4 racial classes) were extensively disaggregated.

While the first models in South Africa were strongly influenced by the work of Naudé and Brixen (1993), the more recent AGE models are only partly built on this approach although many are related. Part of the explanation for this may be found in their difference in focus: extending only a small part of the model such that the model may answer the specific policy questions the modeller intends to address. This has resulted in various national models that are sophisticated with respect to small sub-sections, while

staying highly stylised in other parts of the model (Thissen, 1998). In future work, researchers may want their models to reflect the structural changes in the South African national and sub-national economy which has been taking place, while not forgetting the lessons from earlier models.

4.5.1 The Provincial Decision-Making Enabling (PROVIDE) project

The PROVIDE project was born from a desire to extend capacity in provincial level AGE analysis from the Western Cape to other agricultural departments in South Africa. In 2001, the national Department of Agriculture and the nine provincial departments of agriculture co-funded the PROVIDE project, aiming to develop a series of SAMs that had a regional focus and detailed agricultural accounts as well as an associated AGE model and to use the latter for policy analysis and capacity building (PROVIDE, 2005c).

The project developed a national SAM, four regional SAMs and a multiregional SAM for the base year 2000. The SAMs all hold extensive detail on the agricultural industry. The inclusion of various different tax accounts allows for fiscal policy analysis. Detailed factor and household accounts capture the functional distribution of income to households, making the SAMs suitable to analyse the effects of policy changes on income redistribution (PROVIDE, 2005b). A distinguishing feature of the national SAM is that it contains provincial level information on households and labour, providing critical insight into policy impact at a provincial level.

The PROVIDE regional SAMs were based on the four regions identified for purposes of the PROVIDE project – the Northern Cape and Western Cape; the Eastern Cape and KwaZulu-Natal; the North West Province, Free State and Gauteng; and Mpumalanga and Limpopo.

Besides numerous background papers and technical documents, a series of working papers present the results of various studies conducted as part of the PROVIDE project.

The PROVIDE working paper (2006:1) on the 'Impact of increasing excise duties on the economy' was completed on request from the SA Wine Industry Council. The results were used during negotiations between the SA Wine Council and Provincial Ministers of Finance and Tourism from the Northern and Western Cape and the National Minister of Finance to determine the desired level of increases in the excise duties on wine.

This study investigated the economic impact of a 10 per cent increase in excise duties on wine, focusing on the change in GDP, trade and prices, as well as changes in the factor market and the welfare of households of the Northern and Western Cape (the two major wine producing provinces in the country).

The results indicated that the majority of households in SA would be worse off in terms of real consumption expenditure, and that all households in the Northern and Western Cape would experience welfare losses. Lower-income households would be most affected, as they tend to spend a larger share of their income on beverages and tobacco (PROVIDE, 2006).

The PROVIDE project also made inputs into the ASGISA strategy, estimating the socio-economic impact of investment in irrigation schemes. The study described the results of preliminary investigations into the impact of technical progress (increased efficiency) in agricultural production through additional investments in irrigation systems and a general improvement in the efficiency in the use of primary factors of production, land, labour and capital (Western Cape Provincial Treasury, 2007).

The results confirmed that gains in the non-agricultural sector have the greatest impact on the economy, with efficiency gains in agriculture only adding to growth, employment and household welfare in proportion to its share of the economy. AGE modelling undertaken on a regional level therefore has a definite role to play in informing the policy debate at sub-national level. "*The results might give an indication as to which policy interventions will lead to an expansion of the regional economy and importantly, whether economic growth will be shared growth that will address poverty and inequality, or whether it will have the unintended effect of reinforcing the duality in the economy*" (Western Cape Provincial Treasury, 2007:18). An advantage of AGE analysis is that once there is a detailed SAM of the economy, the data and models may be used with relatively little adjustment to analyse any economic sector or industry.

Through the PROVIDE project, evidence has been presented that the resulting analytical tools are particularly valued for the information they present on the socio-economic impacts of policy decisions and economic shocks, which are of importance from a political perspective in order to gain insight into who will be the potential winners and losers when certain policy changes are considered (Western Cape

Provincial Treasury, 2007). A further advantage of AGE analysis is that it allows for systematic economic analysis, contributing to a more focused, disciplined and hence a more constructive policy debate.

4.6 SUMMARY

The purpose of this chapter was to better understand the factors that drive regional growth and that should be captured in quantitative tools for policy assessment. Sections 4.2 and 4.3 reviewed the quantitative assessment tools of the past and present, which have stemmed from the development economics literature, due to the need for quality regional assessment tools. Following that, the development of AGE modelling, and specifically RAGE was presented in Sections 4.4 and 4.5.

A number of conclusions can be drawn from the literature assessment. The first is that AGE modelling is a vibrant field of study in economics which can provide relevant and useful answers to policy related questions. RAGE modelling, though still relatively new is positively related to increasing returns and negatively related to transport cost. The increasing returns are the result of scale and proximity that impart the efficiency benefits of mass production, specialised intermediate inputs, better alignment of workers and job opportunities, and the availability of public goods and services. Within this framework, the specialisation drives trade. Trade can also be positively related to increasing returns and negatively related to transport cost.

Finally, the chapter showed that the contribution of this thesis is an important one seeing as most AGE modelling has been done on a national level and as it was noted in the first section of this chapter, problems and solutions differ from one region to the next and a national policy strategy might not be the correct one for any/all of the regions. Thus it can be concluded that although AGE has its role to fulfil, RAGE models are more important when it comes to the growth and development of a specific region since a unique policy strategy is needed.

The following chapter will provide a discussion on the methodology and data used in modelling the possible economy-wide impacts of greater diversification/specialisation on the North West Province economy.

CHAPTER 5: METHODOLOGY AND DATA

5.1 INTRODUCTION

In Chapters 3 and 4 it was shown that the contribution of this thesis is an important one seeing that it extends the AGE modelling process to the sub-national level in South Africa. It was also concluded that although AGE has its role to fulfil, RAGE models are more important when it comes to the growth and development of a specific region given the potential impacts of trade policy decisions on sub-national regions.

Following these conclusions this chapter provides an overview of the RAGE model with particular reference to the structural features imposed to ensure adequate representation of the North West Province economy. In this chapter, this thesis focuses on the method of AGE modelling. In order to understand the application of this technique requires a thorough knowledge of both the technical nature and practical consideration of undertaking AGE analyses. The purpose of this chapter is therefore twofold: First, to describe the underlying framework of AGE modelling and its application and value adding effect at regional level, and second, to describe the different role players and their influence on the regional economy. Also, the purpose of this and the following chapters is to highlight the usefulness of this modelling technique for policy evaluation and assessment at sub-national level. In doing so, this thesis extends the AGE modelling approach in South Africa by implementing this technique at sub-national level.

The chapter is structured as follows: Section 5.2 provides a short description of the North West Province SAM used to calibrate the RAGE model. The focus is on the underlying framework which forms the core of the model and is important for understanding the behavioural and technical relationships between the various role players within the economic system. Section 5.3 looks specifically at the North West Province SAM compiled by Conningarth Consultants (2006) that is used as main data source within the RAGE model. Section 5.4 sets out the parameter estimates of the model. Section 5.5 provides a discussion on the RAGE model and approach to be used, particularly in Chapter 6. Section 5.6 concludes.

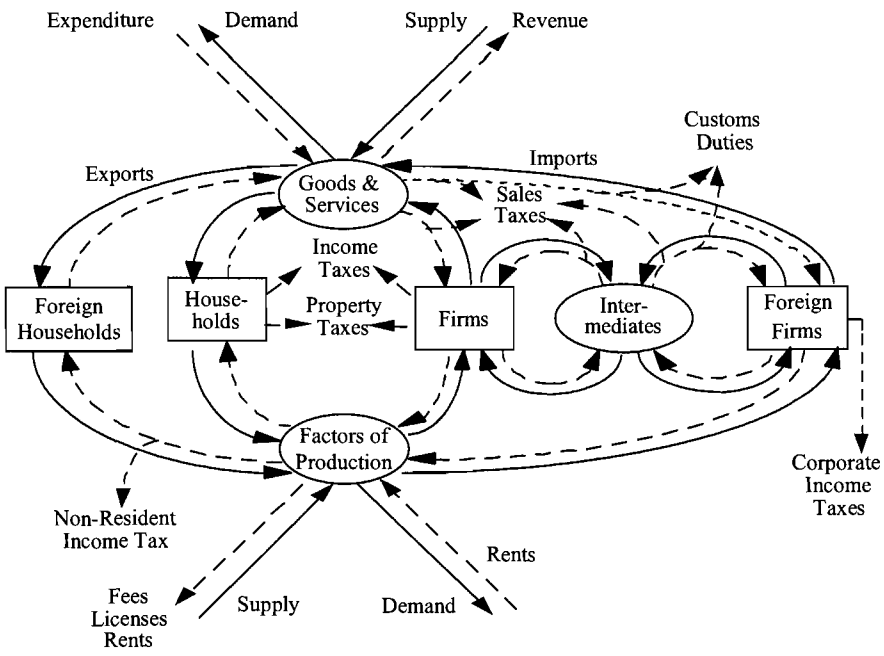
5.2 THE DATA

"*A SAM provides a framework and consistent (base-year) data for economy-wide models with detailed classifications of actors, such as industries, categories of employed persons and institutional sub-sectors, including various socio-economic household groups.*" (United Nations, 1993)

In chapter 1, a SAM was described as a data system taking into account both social and economic data for a national/provincial/regional economy (Cameron, 2003). The SAM provides a "snapshot" of the economy which captures all transactions that take place between the institutions in an economy during a given period (usually a year) (Conningarth Consultants, 2006). The structure of a SAM is determined by the circular flows of goods and services and factor payments in an economy. This is done by means of double-entry bookkeeping, which ensures that both the flows and the financing thereof are taken into account.

The "heart" of a RAGE model is the circular flow of commodities in an open economy (region/province), as shown in Figure 5.1. The main actors in this economy are households and firms, the first of which own the factors of production and are the final consumers of produced commodities, whereas the latter rent the factors of production from households for the purpose of producing goods and services which are then consumed by households. Often RAGE models also explicitly represent the government as part of these flows, but without playing a proactive role in the system (Wing, 2003). The main function of the government in these flows is to collect taxes and distribute these revenues to firms and households as subsidies and lump-sum transfers, subject to rules of budgetary balance that are usually specified by the analyst/modeller (Wing, 2003:5). Households are compensated for their labour services, which then use these resources to buy commodities. Capital income surpluses, plus household and government savings, are used to finance investment (Conningarth Consultants, 2006).

Figure 5.1: Circular flow of transactions in an economy



(Source: Adapted from Berck and Dabalen, 1995:6)

Sub-national SAMs use a similar framework to the one described above, but with the added difference of taking into account the flows of goods and services and transfers between regions and nations. Since a regional SAM represents the circular flow of income in that specific region, it is considered to be a natural candidate for a RAGE model to be based upon (Psaltopoulos *et al.*, 2004). In recent years, numerous studies have applied SAM-based RAGE models to analyse small regions within an economy (see, e.g. Marcouiller *et al.*, 1995; Roberts, 1995, 1998, 2003; Psaltopoulos *et al.*, 2004). According to Pyatt (1988) any model based on a SAM will also satisfy Walras' law.[10] The relationship between SAMs and models can be described as asymmetric in the sense that for each model there exists a corresponding SAM, but for any given SAM a variety of possible models exist. This implies that a SAM, coupled with a conceptual framework that contains the behavioural and technical relationships among variables within and among sets of accounts, can be used for policy assessment rather than purely diagnostic purposes (Pyatt and

[10] Walras' law states that if there are M markets in an economy, and $(M-1)$ of these are in equilibrium, it implies that the M^{th} market will also be in equilibrium (Walras, 1874).

Round, 1985). The afore-mentioned conceptual framework is supplied, for the purpose of this thesis, in the form of a RAGE model.

Though a SAM is often used to calibrate an AGE model, it is often criticised due to it being statistically incorrect. As Kearney (2003:94) put it, "*the data contained within a SAM is based on a single observation and not on a series of observations as would be statistically more significant.*" A more realistic approach would be to use time series data. However, a SAM requires considerable data, which, usually, is difficult to obtain. At regional level this problem becomes more critical, due to the fact that data in most cases are virtually non-existent (Partridge and Rickman, 2007). The SAM provides information to calibrate the majority of the parameters in the model – other parameters in particular, expenditure elasticities[11] are obtained from outside the model (typically from econometric studies or by making plausible guesstimates).

The framework depicted in Table 5.1, which conforms to the System of National Accounts (SNA), illustrates the underlying core and matrix structure used as basis for the North West Province SAM, and also takes into account the circular flow and double-entry bookkeeping system that exists between all of the economic agents in the economy. This highly aggregated version of the SAM (indicating account totals only) distinguishes between the different kinds of accounts within the SAM and is commonly referred to as a macro SAM or National Accounting Matrix (NAM) (Conningarth Consultants, 2006). This is the framework upon which the SAM for the North West Province is based.

The following six major types of accounts, which are representative of the main actors and role players in the North West Province economy, form the basis of the SAM for the North West Province and are indicated in the outline of the SAM in Table 5.1 (Conningarth Consultants, 2006):

- Activity Accounts that capture the value of goods and services produced in an economy (including a breakdown of intermediate and factor costs);
- Commodity Accounts that capture the value of goods and services traded in an economy (whether imported or locally produced);

[11] Expenditure elasticity is the percentage change in expenditure as a result of a percentage change in either incomes of the household or prices of goods being bought. For instance in the present model, households are modelled as having a demand for clothing and textiles, which can be supplied from either domestic sources, or imported. The domestic clothing and textiles and imported clothing and textiles are assumed to be imperfect substitutes. This is known as the 'Armington' assumption.

- Factor Accounts that capture the value of payments made to the essential factors of production (i.e. labour, capital, land, etc.);
- Institutional Accounts that capture the value of transactions by business enterprises, households and government;
- Capital Accounts that reflect investment and the funding thereof, and
- The Rest of the World Accounts that capture the value of imports and exports (between regions and nations) and net capital flows.

Table 5.1: The North West Province social accounting matrix - an outline

	Activities	Commodities	Factors (Capital and Labour)	Enterprises	Households	Government	Investment	ROW and RSA	Total
Activities		Sales/Turnover							**Gross Output**
Commodities	Intermediate Inputs/consumption	Trade and Transport Margins			Private Consumption	Govt. Consumption	Investment	Exports to ROW and RSA	**Demand**
Factors (Capital and Labour)	Value Added							Factor Income from Abroad and RSA	**Total Factor Income**
Enterprises			Factor Income			Transfers		Foreign Transfers	**Enterprise Income**
Households			Factor Incomes	Transfers such as social grants, pensions etc.	Transfers among Households	Transfers		Transfers to Hh from Abroad and RSA	**Household Income**
Government	Taxes on Production	Sales Tax	Tax on Factors	Enterprise Taxes (Direct)	Income Tax	Transfers to Government		Transfers from Abroad and RSA	**Revenue earned by Govt.**
Capital Account				Enterprise Savings	Households Savings	Government Savings		Foreign Savings	**Savings**
ROW and RSA		Imports from ROW and RSA	Transfers to ROW and RSA			Govt. Transfers to ROW and RSA	Capital flows from RSA to ROW		**Foreign Exchange Outflow**
Total	**Overall Production Cost**	**Total Supply**	**Factor Expenditures**	**Enterprise Expenditures**	**Household Expenditures**	**Government Expenditures**	**Investment**	**Foreign Exchange Inflow**	

(Source: Adapted from McDonald and Punt, 2005:68)

The North West provincial government recently made available a SAM for the province, compiled by Conningarth Consultants. The SAM is representative of the provincial economy depicting the flow of goods and services between firms, households, government, and the rest of the world.

The SAM used in this thesis as database for the RAGE model is an aggregated version (aggregated to the 27 industries/commodities of the 1998 Statistics South Africa (StatsSA) (2002) national SAM[12]) of the Conningarth SAM[13] for the North West Province and is based on 2004 data. The aggregated SAM contains the same broad categories as contained in the original SAM, namely activities, commodities, factors, institutions, capital and trade. The institutions and trade accounts in turn are sub-divided into households, incorporated enterprises and the government, and the trade account between the other provinces and foreign countries (McDonald and Punt, 2001). The North West Province SAM is distinguished by the level of detail that is available in the activity/commodity, household and labour factor accounts.

The SAM uses a supply and use structure that allows activities to produce multiple products, and each commodity to be produced by multiple activities (McDonald *et al.*, 2006). Households in the North West Province SAM are divided according to the 12 income deciles, similar to the South African national SAM compiled by StatsSA. Furthermore, taxes are disaggregated to include the major sources of tax revenue for government, including corporate taxes, personal income taxes, Value Added Tax (VAT), and other indirect taxes on products (Customs and Excise), and other indirect taxes on production.

5.3 THE NORTH WEST PROVINCE SAM[14]

The following section draws on the work of Conningarth Consultants (2006). Table 5.1 presented an outline of the North West Province SAM (the NAM or so-called macroeconomic SAM), illustrating the various economic inter-linkages that exist between the different accounts and institutions reflected in a Provincial SAM. Each of the entries in the framework represents either a matrix or a vector

[12] The reasons for this is twofold: first, to split gross fixed capital formation between fixed capital investment and capital stock, which was not done in the original version of the SAM, and second, for comparative purposes.

[13] See Conningarth Consultants (2006) for a full description of the provincial North West SAM.

[14] This section is based on the report by Conningarth Consultants (2006).

depicting monetary flows between the various role-players in the economy. "*This serves to display the transactions recorded in the North West Province economy at a macroeconomic level, and provides a useful overview of the extensive data framework contained in the comprehensive provincial (microeconomic) SAM*" (Conningarth Consultants, 2006:17).

At this point, an important structural characteristic of the Provincial SAM deserves to be highlighted. The trade accounts of the North West Province SAM distinguish between trade with foreign countries as well as trade with the other provinces.

A version of the macro SAM for the North West Province is given in Table 5.2. The SAM for the North West Province has 208 accounts which can be grouped into six broad categories namely activities, commodities, factors, institutions, capital and trade. The institutions and trade accounts in turn are sub-divided into households, incorporated enterprises and the government, and the trade account between the other provinces and foreign countries (Conningarth Consultants, 2006).

Table 5.2: Macro SAM for the North West Province (R Millions, 2004 Prices)

					Current Accounts							Capital Account		Rest of the World					
			Activities	Commodities	Factors		Institutions					Government	All other sectors	Factor payments	Goods & services	Transfers	Capital	Discrepancy	Total
					Labour	Capital (GOS)	Enterprises	Households	National Government	Provincial Government	Local Government								
		Activities	-	148,467	-	-	-	-	-	-	-	-	-	-	-	-	-		148,467
		Commodities	78,027	-	-	-	-	48,162	7,728	2,962	967	4,011	13,909	-	61,922	-	-	-	211,231
Current Accounts	Factors	Labour	32,472	-	-	-	-	-	7,186	7,164	951	-		1,179	-	-	-		44,951
		Capital	37,865	-	-	-	-	-	-	-	-	-		722	-	-	-	-	38,607
	Institutions	Enterprises	-	-	-	29,312	-	-	311	-	137	-	-	-	-	-	-	-	29,840
		Households	-	-	43,159	-	9,137	1,554	-	3,236	-	-	-	-	-	166	-	-	58,013
		Total government	83	9,860	-	[illegible]	6,861	7,620	13,287	205	-	-		-	-	51	-	-	40,618
		National government																	
		- Property income		-	-	645	-	-	-	-	-	-	-	-	-	-	-	-	645
		- Transfers	-	-	-	-	349	151	-	-	-		-	-	-	-	-	-	500
		- Direct tax	-	-	-	-	5,128	6,796	-	-	-	-	-	-	-	-	-	-	11,924
		- Indirect tax	486	10,043	-	-	-	-	-	-		-	-	-	-		-	-	10,529
		- Subsidies	219	183	-	-	-	-	432	-	-	-	-	-	-	-	-	-	-
		Provincial government	151	-	-	1	183	138	13,958	151	-	-	-	-	-	-	-	-	14,313
		Local government	-	-	-	-	1,241	335	867	10	-	-		-	-	51	-	-	2,706
Capital account		Government	-	-	-	306	-	-	2,345	788	632	-	-	-	-	-	-	-	4,071
		All other sectors	-	-	-	1,702	4,779	428	-	-	-	-	-	-	-	-	-	-	9,909
Rest of the world		Factor payments	-	-	1,792	3,577			-	-	-	-	-	-	-	-	-	-	5,369
		Goods & services	-	52,903	-	-	-	-	-	-	-	-		-	-	-	-	-	52,903
		Transfers	-	-	-	-	9,063	250	-	-	-	-		-	-	-	-	-	9,313
		Balance on current account	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,543	-	3,543
		Account																	
		Capital	-	-	-	-	-	-	-	-	-	57	3,600	-		-	-	-	-3,543
		Discrepancy	-	-	-	-	-	-	-	-	-	-		-		-	-	-	-
Total			148,467	211,231	44,951	38,607	29,840	58,013	23,599	14,313	2,706	4,071	9,909	1,900	61,922	220	3,543	-	

(Source: Conningarth Consultants, 2006:18)

The macro SAM reflected in Table 5.2 sets the tone for the nature of the information that will be forthcoming in the microeconomic, disaggregated North West Province SAM. In this highly aggregated form, the macro SAM is a rich source of data relating to the economic activity in the North West Province. Each economic relationship that exists in this economic system is defined in terms of its magnitude, and ultimately equilibrium exists in the system since supply (or income) and demand (or expenditure) is exactly equal for all accounts.

The North West Province SAM comprises 208 accounts: there are 46 commodities, 46 production activities, 48 factors of production, 48 household groups, 6 government accounts, and various capital and rest of the world accounts. The SAM is for 2004 and the macro SAM is shown in Table 5.2.

Features of the North West Province SAM that justify mentioning are:

- The commodity and activity accounts are based upon the account classification scheme used in the Supply and Use tables for South Africa, which follows a principal product system of classification (StatsSA, 2000). Specifically, industry groups are classified by reference to commodities and then firms are allocated to industry groups by reference to the product that they produce most of, i.e. their principal product.
- The factor accounts distinguish between types of labour on the basis of racial group (4) and skill classification (11), giving rise to 41 labour accounts and a capital account which is similar to the structure used in the national SAM published by Statistics South Africa.
- The Household Account has been sub-divided into 48 different household types, corresponding to the four population groups and eleven income categories per group.
- The Government Account has been sub-divided into National, Provincial (Education, Health, Welfare, Economic and Other) and Local Government structures, whilst the capital account makes provision for the public as well as the private sector.
- The trade accounts distinguish between trade with the rest of South Africa and the rest of the world. Trade flows with the rest of South Africa were estimated in net terms, and justify further analyses.

This following section provides a brief overview of the content of the North West Province SAM. As such, it does not present all of the detailed figures that are encapsulated in the SAM.

5.3.1 Activities

The Activities element of the SAM performs a very important role. Activities accounts record transactions by the productive entities in an economic system and, as such, provide information about the generation of value added within the economy (Conningarth Consultants, 2006).

The North West Province SAM used for data input in the RAGE model allows for 46 production activities. The 46 activities are classified exactly according to the classification of the commodities. The activities or industries are a group of homogeneous establishments defined in terms of inputs, production processes and outputs. These activities may also be aggregated to the nine activities according to the Standard Industrial Classification (SIC) 1 level classification, namely agriculture, mining, manufacturing, electricity and water, construction, transport and communication, trade and accommodation, financial and business services, and community services (Kearney, 2003).

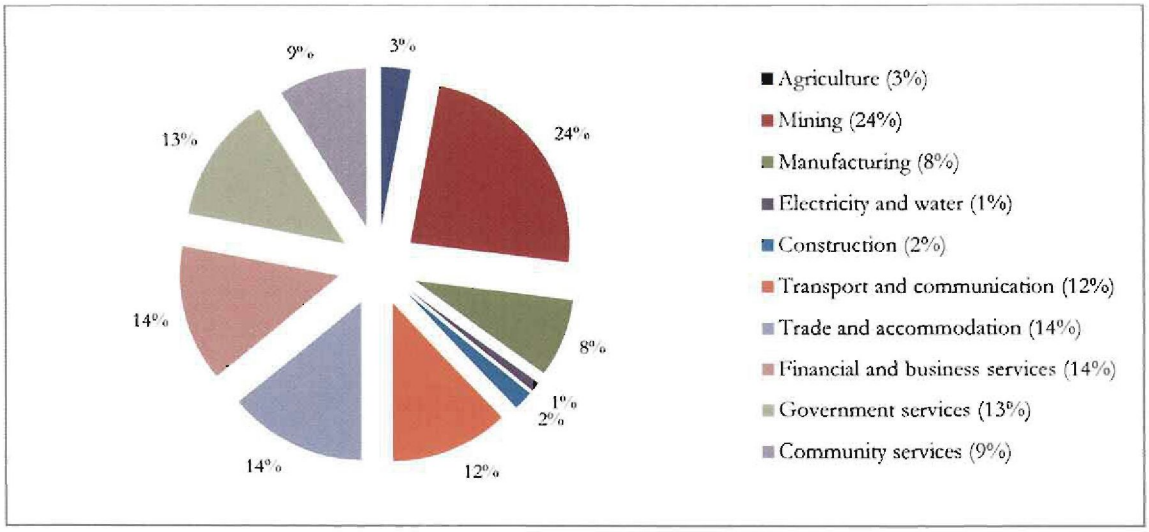
Table 5.3: Commodities and activities included in the North West Province SAM

	Commodities/Activities		Commodities/Activities
1	Commercial Agriculture	24	Communication, and Other Electronic Equipment
2	Subsistence Agriculture	25	Manufacturing of Transport Equipment
3	Platinum Mining	26	Handcrafts and Curios
4	Gold Mining	27	Other Manufacturing and Recycling
5	Other Mining	28	Informal Manufacturing
6	Meat, Fish, Fruit, Vegetables, Oils and Fat Products	29	Electricity
7	Dairy Products	30	Water
8	Grain Mill, Bakery and Animal Feed Products	31	Buildings
9	Other Food Products	32	Other Construction
10	Beverages and Tobacco Products	33	Informal Construction
11	Textiles, Clothing, Leather Products and Footwear	34	Trade
12	Wood and Wood Products	35	Accommodation
13	Furniture	36	Informal Trade, Accommodation and Entertainment
14	Paper and Paper Products	37	Transport Services
15	Publishing and Printing	38	Communications
16	Chemicals and Chemical Products (incl. Plastic Products)	39	Transport – Combi Taxis
17	Rubber Products	40	Insurance
18	Non-Metallic Mineral Products	41	Real Estate
19	Basic Metal Products	42	Business Activities
20	Structural Metal Products	43	General Government
21	Other Fabricated Metal Products	44	Health and Social Work
22	Machinery and Equipment	45	Activities/Services
23	Electrical Machinery and Apparatus	46	Other Informal Services

(Source: Adapted from Conningarth Consultants, 2006:25)

Figure 5.2 shows that the North West Province is still heavily dependent on the mining sector for its economic performance. Manufacturing contributes 8 per cent to the GDP, which is to a large extent dominated by mining-related industries (i.e. metal products and machinery, non-metallic mineral products and chemical and chemical products). The economic structure of the North West Province differs quite markedly from that of South Africa. The contribution of each of the sectors in the SAM to total output can be seen in Figure 5.2 below.

Figure 5.2: Contribution per activity from the North West Province SAM



(Source: Authors' calculations from the 2004 SAM for the North West Province)

5.3.2 Commodities

There are 46 commodities and services depicted in the North West Province SAM. The North West Provincial government produces five of the 46 commodities and services. Table 5.3 above provides a list of the commodities in the SAM.

The 46 commodities within the North West Province SAM can be aggregated to the SIC1 level, including, agriculture, mining, manufacturing, electricity and water, construction, transport and communication, trade and accommodation, financial and business services, and community services (Kearney, 2003).

5.3.3 Factor accounts

The factors of production are divided into labour and capital. Labour is turn is divided into unskilled (elementary occupations, domestic workers), semi-skilled (clerks, service workers, skilled agricultural workers, craft workers, plant and machine operators), and skilled labour (legislators, professionals, technicians). Income flowing to factor accounts (i.e. the remuneration of labour and the return on capital) can come from employment of factors (both locally and foreign owned) by domestic activities or as payments for domestically owned factors used in the rest of the world. Mainly, factor income from the foreign countries is in the form of interest on capital, while remuneration of factors employed is made up of remuneration of labour and capital (Conningarth Consultants, 2006).

Expenditures by factor accounts are distributed between domestic and foreign based owners of the factors. As with factor incomes, the payments for factor services to the rest of the world are usually in respect of the remuneration of capital. Typically households own all labour services. Consequently, payments to domestically based factor owners are distributed across the different types of households as labour income and distributed profits, and to enterprises as non-distributed profits. These distributions take place after the payment of factor specific taxes to the government.

Income levels (in terms of percentiles described in Table 5.4) are: E1 - low (percentiles P1 and P2); E2 - low middle (P3 to P5); E3 - middle (P6 to P8); E4 - high middle (P9 and P10); and E5 - high (P11 and P12).

Table 5.4: Labour by activities

	Agriculture	**Mining**	**Manufacturing**	**Electricity, gas and water**	**Construction**	**Trade**	**Transport**	**Finance and business services**	**Community and social services**
Skilled	14%	30%	37%	39%	23%	33%	35%	63%	69%
Semi-skilled	42%	60%	52%	56%	61%	56%	56%	34%	26%
Unskilled	44%	11%	11%	6%	16%	11%	9%	3%	5%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

(Source: Conningarth Consultants, 2006:34)

Table 5.4 depicts the skills levels employed in the main activities. Important to note is that some sectors employ predominantly skilled people, whilst others employ mainly unskilled people. In particular, the tertiary sector has mostly skilled employees, whilst the primary and construction sectors have mostly semi-skilled and unskilled employees.

Naturally, information can be obtained at a much more detailed level from the SAM itself for all activities and occupations.

Table 5.5: Labour remuneration vs. skill levels

	Skilled	Semi-skilled	Unskilled	
E1	19%	60%	21%	100%
E2	28%	59%	12%	100%
E3	40%	49%	11%	100%
E4	44%	44%	12%	100%
E5	60%	36%	4%	100%

(Source: Conningarth Consultants, 2006:34)

Table 5.5 serves as a bridge between skills and income levels. As would have been expected, the skilled employees contribute mostly at the medium and high income, and the unskilled to medium and low income levels

5.3.4 Enterprises

The North West Province SAM makes provision for the inclusion of enterprises separately from other institutions. The enterprises included in the North West Province SAM were divided between public enterprises, private business enterprises, combi-taxi enterprises, and informal enterprises.

Enterprises in the North West Province use the bulk of their income to pay interest and dividends to households in the North West Province as well as to the rest of the world. Approximately 50.2% of the interest and dividends paid out to households are destined for households in the North West Province.

Private business enterprises constitute 67% of the total outflows from enterprises in the North West Province, while public enterprises represent 31.2% of the total. As expected the combi-taxi and informal enterprises are relatively low compared to their commercial counterparts.

5.3.5 Households

In the North West Province SAM the households are divided into five income categories. Moreover, four population groups (Africans/Blacks, Coloureds, Indians/Asians, and Whites) are presented in the North West Province SAM. By combining households into meaningful groups, the SAM makes it possible to clearly distinguish how the economic welfare of each group is determined within the economic system.

Table 5.6: Key between percentiles and annual household expenditure

	Percentage of Population		
Percentile	**National**	**North West**	**Expenditure Strata (2004 prices)**
P1	5%	1%	1 - 1 004 — E1 (low)
P2	10%	18%	1 005 - 10 602 — E1 (low)
P3	20%	31%	10 603 - 15 802 — E2 (low middle)
P4	30%	41%	15 803 - 19 932 — E2 (low middle)
P5	40%	50%	19 933 - 24 172 — E2 (low middle)
P6	50%	59%	24 173 - 29 440 — E3 (middle)
P7	60%	69%	29 441 - 37 185 — E3 (middle)
P8	70%	78%	37 186 - 49 394 — E3 (middle)
P9	80%	86%	49 395 - 70 464 — E4 (high middle)
P10	90%	92%	70 465 - 107 537 — E4 (high middle)
P11	95%	95%	107 538 - 141 062 — E5 (high)
P12	100%	100%	141 063 + — E5 (high)

(Source: Conningarth Consultants, 2006:38)

In the North West Province as in the rest of South Africa the distribution of income is highly unequal. Raw data collected for the IES 2000 survey was used for disaggregating both the income and expenditure aggregates to fit the North West Province SAM. It should be noted that the IES 2000 is a survey stratified on a national basis making it statistically acceptable for use on a provincial level of disaggregation but may be suspect at population group levels (Conningarth Consultants, 2006).

The tables that follow detail the structures arrived at for both household expenditure and household income. It is important to note that some of the tables below only demonstrate, for discussion purposes, a small part of the information that has in fact been incorporated in the SAM.

Table 5.7: Household expenditure structures (total population)

Expenditure Group	Consumption expenditure	Transfers between Households	Direct Taxes and transfers paid to the Government	Household savings
E1	3%	9%	1%	0%
E2	17%	39%	10%	2%
E3	29%	50%	30%	11%
E4	26%	2%	31%	27%
E5	25%	0%	29%	60%
TOTAL	100%	100%	100%	100%

(Source: Conningarth Consultants, 2006:40)

Table 5.7 provides a picture of the overall household consumption expenditure patterns within the North West Province divided between major spending categories. Households show an expected expenditure pattern, viz. the higher income brackets are largely responsible for savings, taxes and transfers. The same goes for consumption expenditures but to a lesser degree. Although this table is prepared on the basis of all population groups, the data available in the SAM allows similar tables to be prepared for each population group.

Table 5.8: Household income structures (based on column totals)

Expenditure Structure	Labour	Inter Household Transfers	Enterprises	Government
E1	3%	9%	5%	74%
E2	10%	39%	37%	26%
E3	23%	50%	41%	0%
E4	18%	2%	11%	0%
E5	46%	0%	6%	0%
TOTAL	100%	100%	100%	100%

(Source: Conningarth Consultants, 2006:40)

In a similar fashion this table details the sources of all income streams to each household category arranged according to household expenditure groups. The information contained in the above two tables can also be rearranged so that percentages are calculated on a row-basis to add up to 100. The results are shown in the following two tables.

Table 5.9: Household expenditure structures (based on row totals)

Expenditure Group	Consumption Expenditure	Transfers Between Households	Direct Taxes And Transfers Paid To The Government	Household Savings	Total
E1	89%	8%	3%	0%	100%
E2	86%	6%	8%	0%	100%
E3	82%	5%	14%	0%	100%
E4	83%	0%	16%	1%	100%
E5	83%	0%	15%	2%	100%

(Source: Conningarth Consultants, 2006:40)

Table 5.10: Household income structures (based on row totals)

Expenditure Group	Labour	Inter Household Transfers	Enterprises	Government	Total Income
E1	27%	3%	10%	60%	100%
E2	45%	7%	37%	11%	100%
E3	68%	5%	26%	0%	100%
E4	89%	0%	11%	0%	100%
E5	97%	0%	3%	0%	100%

(Source: Conningarth Consultants, 2006:41)

5.3.6 The Government

5.3.6.1 General government

As in other countries, the general government of South Africa fulfils a cardinal role in the national economy. The collection of tax revenues and the spending thereof in the form of salaries, purchases of commodities, distribution of welfare grants and the building of public infrastructure do all impact on the South African economy. Accordingly there are a number of interactions with the various entities in the economy.

The Government accounts in the SAM relating to the North West Province are discussed for all three spheres of the General Government namely:

- Central Government Income and Expenditure within the Province;
- Provincial Government; and
- Local Government.

The transfers between these government spheres in the North West Province and the interaction with the rest of the South African economy are also incorporated.

The control totals for the operations and transactions of the aforementioned spheres in the North West Province (obtained through an elaborate research process) are reflected in Table 5.11 and will now be discussed in more detail in respect of each of the government spheres.

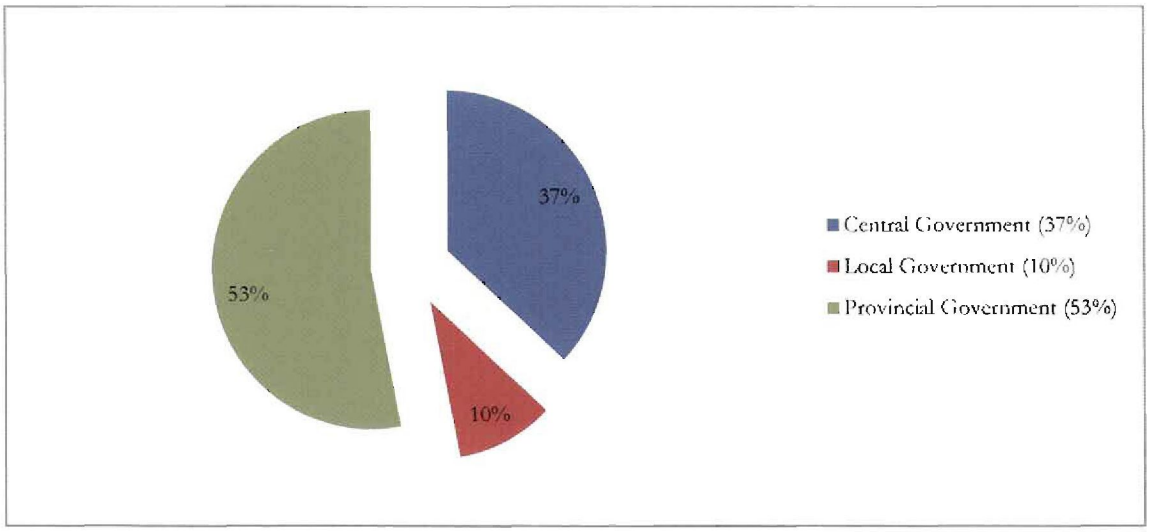
Table 5.11: Income and expenditure of Central, Provincial and Local government spheres, current prices 2004 (R millions)

	CURRENT INCOME	Central from and to North West Province	Provincial North West Province	North West Province Local
1	Activities			
	Other taxes on production	486	-	-
2	Commodities			
	Taxes on products	10043	-	-
3	Capital (GOS)			
	Income from property	645	4	-
4	Enterprises			
	Company tax	5128	-	-
	Current transfers from incorporated business enterprises	349	183	1201
5	Households			
	Personal tax	6796	-	-
	Current transfers receivable from households	151	138	535
6	Rest of the World			
	Transfers from the rest of the world			54
7	Allocations by government			
	Central to provincial	-	13988	-
	Provincial to Local	-	-	49
	Central to Local	-	-	867
	Total Current Income	23599	14313	2706
	CURRENT EXPENDITURE	**Central from and to North West Province**	**Provincial North West Province**	**North West Province Local**
1	Subsidies on Production	249	154	-
2	Subsidies on Products	183	-	-
3	Commodities	1728	2902	967
4	Labour	3186	7164	951
5	Current transfers to enterprises (interest on public debt)	311	-	157
6	Transfers to households (pensions/grants)	741	3256	-
7	Transfers to rest of the world	-	-	-
8	Allocations: Expenditure			
	Central to Provincial	13988	-	-
	Provincial to Local	-	49	-
	Central to Local	867		
	Total Expenditure	21254	13525	2075
C	Savings	2345	788	632
D	Gross Investment	2584	720	710
E	Capital Flows	-239	68	228

(Source: Conningarth Consultants, 2006:42)

Total government expenditure (current and investment after taken into account transfers between spheres of government) amounted to R40.6 billion at a national, provincial and local level. The following chart indicates the composition of government expenditure by the three governmental spheres identified in the macro SAM.

Figure 5.3: Composition of government expenditure in the North West Province in 2004



(Source: Authors' calculations from the 2004 SAM for the North West Province)

Expenditure by the Central Government comprises 37% of the total government expenditure in the North West Province, whilst provincial and local government contribute 53% and 10% respectively.

5.3.6.2 Central government

The Central Government is economically active in all nine South African provinces, by means of inter alia collecting taxes as well as expenditure via its departments. Transfers are also made by Central Government to the other two Government spheres, i.e. provincial and local (municipal) governments. The Central Government collects revenues i.e. income via the South African Revenue Services (SARS). These taxes range from personal and company taxes to VAT on commodities.

Unfortunately the disaggregation of these revenues to a provincial level is not easily available. In order to calculate the relevant figures for the North West Province it was decided to use of the National

Accounts for South Africa as the basis. These latter accounts are published in the Quarterly Bulletins of the South African Reserve Bank. The relevant information appears mainly in Tables S75, S136 and S137 in the SARB Quarterly Bulletin for September 2005.

For the disaggregation i.e. allocation of the aforementioned Income of the Central Government to the provinces, appropriate secondary economic indicators were selected. This application is a dynamic process in that up to five indicators can be used and different weights allocated to each indicator. For example, to calculate the taxes on production, it was firstly necessary to exclude R21 589 of property rates and taxes levied by Local governments. The remainder of R7 111 are taxes and/or levies by Central Government to which secondary indicators were applied.

5.3.6.3 Provincial government

In this Section the figures in the column under the heading "Provincial North West Province" (See Table 5.11) will be analysed. The main source for the relevant figures is the "Estimates of Revenue and Expenditure for the year ending 31 March 2004" as submitted to the North West Province Provincial legislature. For the purposes of this SAM, 25% of the 2003/04 budget was added to 75% of the 2004/05 budget in order to calculate the figures for the 2004 calendar year. A few primary departmental operations that could be identified as taking place in the province, such as Education, Health, Welfare, Economic Affairs and Other were used to calculate the distribution of funds within the province for purposes of this study (Conningarth Consultants, 2006).

It should be noted there is no provision made in Table 5.11 for provincial taxes on production, commodities, enterprises and households as all these taxes are levied by the Central Government.

The North West Province does derive some direct income such as property income. The second source of income is derived from transfers by enterprises and households to the North West Province Provincial Government. However, the main source of income for the North West Province Provincial Government is the grants made by the Central Government sphere to the nine provinces in terms of the National Constitution. In this case the amount of R13 988 million was made up as follows:

Equitable share R12 627 millon

Conditional grant	R1 361 million
	R13 988 million

5.3.6.4 Provincial grants to local municipalities

According to the North West Province Estimates of Revenue and Expenditure (2004:20), a total of R49 million was made available during 2004 in the form of grants to the local municipalities in the North West Province. There are 25 local municipalities in the North West Province. They range according to their total expenditure from Rustenburg (R700 million) being the largest to Molopo (only R4 million) being the smallest.

The main information source for allocating the income and expenditure of the 25 local municipalities in the North West Province is the "Trends in Intergovernmental Finances: 2000/01 – 2006/07", published by the National Treasury in 2004. However, the figures provided in this report are for the 2003/04 municipal financial year ending 30 June 2004. In order to adjust these figures for the 2004 calendar year they were increased by 4%.

5.3.7 The Rest of the World

According to the SNA for 1993, the Rest of the World refers to all non-resident institutional units that enter into transactions with resident units, or have other economic links with resident units. The Rest of the World comprise those categories of accounts necessary to capture the full range of transactions that take place between the total economy and the Rest of the World (i.e. between residents and non-residents). The trade accounts distinguish between trade with the rest of South Africa and the rest of the world. Trade flows with the rest of South Africa were estimated in net terms, and justify further analyses. See Section 6.3.2 in Chapter 6 for a detailed discussion on exports in the SAM.

For the year 2004, the North West Province had a positive balance of payments. Therefore, it also holds that the province will also have positive savings. This can be attributed to the fact that this Province

is regarded as a mining hub particularly with regard to platinum and gold which has got a high export potential and bring very high export earnings (Conningarth Consultants, 2006).

5.4 (ELASTICITIES) PARAMETER ESTIMATES

Apart from a SAM as database, the RAGE model further requires a set of trade elasticities as data input (Kearney, 2003). In the RAGE model, parameters are determined in various ways. Some are determined on the basis of a survey of empirical literature, some are chosen arbitrarily, and the remainder are set at values which allow the model to replicate the data of a chosen benchmark year. Two reasons can be advocated for including trade elasticities in the RAGE model. First, the model assumes imperfect substitution of commodities in trade and second, the inclusion of elasticities will make the model more realistic (Kearney, 2003:107).

Not including elasticity coefficients in the RAGE model would imply that perfect substitution is assumed between commodities which, in turn implies that the elasticity of substitution between two commodities is infinite, and that the corresponding price ratios are constant (Kearney, 2003). To make the model more realistic and capable of better representing the 'real-world' effect of shocks applied to the model, imperfect substitution is assumed. Trade elasticities are then estimated using trade data and included in the RAGE model. Combining the estimated trade elasticities with other elasticities calibrated within the SAM, will also balance and configure the base RAGE model.

Various authors have estimated trade elasticities for South Africa. The Industrial Development Corporation (1997) estimated trade elasticites for 25 manufacturing sectors for a sample period from 1973 to 1993. In 2003 Gibson estimated Armington elasticites for South Africa at industry level for the short and long run. The estimation was done for 42 industry categories for the period 1970 to 2001 (as in Gibson, 2003:8-10).

Since no studies have been conducted as to the elasticity of trade at sub-national level (including substitution in trade between regions and nations) for the purposes of this thesis, national estimates will be used. The estimations done by the IDC (1997) will form the core of the elasticities used in this RAGE model. Other elasticites will be obtained from other sources including Gibson (2003), the UPGEM model

of the University of Pretoria, the ORANI-G data files, as well as from the DTIGEM model of the Department of Trade and Industry.

5.5 THE RAGE MODEL

The RAGE model is an economy-wide, comparative static model of the North West Province economy which considers the regions' economy as a complete system of interdependent components (including, industries, households, investors, governments, importers and exporters) (Naudé and Coetzee, 2004). This implies that the model will capture the feedback effects between the various components of any external shock applied to a component(s) in the regions' economy. These effects are captured at the microeconomic level in a structural mathematical model taking into account various macroeconomic constraints (Pauw and Edwards, 2006). AGE models are usually calibrated to reproduce a base year. The RAGE model developed for this thesis is constructed to exactly reproduce the economic conditions of the fiscal year 2004/05 for the North West Province economy.

The RAGE model is applied (or computed) using economy-wide consistent data on the North West Province economy as is contained in the North West Province SAM (discussed in section 5.2). The system of equations is solved so that the original SAM database is obtained as a solution to the system of equations. Simulations are now carried out by changing parameter values or exogenous variables and solving the model to obtain a new SAM as solution. By comparing the new SAM with the original SAM database will indicate the extent of changes implied by the policy or shock that was simulated. Thus, RAGE analyses are mostly comparative static[15] in nature, comparing different equilibrium positions associated with policy changes or shocks.

The RAGE model used in this thesis is an adaptation of ORANI-G[16] model. It is known as the North West Province General Equilibrium Model, NWPGEM and was developed for the North West

[15] This method of analysis differs significantly from statistical models and analyses, since results are determined by the behavioural relationships and the need for full consistency rather than on estimates based on observed variations (Pauw and Edwards, 2006).

[16] ORANI-G ('G' stands for 'generic') is a version of ORANI which serves as a basis from which to construct new models. It has been applied to many countries including China, Thailand, Korea, Pakistan, Brazil, the Philippines, Japan, Ireland, Vietnam, Indonesia, Venezuela, Taiwan and Denmark (Horridge *et al.*, 1993).

Province for the purpose of this thesis. The NWPGEM model used to conduct the simulations distinguishes 27 sectors, 12 household types and labour is disaggregated into 11 occupational categories, 4 skill groups and 4 population groups. For a more detailed exposition of the modelling approach followed in NWPGEM, see Horridge *et al.* (1993). This thesis contains the first application of the NWPGEM.

Due to the computational complexity of solving the systems of non-linear equations that characterises RAGE models, a number of software packages have been developed that makes implementation on a personal computer possible. The most popular are the General Algebraic Modelling System (GAMS) and the General Equilibrium Modelling PACKage (GEMPACK). The main difference between these two packages lies in the fact that the latter, developed in Australia, uses a log-liberalisation procedure to solve the system of equations, whilst GAMS uses a non-linear solution algorithm (see Dixon *et al.*, 1982).

Research and further development work on the NWPGEM is undertaken on a continuous basis and this chapter briefly outlines the background to the development of the model and the theoretical structure of the model. A complete description of the ORANI-G model is contained in Horridge *et al.* (1993); however, the basic assumptions and model characteristics are set out below.

5.5.1 The treatment of time

Like the majority of RAGE models, the NWPGEM was designed originally for comparative static simulations. Ginsburgh and Keyzer (1997) describe this approach as comparing the economy at two distinct points in time, without modelling any explicit time periods or time path. Therefore the model is essentially 'timeless', comparing some hypothetical future scenario with its initial solution. Typically, the two states compared are the state of the economy with a given policy change and the state of the economy without the policy change. Consequently, this method of analysis does not provide any details of the adjustment path of the economy between the two points in time. A broad timeframe for these simulations, e.g. short run or long run, is specified by the closure (Ginsburgh and Keyzer, 1997).

5.5.2 Dimensions of the model

The industry and commodity classifications of the NWPGEM are listed in Table 5.12. In future variations of this version, more or less sectors may appear. Each of the industries produces a unique commodity. Three categories of primary factors (labour, capital and land) are distinguished in the model, with the last used only in industries I1, I2, I3 and I4.

Table 5.12: Commodity and industry classification

	Commodities		Industries
1	Agriculture, forestry, fishing and hunting	1	Agriculture, forestry, fishing and hunting
2	Mining of coal and lignite	2	Mining of coal and lignite
3	Mining of gold and uranium ore	3	Mining of gold and uranium ore
4	Other mining and quarrying (incl. 22)	4	Other mining and quarrying (incl. 22)
5	Food, beverages and tobacco products	5	Food, beverages and tobacco products
6	Textiles, clothing and leather goods	6	Textiles, clothing and leather goods
7	Wood and wood products	7	Wood and wood products
8	Fuel, petroleum, chemical and rubber products	8	Fuel, petroleum, chemical and rubber products
9	Other non-metallic mineral products	9	Other non-metallic mineral products
10	Metal products, machinery and household appliances	10	Metal products, machinery and household appliances
11	Electrical machinery and apparatus	11	Electrical machinery and apparatus
12	Electronic, sound/vision, medical & other appliances	12	Electronic, sound/vision, medical & other appliances
13	Transport equipment	13	Transport equipment
14	Furniture and other items NEC and recycling	14	Furniture and other items NEC and recycling
15	Electricity, gas, steam and hot water supply	15	Electricity, gas, steam and hot water supply
16	Collection, purification and distribution of water	16	Collection, purification and distribution of water
17	Construction	17	Construction
18	Trade Services	18	Trade Services
19	Accommodation	19	Accommodation
20	Transport Services	20	Transport Services
21	Post and telecommunication	21	Post and telecommunication
22	Finance and Insurance	22	Finance and Insurance
23	Real estate activities	23	Real estate activities
24	Other business activities	24	Other business activities
25	General government services	25	General government services
26	Health and social work	26	Health and social work
27	Other service activities	27	Other service activities

(Source: Statistics South Africa, 2002)

Commodities C18 and C20 are margins commodities, i.e. they are required to facilitate the flows of other commodities from producers (or importers) to users. Hence, the costs of margins services, together with indirect taxes, account for differences between basic prices (received by producers or importers) and purchasers' prices (paid by users).

Labour is disaggregated into 11 occupational categories, 4 skill groups and 4 population groups.

Population:

- Africans

- Coloureds
- Indians
- Whites

Skill Groups:

- 4: Education which begins at the age of 18 or 19, lasts about three, four or more years, and leads to a university or post-graduate university degree.
- 3: Education which begins at the age of 17 or 18, lasts about one to four years, and leads to an award not equivalent to a first university degree.
- 2: Secondary education which begins at the age of 13 or 14 and last about five years. A period of on-the-job-training and experience may be necessary.
- 1: Primary education which generally begins at the age of 6 or 7 and lasts about 7 years. Including persons without any formal primary education, or with incomplete primary education.

Occupation linked to skills (in brackets):

- Legislators (4)
- Professionals (4)
- Technicians (3)
- Clerks (2)
- Service workers (2)
- Skilled agricultural workers (2)
- Craft workers (2)
- Plant and machine operators (2)
- Elementary occupations (1)
- Domestic workers (1)
- Occupation unspecified (1)

Income and expenditure are linked to population group. A comparison of annual household expenditure between households in the North West Province and South Africa is shown in Table 5.13.

Table 5.13: Key between percentiles and annual household expenditure

Percentile	Percentage of Population		Expenditure Strata (2004 prices)
	National	North West	
P1	5%	1%	1 - 1 004
P2	10%	18%	1 005 - 10 602
P3	20%	31%	10 603 - 15 802
P4	30%	41%	15 803 - 19 932
P5	40%	50%	19 933 - 24 172
P6	50%	59%	24 173 - 29 440
P7	60%	69%	29 441 - 37 185
P8	70%	78%	37 186 - 49 394
P9	80%	86%	49 395 - 70 464
P10	90%	92%	70 465 - 107 537
P11	95%	95%	107 538 - 141 062
P12	100%	100%	141 063 +

(Source: Conningarth Consultants, 2006)

5.5.3 Theory and structure of the model

The theoretical structure of the NWPGEM is modelled closely on that of ORANI-F. The main characteristics of the model are listed below.

Table 5.14: Main characteristics of the NWPGEM

Assumptions about producers	Assumptions about investors	Assumptions about households	International exports	Government
Single-product industries Price takers Minimise costs Nested Leontief/CES production functions allowing substitution between: Sources of produced inputs; labour, capital and land; occupations; and race groups	Price takers Minimise costs Production functions allow substitution between sources Aggregate investment normally exogenous but composition depends on relative rates of return	Disaggregated by race group and income Consumption proportional to disposable income Substitution between commodities and between sources	Two distinct treatments for export commodities exist Downward-sloping demand curves for individual traditional exports and for a composite non-traditional export Downward sloping demand curves for each export commodity with a transformation function for export production (i.e. Commodities exported differ from those sold on the domestic market and producers switch between domestic production and export production based on the relative price of producing for each market)	Structure of consumption exogenous Articulation of revenue sources

Trade and transport margins	Prices	Market clearing	Identities define macro variables	Regional desegregation
Fixed proportions to commodity flows	Zero pure profits conditions and constant returns to scale imply basic values are functions just of input prices Purchasers' prices are sums of basic values, sales taxes and margins	For commodities Labour market need not clear	E.g., GDP, trade balance, price indices Macro equation system structured around a SAM	No desegregation to the sub-national level as this is a single-region model

(Source: Adapted from Cameron, 1998:6)

5.5.4 The Database

Figure 5.4 below provides a detailed schematic representation of the models input-output database. The rows show the structure of purchases made by each of the agents identified in the columns. The columns represent the cost structure to each of the agents in the North West Province economy. It is important to note that investors consume the output of producers and hence no primary factors are reflected in the cost structure of investors (Horridge *et al.*, 1993).

Figure 5.4: Stylised representation of the NWPGEM database

		Producers	Investors	Households	Exports	Government	Total Output
	Size	**27 Industries**	**27 Industries**	**12 Income groups and 4 Population groups**			
Basic Flows	**27 Commodities and 2 Sources**	Commodities used as intermediate inputs for production	Commodities used as investment goods by each industry	Household demand for commodities	International demand for North West (SA) commodities	Government demand for commodities	Total Demand for Domestic and Imported Commodities
Margins	**2 Margins Industries**	Trade and transport margins paid in the production process	Trade and transport margins paid on investment goods	Trade and transport margins paid by households	Trade and transport margins paid on international exports	Trade and transport margins paid by the government	Total Trade and Transport Margins
Taxes	**27 Commodities**	Taxes paid by producers. Includes direct and indirect tax payments	Taxes paid on investment goods	Total direct and indirect taxes paid for commodities	Export subsidies received for exports		Total Tax Paid
Labour	**11 Occupations and 4 Skill groups**	Labour cost by occupation and source for producers					Total Labour Cost = Total Pre-tax Household Income
Capital		Cost of Capital					Total Capital Stock
Land		Cost of Land					Total Land
Other Costs		Residual Costs					Total Residual Costs
Total Costs		Total Production Cost	Total Investment	Total Household Consumption	Total International Exports	Total Government Consumption	

(Source: Adapted from the Joubert, 1994:46)

5.5.5 Production functions

The following section draws on the work of Horridge *et al.* (1993).

5.5.5.1 Industry output

In the NWPGEM each industry is a single commodity producer, using domestic and imported intermediate commodities, labour according to 11 occupational groups and 4 race groups as well as migrant workers, land, capital and "other costs" as inputs in the production process. The structure of the production process as modelled in NWPGEM is represented by the diagram in Figure 5.5 as a sequence of nests.

5.5.5.2 Labour demand

The demand for labour is determined by both race and occupational group. The occupational composition of labour demand in each industry is derived from the following optimisation problem. Use inputs of occupation-specific labour to minimise total labour cost for each industry, $\sum_i P_i X_i$ (i = 12,...103), subject to the production function:

$$Z_i = \left(\sum_j \delta_j \left[X_j \right]^{-\rho} \right)^{-1/\rho} \quad (i = 1,2..103 \text{ and } j = 1,2..13) \tag{5.1}$$

$$\text{where} \quad \sigma = \frac{1}{1+\rho} \tag{5.1b}$$

is an elasticity of substitution between occupational groups. Similarly the racial composition of labour demand for each industry is the optimisation problem of minimising total labour cost for each occupational group, $\sum_j P_j X_j$ (j = 12,...13), subject to the production function:

$$Z_j = \left(\sum_k \delta_k \left[X_k \right]^{-\rho} \right)^{-1/\rho} \quad (j = 1,2...13 \text{ and } k = 1,2,...5) \tag{5.2}$$

where σ (5.1b) is an elasticity of substitution between the four race groups and migrant workers.

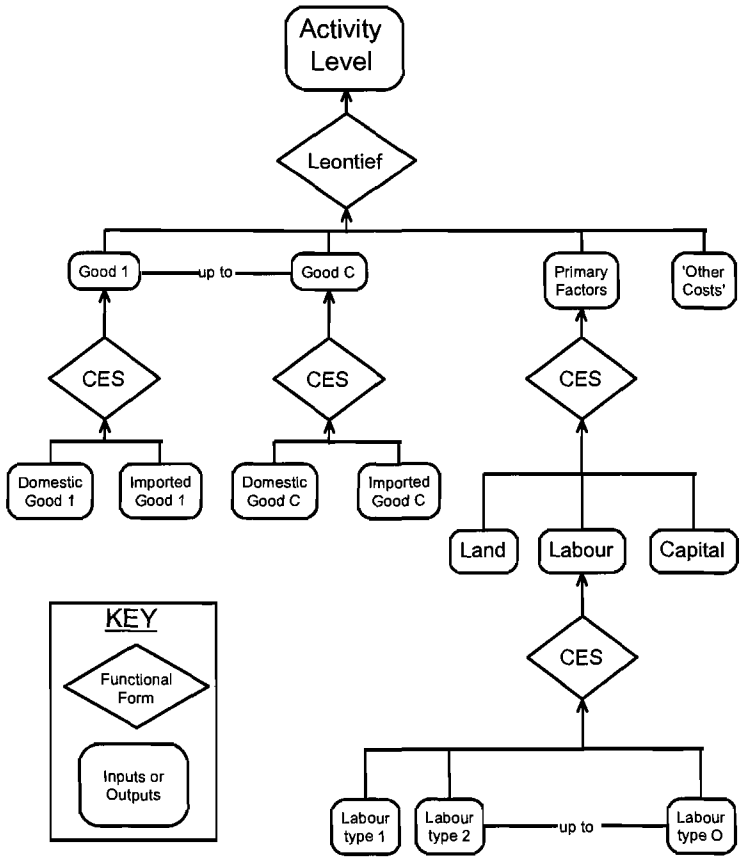
5.5.5.3 Primary factor demand

The demand for primary factors (*PFD*) is of the form $PFD = CES\left[\frac{Labour}{Alab}, \frac{Capital}{Acap}, \frac{Land}{Alnd}\right]$. *Alab*, *Acap* and *Alnd* are coefficients of factor-saving technical changes. These coefficients allow for more, or less, effective use of primary factors in the production process. Similar to the previous nest, total primary factor cost, $\sum_m P_m X_m$, (m = 1,2,3) is minimised subject to the production function:

$$Z = \left(\sum_m \delta_m \left[\frac{X_m}{A_m} \right]^{-\rho} \right)^{-1/\rho} \quad (m = 1,2,3) \tag{5.3}$$

where σ (5.1b) is an elasticity of substitution between primary factors and A_m the coefficient of factor-saving technical changes.

Figure 5.5: The structure of production



(Source: Horridge et al., 1993:18)

5.5.5.4 Demand for intermediate inputs

Producers are allowed to substitute between domestic and imported intermediate commodities based on relative price changes in the domestic and imported commodities. The producers need to minimise $\sum_m P_m X_m$, (m = 1,2,3) subject to the production function:

$$Z = \left(\sum_m \delta_m \left[X_m \right]^{-\rho} \right)^{-1/\rho} \quad (m = 1,2,3) \tag{5.4}$$

where σ (5.1b) is an elasticity of substitution between domestic and imported commodities for use in intermediate production.

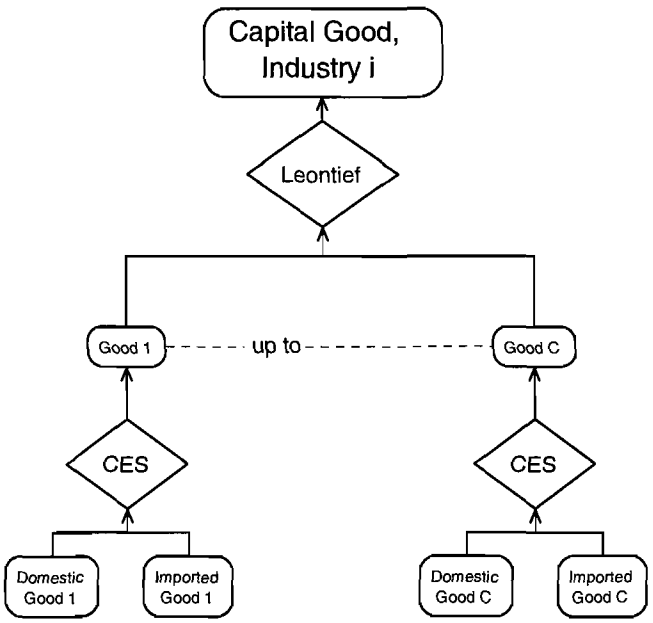
5.5.5.5 Total industry output

It is assumed that producers use the intermediate inputs and primary factors in fixed proportions to produce any given output (standard input-output assumption). This implies that producers cannot substitute primary factors for intermediate inputs to increase production. However, allowance is made for the more efficient use of intermediate inputs due to technological changes. Total output is derived from a Leontief production function which is a special case of the CES production function, where σ (5.1b) is set to 0.

5.5.5.6 Investment

In section 0 it was noted that investors purchase the output of producers for use as investment equipment and hence does not need any additional primary factors to produce the investment equipment. Investors minimise costs by substituting between domestic and imported investment inputs based on a CES production function (5.1 and 5.1b). The structure of the production of investment goods is depicted in Figure 5.6 below.

Figure 5.6: Production of investment goods



(Source: Horridge et al., 1993:27)

5.5.5.7 Household expenditure

Consumers maximise utility (U) subject to the budget constraint $\sum_i P_i X_i$. The utility function used in NWPGEM allows consumers to vary the basket of goods they consume according to their income (i.e. the budget constraint). The Stone-Geary utility function:

$$U = \sum_i \beta_i \ln(H_i - \gamma_i)$$

where, β_I is the marginal budget share; H_i is the subsistence expenditure; and γ_I is a parameter; is used in NWPGEM.

5.6 MODEL CLOSURE AND STRUCTURAL FEATURES

To implement a simulation requires a number of further assumptions which relate to the closure of the model. The RAGE model needs to be 'closed' since the number of endogenous variables cannot exceed the number of exogenous variables (Horridge, 2000). Exogenous variables are variables that are

determined outside of the model, and as such are fixed in the model. They are contrasted by endogenous variables, which are determined as an outcome of the model. Mathematically, a system of equations has a unique solution only if the number of equations equals the number of endogenous variables. Because the number of total variables by far exceeds the number of equations in RAGE models, a decision has to be made which of the variables are exogenous and which are endogenous. This procedure or decision is known as the 'closure rule'[17].

Two further fundamental purposes for the 'closure' are — (1) that it helps determine the run of the model, and (2) it serves to aid in the setting or specification of the shocks the user/modeler/policy maker wishes to apply to particular variables, which are derived from the topic of this thesis. For example, the question "*What would be the effect on the economy of an X% tariff reduction on commodity Y?*" would be implemented via a negative shock to the relevant tariff variable in the model (Dixon and Parmenter, 1996).

In most studies, a typical short run comparative static closure is used to model policy related questions. This implies that the impact reflects the change in a short period of time (approx. 2 to 3 years) before investment can react to the changed market conditions. Herein, the rate of return on capital, employment, trade balance, technology variables and the real wage, amongst others, are taken as exogenous. On the income-side of GDP one has the real wage and capital exogenous (and real cost of labour) and nominal rate of return on capital to adjust. On the expenditure-side of GDP one has private consumption expenditure, investment, and government expenditure exogenous, which only leaves the trade balance to adjust.

A number of the structural features were introduced in the RAGE model. Of these structural features include the following:

The labour market The NWPGEM contains more disaggregated specifications of the labour market and of the household sector than does ORANI-G. The workforce is disaggregated by occupation and segmentation by population group is recognised. The model's nested production functions specify an industry's aggregate labour input as a CES combination of occupation-specific labour inputs, each of which is a CES combination of labour drawn from the different population groups (Coetzee *et al.*, 1997).

[17] An in-depth discussion on the 'closure' of a model can be found in Horridge (2000).

Therefore, if relative wages change, employers will substitute between occupations and between population groups. The household sector in the NWPGEM is also disaggregated by population group. Within each population group are recognised income levels, defined as divisions of the group's income distribution. With these labour-market and household disaggregations, the model can project the effects of economic developments on the distribution of employment and income in the North West Province.

International trade The transformation option is adopted for non-traditional exports, rather than the composite non-traditional downward sloping demand curve adopted in ORANI-F. This implies that domestic and export production of these commodities is determined through a production frontier curve. If domestic producers want to export more (without a change in technology) they will have to reduce domestic production and vice-versa.

Tariffs In South Africa, as well as in the North West Province, various formula duties and rebates have a significant influence on the effective tariff paid on imported goods based on the use of the final good. In the NWPGEM it is possible to vary tariffs according to the final use, i.e. intermediate input, investment good or final consumption good. However, such policy is usually implemented at national level in South Africa.

Industry specific behaviour The output of the gold industry is ounces of fine gold produced, not tons of gold ore mined. As the world gold price varies, gold mining would switch to richer or poorer ore. Although the tons of ore mined may vary, the output in value terms of the industry would not vary significantly. This is done to maximise the long term life and profitability of the mines (Cameron, 2003). The NWPGEM captures this behaviour of the gold mining industry.

5.7 SUMMARY

The purpose of this chapter was to provide an overview of the data and elasticities/parameter estimates of the NWPGEM RAGE model with particular reference to structural features imposed to ensure adequate representation of the North West Province economy. 12 household types and labour is disaggregated into 11 occupational categories, 4 skill groups and 4 population groups.

The RAGE model requires a SAM as part of the data input. The North West Province SAM, commissioned by the Development Bank of Southern Africa, is used as data input into the RAGE model for the North West Province. The SAM is based on 2004 data. The North West Province SAM disaggregates activities into 46 separate activities, including informal sectors. Factors are divided into capital and labour. Labour in turn is divided into 11 occupational categories by 4 skill groups. Commodities are disaggregated into 46 commodities exactly according to the classification of activities. Households are divided according to the 12 deciles, as contained in the 1998 South African national SAM. This gives a total of 12 households. Furthermore, income and expenditure are linked to population group. Other institutions included are enterprises, the government and the rest of the world. Taxes are disaggregated to include the major sources of tax revenue for the provincial government. Taxes included are corporate taxes, personal income taxes, VAT, customs and excise, other indirect taxes on products, and other indirect taxes on production.

Given that Chapters 2, 3, 4 and 5 have put the matter of regional economic development and the quantitative modelling tools available to assist in the development of optimal policies, into perspective, this technique can now be applied to South Africa's North West Province. Thereafter, in Chapter 7, the simulation set-up and results from empirical studies and simulations of the NWPGEM on the economic growth in the North West Province are presented.

CHAPTER 6: THE NORTH WEST PROVINCE: OVERVIEW OF THE REGIONAL ECONOMY

6.1 INTRODUCTION

Export-led economic growth has been an important feature of almost all economies where significant economic progress has taken place over the past 30 years. Also in South Africa after 1994, the achievement of growth through the acceleration of non-traditional (i.e. non-mining and agricultural) exports has been recognised as a policy imperative by the government.

In the North West Province, exports have been dominated by mining, due to the province's endowments of platinum, gold, diamonds and other commodities. In contrast, the province has yet to raise its non-traditional exports, such as those of manufactured goods, in any significant way. However, doing so is becoming an imperative not only for accelerated growth, but also for growth that is shared to a greater degree, and growth that is based on sustainable economic activities. This typically calls for greater manufacturing exports.

Also, whether countries/regions should pursue diversification or specialisation in export production has been a topic that has generated much discussion in the theoretical literature and in policy circles. Moreover, the effect of such policy at regional level may differ substantially from that at national level, due to significant sub-national diversity. Broadly seen, one strand of the literature advocates greater export diversity as good for economic growth and development, while another sees specialisation, in accordance with a country/region's comparative advantage, as more appropriate. Despite much theorising however, the empirical evidence on the relationship between export diversification and economic development remains limited[18] (Herzer and Nowak-Lehmann, 2006:1826). There is even less evidence on the economy-wide impacts and requirements of greater export diversification *vis-à-vis* specialisation.

[18] The few existing studies find a positive relationship between export diversification and economic growth (De Ferranti *et al.*, 2002; Al-Marhubi, 2000; Hausmann, *et al.*, 2005; Matthee and Naudé, 2007; Funke and Ruhwedel, 2005). Feenstra and Kee (2004) find that a 10 per cent increase in export variety in a country's industries raises a country's productivity with 1.3 per cent. Lederman and Maloney (2002) find that highly concentrated exports are negatively associated with growth.

A study of this question at regional level, coupled with a comparison of national-sub-national differences, will add to the empirical literature on export diversification and specialisation in two ways. This thesis investigates the extent of export diversification and specialisation in the North West Province over the period 1995-2006 and its relationship to GDP per capita, and in Chapter 7, the RAGE model described in Chapter 5 is used, together with a national AGE model analysis, to investigate the economy-wide impacts of greater export diversification versus greater export specialisation on the North West Province and South African economies. By focusing on the North West Province, as compared to South Africa, this thesis contributes towards understanding better the export dynamics of this region, which has not been able to significantly generate export-led growth nor substantially diversify its range of manufactured exports (Hausmann and Klinger, 2006). It has been claimed that South Africa (at both national and sub-national level) might have started prematurely de-industrialising and thereby increasing the concentration of its production and export structures (Tregenna, 2007). Most of the concern with South Africa's export dynamics has been focused on its export performance and determinants (e.g. Jonsson and Subramanian, 2001; Naudé, 2001), with only a few recent studies beginning to investigate the diversification or specialisation patterns in South African trade (e.g. Matthee and Naudé, 2007; Edward and Alves, 2006; Petersson, 2005).

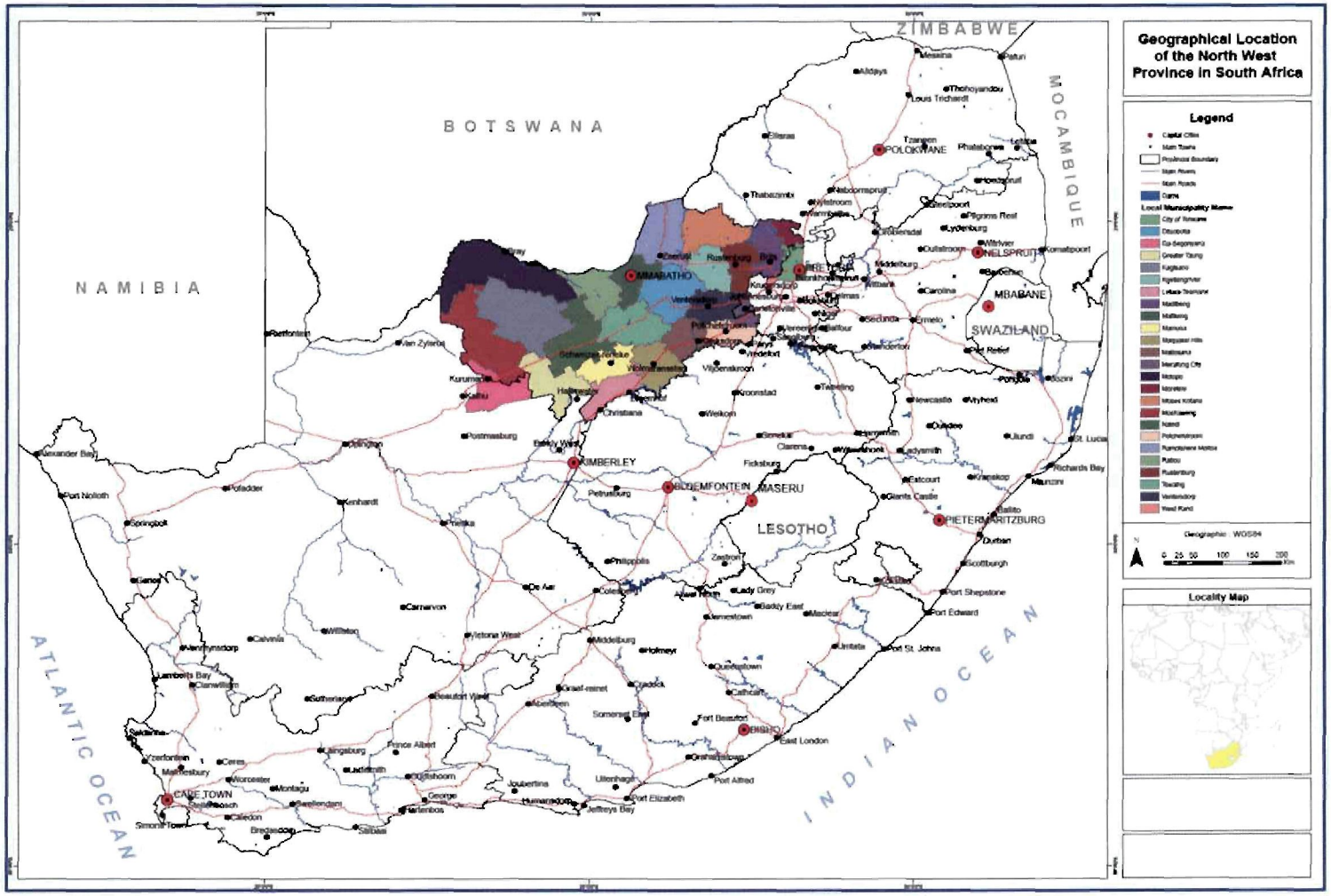
The need for RAGE models was first set out in Chapter 1 (introduction), the theoretical background to RAGE models discussed in Chapter 2, 3, and 4, and the data requirements, in the form of a SAM, discussed in chapter 5 (methodology). In this chapter, a potential application of the RAGE model is discussed for the North West Province. Section 6.2 provides a brief overview of the social and economic challenges faced in the North West Province. Section 6.3 provides a description of the export and production structure in the North West Province as indicated in the SAM for the North West Province. This is followed in Section 6.4 by a brief overview of the theoretical understanding of export diversification and specialisation, and discussion of the various ways in which the degree of diversification (both vertical and horizontal diversification) can be measured. In Section 6.5 the current state of export diversification and specialisation in the North West Province is discussed, and the relationship between

export diversification and economic growth is tested. Section five concludes. This overview will serve as background towards the formulation of the simulations performed in chapter 7.

6.2 SOCIAL AND ECONOMIC CHALLENGES IN THE NORTH WEST PROVINCE

Considering the other provinces in South Africa, the North West Province is seen as being relatively medium in size. Its contribution towards South Africa's GDP is perceived to be small contributing only 7 per cent in 2003 and 2004. It is important to note that the mining sector contributes 25 per cent to the region's GDP, which leads to the conclusion that it must also employ most of the economic active population (EAP). The mining sector is responsible for 30 per cent of the employment of the EAP (Conningarth Consultants, 2006). Apart from the mining, other important sectors for the North West Province include; energy, construction, trade, transport and communication, community, social and personal services, manufacturing and finance, insurance and business services. Figure 6.1 indicates the geographical location of the North West Province within South Africa.

Figure 6.1: Geographical location of the North West Province in South Africa



(Source: Map drawn for this chapter by Giscoe (Pty) Ltd, Potchefstroom)

When one considers the socioeconomic problems plaguing the North West Province, it does not differ that much from South Africa's as a whole. The province is characterised by high levels of unemployment (27.4 per cent in 2004), high levels of poverty (35.4 per cent of the population lives on roughly less than $1 435 per year), low literacy rates (19.9 per cent) and an increasingly high level of HIV/Aids prevalence rate (Statistics South Africa, 2005). According to the National HIV and Syphilis Prevalence Survey in South Africa (2006), an estimated 31.8 per cent of the North West Province's population was considered to be HIV positive in 2005 (increasing from 29.9 per cent in 2003).

These challenges have placed increasing pressure on the North West Provincial government to become pro-active in promoting growth and development within the province.

6.3 THE NORTH WEST PROVINCE's EXPORT AND PRODUCTION STRUCTURE

The need for accelerated manufacturing exports is recognised in the North West's Provincial Growth and Development Strategy (PGDS). More recently, the Accelerated and Shared Growth Initiative for South Africa (ASGISA) identified growth rates exceeding at least 6 per cent from 2009 onwards as a requirement if South Africa is to come near achieving the targets of halving poverty and unemployment by 2014. This in turn would require a number of obstacles for higher growth to be identified and removed. As recently argued by Hausmann and Klinger (2006:11) "*for much of South Africa's history, GDP has been pulled down by the low level of sophistication of its export basket*" and according to Rodrik (2006:3) "*The weakness in particular of export-oriented manufacturing has deprived South Africa from growth opportunities.*" In the North West Province, this implies that this obstacle, namely the lack of adequate, sophisticated and diversified manufactured exports, be addressed as a matter of priority under the province's ASGISA contributions.

The purpose of this section is to provide a macro-overview of the major trends and patterns in the North West Province's exports. More detail concerning the diversity of exports in the province, will be provided in Section 6.6.

6.3.1 Exports from the North West Province

Table 6.1 below contains the total amounts of estimated exports from the North West Province since 1995. It can be seen that about 25 per cent of the province's GDP is currently being exported, and that exports from the North West Province amounts to 4.14 per cent of South Africa's total exports.

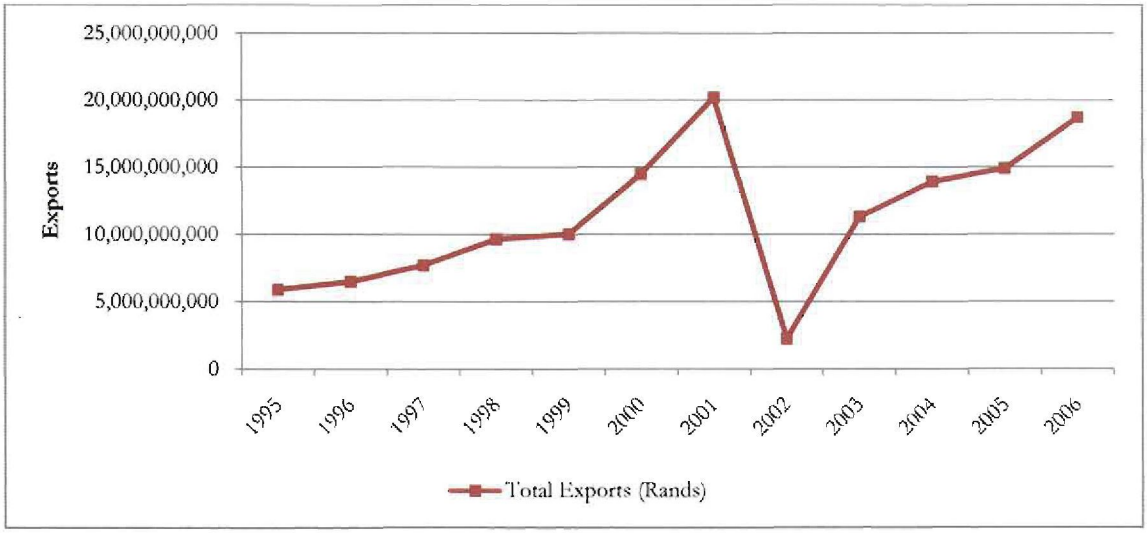
Table 6.1: Total exports from the North West Province, 1995 – 2006

Year	Total GVA (Rands)	Exports (Rands)	Exports as % of GDP	Regional share of Exports (%)
1995	49,190,214,371	5,886,710,055	11.97	8.04
1996	52,060,709,428	6,477,263,907	12.44	7.18
1997	51,828,467,360	7,679,973,076	14.82	7.59
1998	52,010,214,012	9,622,638,311	18.50	8.19
1999	52,872,090,372	10,017,873,791	18.95	6.40
2000	53,858,055,039	14,484,735,682	26.89	7.23
2001	54,358,465,080	20,187,826,215	37.14	7.66
2002	55,314,587,857	2,239,602,509	4.05	0.81
2003	57,827,460,266	11,302,734,055	19.55	4.40
2004	60,670,889,456	13,906,965,977	22.92	4.99
2005	62,845,292,723	14,884,448,554	23.68	4.02
2006	73,379,728,872	18,696,201,599	25.48	4.14

(Source: Authors' calculations based on Quantec Easydata, RSA Regional Market Indicators, 2007)

As shown in Figure 6.2 below, total export receipts have been in an upward trajectory until 2002, after which there appears to have been a significant slump in total exports.

Figure 6.2: Trend in total exports (Rands), 1995 – 2006



(Source of data: Quantec Easydata, RSA Regional Market Indicators, 2007)

Table 6.2 below contains the estimated total exports from North West classified according to tradition (mining and agriculture) and non-traditional.

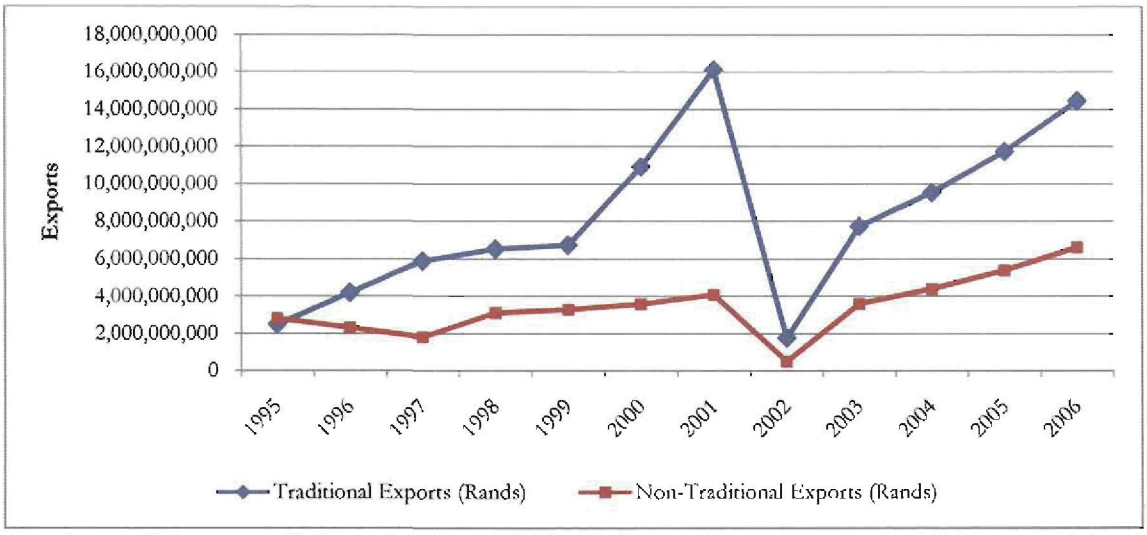
Table 6.2: Traditional and non-traditional exports from the North West Province, 1995 – 2006

Year	Traditional Exports (Rands)	Non-Traditional Exports (Rands)	Total Exports (Rands)
1995	2,478,681,596	2,795,090,861	5,886,710,055
1996	4,183,497,638	2,292,919,236	6,477,263,907
1997	5,888,313,680	1,790,747,610	7,679,973,076
1998	6,514,353,864	3,107,464,102	9,622,638,311
1999	6,731,116,640	3,285,876,691	10,017,873,791
2000	10,908,202,611	3,575,640,054	14,484,735,682
2001	16,114,513,656	4,073,312,559	20,187,826,215
2002	1,751,180,437	488,333,717	2,239,602,509
2003	7,719,936,819	3,582,797,236	11,302,734,055
2004	9,514,614,880	4,392,351,097	13,906,965,977
2005	11,726,507,409	5,384,828,360	14,884,448,554
2006	14,452,605,571	6,601,561,629	18,696,201,599

(Source of data: Quantec Easydata, RSA Regional Market Indicators, 2007)

Table 6.3 shows that by 2004, non-traditional exports remain the most important type of exports from the North-West, and that both types of export products have seen a marked increase in growth after 2002.

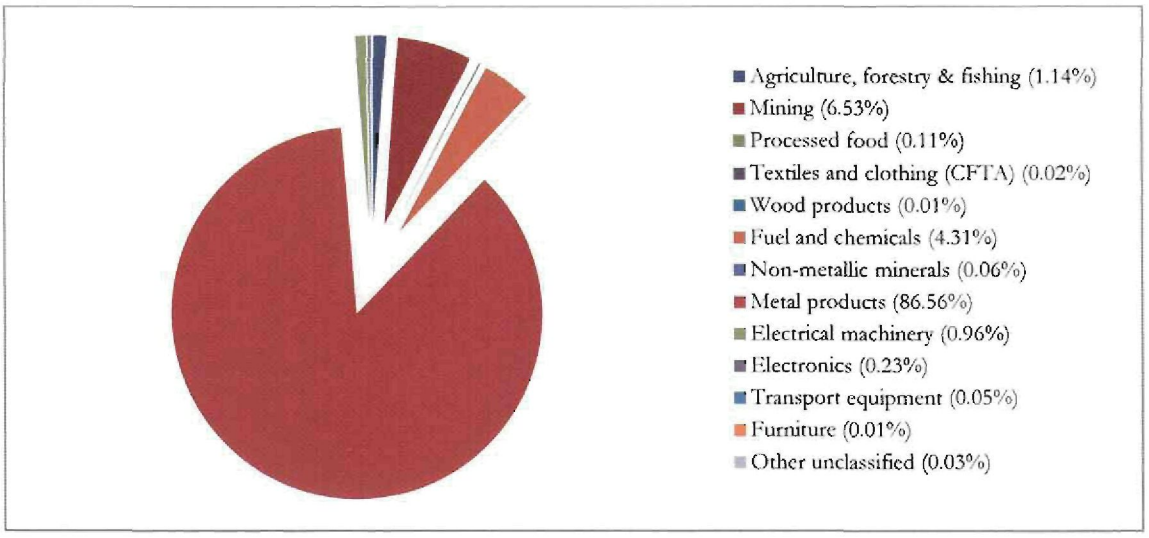
Figure 6.3: Trends in traditional and non-traditional exports, 1996 – 2004



(Source of data: Quantec Easydata, RSA Regional Market Indicators, 2007)

The main export product categories from the North West Province in 2006 are shown in Figure 6.4 below.

Figure 6.4: Exports from the North West Province by sector in 2006



(Source of data: Quantec Easydata, RSA Regional Market Indicators, 2007)

Figure 6.4 shows that in 2006, the single most important sector was the exports of metal products (87 per cent) followed by mining products (7 per cent), fuel and chemicals (4 per cent) and agriculture products (1 per cent). The figure emphasises the fact that the North West Province currently exports a very narrow range of products, and that outside of mining, the bulk of exports are from only two sectors.

In the next section, the focus will be on the structure of production in the SAM for the North West Province.

6.3.2 Structure of production and trade in the North West Province SAM

An important consideration for diversification and for the formulation of the simulations to be modelled in Chapter 7 is to consider the current trade structure in the North West Province based on the underlying framework used in the RAGE model. Making use of the North West Province SAM, described in Chapter 5, the following exports from the different economic sectors can be identified (as a percentage of total production). In Table 6.3 the manufacturing sub-sectors are highlighted.

Table 6.3: Activity composition and destination of exports from the North West Province in 2004, (Percentages)

Sectors	Local sales in North West	Exports to other Provinces	Exports to foreign countries	Total
Agriculture	31	59	10	100
Platinum mining	0	10	90	100
Gold mining	0	1	99	100
Other mining	45	8	47	100
Meat, Fish, Fruit, Vegetables, Oils and Fat Products	85	9	6	100
Dairy products	85	9	6	100
Grain Mill, Bakery and Animal Feed Products	85	9	6	100
Other food products	85	9	6	100
Beverages and Tobacco products	84	13	4	100
Textiles, Clothing, Leather Products and Footwear	53	36	11	100
Wood and Wood Products	63	27	9	100
Furniture	66	28	5	100
Paper and Paper Products	65	28	7	100
Publishing and Printing	69	30	1	100
Chemicals and Chemical Products (incl. Plastic Products)	62	30	8	100
Rubber Products	74	22	4	100
Non-Metallic Mineral Products	66	26	8	100
Basic Metal Products	60	8	32	100
Structural Metal Products	68	26	6	100
Other Fabricated Metal Products	58	35	7	100
Machinery and Equipment	64	25	12	100
Electrical Machinery and Apparatus	66	28	5	100
Communication, Medical and other Electronic Equipment	48	48	5	100
Manufacturing of Transport Equipment	40	55	4	100
Other Manufacturing and Recycling	56	37	6	100
Electricity	100	0	0	100
Water	100	0	0	100
Buildings	100	0	0	100
Other construction	100	0	0	100
Trade	72	21	8	100
Accommodation	65	23	12	100
Transport services	74	19	7	100
Communications	87	10	3	100
Insurance	49	49	3	100
Real estate	90	10	0	100
Business activities	77	19	3	100
Central Government	97	2	1	100
Health and Social Work	99	0	1	100
Activities/Services	98	2	0	100
Total	63	14	23	100

(Source: Social Accounting Matrix for the North West Province, Conningarth Consultants, 2006)

This table shows clearly that currently, most manufacturing firms (the highlighted sections) produce predominantly for the local (North West Province) market. Some also supply the rest of South Africa (for instance 55 per cent of transport equipment are destined for elsewhere in South Africa). With regards to the sectors that do export, the metal product sector (32 per cent), machinery and equipment (12 per cent), and textiles (11 per cent) and non-metallic minerals (8 per cent) and the largers exporters.

The North West Province is largely a mining economy with 54.4 per cent of total GDP at factor cost being generated within the mining sectors. Table 6.4 shows the distribution of production and trade across the sectors included in the SAM. Column one shows the importance of each sector in generating total value-added in the economy. The single largest mining sector in the North West Province is Platinum production accounting for almost 22 per cent of total value-added. Other large sectors within the economy include gold mining (3.7 per cent), and commercial agriculture (2.5 per cent).

None of the remaining individual manufacturing sectors, other than non-metallic minerals, account for more than around one percent of total value-added. The service and remaining secondary sectors are an important source of value-added and together amount to 61.7 per cent. Within these sectors it is general government, trade and transport services that contributes the most (32.3 per cent) followed by insurance, real estate and other services/activities (15.86 per cent).

Turning to international trade, column three shows that just under a quarter of total import expenditures are for the purchase of equipment. Other important imported commodities in order of magnitude are chemicals and chemical products (9.2 per cent), and other mining (8.8 per cent). Agricultural imports also exceed exports by 1.9 per cent. Columns three and four show export to domestic output and import to domestic demand ratios. The former shows that around 39 per cent of communication products used within the North West Province are imported from abroad. Similarly for exports, gold and platinum mining have very high proportions of output sold abroad (with the exception of other mining). Finally, the non-traditional export sectors have lower export intensities than the more traditional export sectors.

Table 6.4: The structure of production and foreign trade in the North West Province (2000)

Activity/Commodity	Share of total value (%)			Export-output	Import-demand
	Value	Exports	Imports		
Agriculture - Commercial	2.54	4.40	6.29	0.69	1.02
Agriculture - Subsistence	0.03	0.00	0.00	0.00	0.00
Platinum mining	21.70	42.37	0.00	0.99	0.00
Gold mining	3.69	8.59	0.00	1.08	0.00
Other mining	2.52	3.39	8.81	0.54	1.46
Meat, Fish, Fruit, Vegetables, Oils and Fat Products	0.04	0.08	4.35	0.15	8.45
Dairy products	0.35	0.28	0.13	0.15	0.07
Grain Mill, Bakery and Animal Feed Products	0.37	0.34	3.22	0.15	1.47
Other food products	0.55	0.34	0.00	0.15	0.00
Beverages and tobacco products	0.47	0.30	2.33	0.16	1.32
Textiles, Clothing, Leather Products and Footwear	0.30	0.78	5.61	0.46	3.42
Wood and Wood Products	0.17	0.27	0.41	0.37	0.57
Furniture	0.49	0.42	1.22	0.34	1.01
Paper and Paper Products	0.07	0.14	0.98	0.35	2.50
Publishing and Printing	0.09	0.10	0.67	0.31	2.20
Chemicals & Chemical Products (incl. Plastic Products)	0.62	1.32	9.22	0.38	2.75
Rubber Products	0.32	0.43	0.69	0.26	0.42
Non-Metallic Mineral Products	1.32	1.78	1.02	0.34	0.20
Basic Metal Products	0.88	2.05	1.54	0.40	0.31
Structural Metal Products	0.16	0.29	1.24	0.32	1.43
Other Fabricated Metal Products	0.36	0.71	0.10	0.43	0.06
Machinery & Equipment	0.46	0.91	11.27	0.36	4.65
Electrical Machinery & Apparatus	0.51	0.97	1.97	0.33	0.70
Communication, Medical and other Electronic Equipment	0.04	0.10	6.99	0.52	38.51
Manufacturing of Transport Equipment	0.14	0.63	10.64	0.60	10.34
Handcrafts & curios - Informal	0.01	0.00	0.14	0.00	1.22
Other Manufacturing & Recycling	0.08	0.11	3.50	0.44	14.08
Other manufacturing - Informal	0.02	0.00	0.48	0.00	12.20
Electricity	0.91	0.01	1.93	0.00	0.90
Water	0.16	0.00	1.07	0.00	1.79
Buildings	0.63	0.00	0.03	0.00	0.01
Other construction	1.21	0.00	0.02	0.00	0.00
Construction - Informal	0.06	0.00	0.00	0.00	0.00
Trade	9.80	6.88	0.97	0.28	0.04
Accommodation	1.21	1.52	2.24	0.36	0.55
Trade, accommodation & entertainment - Informal	0.04	0.00	0.00	0.00	0.00
Transport services	9.16	7.76	0.68	0.27	0.02
Transport - Combi-taxi	0.47	0.00	1.25	0.00	1.37
Communications	3.74	1.53	0.00	0.13	0.00
Insurance	6.82	7.51	7.28	0.51	0.51
Real estate	5.04	1.05	0.14	0.10	0.01
Business activities	2.17	1.60	0.80	0.24	0.12
General Government	13.34	0.79	0.00	0.03	0.00
Health and social work	2.70	0.07	0.67	0.01	0.08
Activities/services	4.00	0.18	0.09	0.02	0.01
Other services - Informal	0.25	0.00	0.00	0.00	0.00
All sectors	100.00	100.00	100.00	0.27	2.52

(Source: Authors' calculations from the 2004 SAM for the North West Province)

Based on these results, the structure of the North West Province economy is typical of a sub-Saharan region. There is a high dependence on natural resource production (mining and agriculture), with exports being dominated by traditional, and to lesser extent non-traditional sectors. The exporting of food products that does take place is likely to be trade with other provinces within South Africa. The manufacturing base is relatively small and is largely concentrated in the production of textile, non-metallic mineral and metal products. Finally, general government, retail trade and transport services drive production in the service sector.

Thus, this section can conclude with the recommendation that the metal products, *non-metallic mineral products*, and *machinery production* sectors be considered as the most promising sectors from which to start export promotion drive. The next section will provide a brief overview of the theoretical understanding of export diversification and specialisation, and discuss the various ways in which the degree of diversification (both vertical and horizontal diversification) can be measured.

6.4 EXPORT DIVERSIFICATION: THEORY AND MEASUREMENT[19]

6.4.1 Theory

One of the earliest ideas in the theory of economic development is that the degree of specialisation or diversification of a country/region's production and trade structure is important for its economic development. From Adam Smith's recognition of the importance of the division of labour and specialisation for economic growth and development, to the standard Heckscher-Ohlin Samuelson (HOS) model of international trade, the position in neoclassical economics has been that countries/regions should specialise in producing and exporting according to their comparative advantage.

However, after the Second World War, with the reconstruction of Europe and increasing independence of many developing former colonies, one of the earliest ideas in the emerging new discipline of development economics was that economic diversification – and not specialisation- may be good for economic growth and development. Active government intervention in industrialisation and export

[19] This section is based on the paper by Naudé and Rossouw (2007).

diversification was encouraged. Seminal contributions in this regard include the Prebisch-Singer thesis (Prebisch, 1950; Singer, 1950) and the 'Big Push' arguments advocated by Rosenstein-Rodan (1943). The key argument was based on the view that developing countries' dependence on primary commodity production and exports leave them vulnerable to commodity shocks, price fluctuations and declining terms of trade, especially since the income elasticity of the demand for primary commodities is low. This in turn results in countries' foreign exchange reserves, and thus their ability to afford imported inputs, becoming subject to fluctuation and uncertainty. In such a case, beneficiation of raw commodities before exporting is seen as adding more value to production and raising employment, and providing more stability and growth in export earnings.

At this point it is necessary to make a distinction between vertical and horizontal diversification. Vertical diversification has been the main focus in this initial development literature. It is said to occur when a country/region's production and export structure shifts from primary commodities to manufactured goods. Most often it occurs when country/region's start processing commodities that were previously exported in raw form (Cramer, 1999:1247).

During the 1980s and 1990s four further strands of literature stressed the potential benefits of export diversification for economic development. One strand proposed that countries/regions should produce and export goods for which the world demand is increasing, and that irrespective of whether or not a country/region produces primary goods or manufactured goods, it is this compatibility with world demand that will determine the extent to which a country/region's exports will grow. This strand of literature is strongly based on the view that exports is good for economic growth, and that export-led growth (as experienced by Japan and the East Asian Tigers) is the most appropriate development path for the developing world (Alexander and Warwick, 2007). In this view export diversification's impact is conditional on the type of goods, and its consistency with world demand, that are exported.

A second strand of literature has its base in endogenous growth theory which sees diversification of exports from primary commodities into high-skilled, high-technology goods as desirable because trade in these products allow for more scope for growth through productivity gains than traditional commodity exports. There are more opportunities for spillover effects in manufactured trade than in primary

commodity trade (Herzer and Nowak-Lehmann, 2006:1825). Spillover effects are partly due to skills and technological upgrading (learning-by-doing and learning-by-exporting)[20], which has more positive externalities, than in primary commodity production (Peterssen, 2005:790). Mengistae and Pattillo (2004) for instance find that manufacturing exporting firms in Africa are up to 17 per cent more productive than non-exporters, primarily due to learning-by-exporting effects.

The two strands discussed above often come to the same practical conclusion in recommending that (a) countries/regions diversify exports into high-skilled, high-technology products and (b) that countries/regions use trade liberalisation as the primary means to obtain higher and more diversified exports (Pineres and Ferrantino, 1997; Edwards and Alves, 2006:475).

A third strand takes a portfolio theory approach. Brainard and Cooper (1968) proposed that risk-averse countries/regions should diversify their exports taking into consideration the covariability of different export goods' world prices. It recognises the merits in the neoclassical HOS- trade models' recommendation that a country/region should specialise according to comparative advantage, but point out that this might not hold under uncertainty, and that uncertainty will reduce overall world trade as risk-averse producers of primary commodities reduce their production thereof (Ruffin, 1974; DeRosa, 1991). Diversification in exports is needed to offset uncertainty if, as is for instance the case in many African countries and regions, financial institutions that can provide insurance are lacking (see Chang, 1991; Osakwe, 2007). Using cross-country data Strobl (2005) finds that trade liberalisation results in greater variability in export earnings, and that there are significant welfare gains for countries in diversifying into a more 'optimal' export structure , although the precise magnitude of these gains are country specific.

A fourth strand of literature where diversification is advocated originated from among the explanations of African countries' poor economic growth in the 1980s. Here it was observed that countries that have a rich endowment of natural resources, and tend to depend on exporting one or a few highly-valued natural resources, such as oil, minerals or coffee, tend to grow slower than countries with a more diversified, non-resource based export structure (Arezki and Van der Ploeg, 2007). Sachs and Warner

[20] In the endogenous growth models, learning-by-doing and learning-by-exporting and the resulting greater diversification of exports occurs through imitation of developed countries (Pineres and Ferrantino, 1997:376).

(2001) termed this the 'natural resource curse'. Three main reasons for why a rich endowment of natural resources would be bad for economic growth has been advanced: 'Dutch-disease' effects whereby the real exchange rate appreciate during resource booms (Bonaglia and Fukasaku, 2003), increasing rent-seeking behaviour and corruption, and civil conflict over these valuable resources.

Despite the apparent need for diversification as motivated in the literature surveyed above, there have remained a thread of scepticism on the appropriateness and practicality of greater export diversification in many developing countries/regions. Owens and Wood (1997) argue that in the case of Africa, comparative advantage implies that the emphasis should not be on vertical diversification, but on expanding primary commodity exports, and horizontally diversifying only primary production and exports. According to Rodrik (1998) the ratio of trade to GDP in Africa is comparable to that of countries of similar size and income. This is taken to suggest that the continent's specialisation according to its comparative advantage is not the constraint on its growth.

There is also a growing literature that doubts the practicality of diversification for resource-rich, skill-scarce developing countries/regions. Krugman (1987) illustrates the difficulty of diversifying due to the self-reinforcing (lock-in) effects of initial specialisation, which may act as a 'development trap' if that specialisation is in slow-growing sectors (Bardhan and Udry, 1999:189). DeRosa (1991) notes that export diversity may not come about without government targeting certain sectors which however may be welfare-reducing if fiscal resources are used in this process. Cramer (1999) discusses some of the practical difficulties and country experiences in attempting vertical diversification. These include poor macro-economic policies, a high-transaction costs business environment and political uncertainty that reduce foreign direct investment, as well as a lack of efficient trade facilitation[21] (Zanamwe, 2005:6). Developed country policies towards the developing world have also been seen as detrimental in some cases to export diversification. Foreign aid has for instance identified as leading to 'Dutch Disease' type of effects in African countries, thereby contributing to limited export diversification (Osakwe, 2007:4). Trade preferences (Special and Differential Treatment under the WTO) have been argued to be undermining

[21] In many developing countries, especially in Africa export diversification is hampered by insufficient physical infrastructure and facilities for the movement of goods, diverse and uncertain custom procedures, and the use of outdated and inefficient information and communication technology for the exchange of trade-related information (Zanamwe, 2005:7).

African countries' ability to diversify their export structures (Mold, 2005). Gamberoni (2007:2) for instance finds evidence that some EU preference schemes (e.g. the ACP Lomé scheme) have been hindering export diversification, either through creating an incentive for countries to specialise in the product (s) which has preferential access, or by limiting efforts of developed countries to open up their markets more generally.

More recently diversification and specialisation has been studied as the part endogenous outcome of a country's stage of development (e.g. Acemoglu and Zilibotti, 1997; Imbs and Wacziarg, 2003). While this literature focuses on a country/region's production structure, it has implications for its export structure, given that there is a relation between what countries/regions produce and what they export[22]. One such implication is that a country/region's sector diversification will benefit the development of its financial sector (by spreading risk), and that the development of its financial sector will in turn support further diversification of the economy (Acemoglu and Zilibotti, 1997). Ramacharan (2006:5) finds that a one standard deviation increase in diversification is associated with about a 0.81 standard deviation increase in the level of credit to the private sector. Thus, diversifying the sectoral composition of the economy, will benefit financial development, which in turn, as shown by Chang (1991) may allow countries to engage in more specialisation of exports, given that developed financial markets may provide insurance against risk. This reasoning may lead one to infer that countries'/regions' export structure may go through phases, from less diversified to more diversified, followed by a phase of less diversification and more specialisation, as the financial sector development deepens (Saint-Paul, 1992). Diversifying the production structure of the domestic economy may therefore be a prerequisite for export diversification and later export specialisation[23]. This does not necessarily imply that we are back at the infant-industry argument for protection: trade policy has been found not to be the first-best policy to address this (Venables, 1996; Bardhan and Udry, 1999:189). Better ways that have been identified include financial sector development / credit market intervention (Krugman, 1987), co-ordination of investments between sectors (Murphy *et al.*, 1989; Krugman, 1991b) and science and technology policy to raise the rate of creativity (innovation) and

[22] This was already recognized by Adam Smith in his 'vent-for-surplus' theory of exports. In the HOS model of international trade, this will also arise when countries differ in the proportions of their incomes that they consume (DeRosa, 1991:10).

[23] According to Hausmann and Klinger (2006) a reason for South Africa's slow growth in exports per capita is due to the 'lagging process of structural transformation' of the economy.

information spillovers in a country in order to find dynamic comparative advantages (DiPietro and Anuruo, 2006; Hausmann and Rodrik, 2006; Redding, 1999).

Diversification may also result more endogenously from a growing demand for a variety of goods as a country/region's income increases (Imbs and Wacziarg, 2003:82). This in turn suggests that low-income countries/regions with a specialised export structure should aim to maximise the benefits of such exports for household income and demand. It implies that an unequal distribution of income may act as constraint on diversification.

Imbs and Wacziarg (2003) using cross-sectional and cross-country data finds a U-shaped relationship between the degree of sectoral concentration in a country's production structure and the level of development (as measured by per capita income). This evidence is consistent with the view that countries/regions will first diversify and then specialise in their production (and exports) over their stages of development. Hummels *et al.* (2001) and Yi (2003) gives further support to the notion that countries at further stages of development may tend to specialise also in their export structure, by identifying the importance of vertical specialisation (when a country/region specialises in a specific stage of production, rather than in the production of the whole product) in global trade. Vertical specialisation has for example been responsible for 50 per cent of the growth in USA trade since 1962 (Yi, 2003:9).

6.4.2 Measurement

The degree of export diversification (specialisation) can be measured in a number of ways. Often the extent of diversification or specialisation is merely described by referring to the share of primary and manufactured exports in total exports (vertical diversification) and the shares of the various Standard International Trade Classification (SITC) categories of manufacturing sub-sectors in total manufacturing for horizontal diversification (e.g. Edwards and Alves, 2006; Bonaglia and Fukasaku, 2003). While useful to describe broad patterns of structural change, these share measures are less useful when export diversification is manifested through changes in export composition within sectors. In such cases, better summary measures of diversification or specialisation can be obtained by calculating one of a number of concentration indices. The most common in this regard are the Herfindahl, normalized-Hirschmann and

absolute deviation measures (e.g. Petersson, 2005; Pineres and Ferrantino, 1997). These will be used in section 6.5 to describe the extent of export diversification in the North West Province of South Africa.

The Herfindahl Index can be constructed as follows (Petersson, 2005):

$$SPEC_{jt} = \sum_i \left(\frac{E_{jit}}{\sum_j E_{jit}}\right)^2 \tag{6.1}$$

Where E_{ijt} is the exports of a region j of a particular industry (or export sector) i in a given year t. An index value approaching one indicates a high degree of export concentration (or specialisation), whereas a value approaching zero signifies a high degree of export diversification (Petersson 2005).

The normalised-Hirschmann index can be calculated as follows (Al-Marhubi, 2000; Naqvi and Morimune, 2005):

$$H_{jt} = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{x_{it}}{X_{jt}}\right)^2} - \sqrt{\frac{1}{n}}}{1 - \sqrt{\frac{1}{n}}} \tag{6.2}$$

Where x_{it} is the value of exports of industry i located in region j and X_{jt} is the total exports of region j in a given year t. The number of industries is indicated by n. An index value nearer to 1 indicates extreme concentration. Likewise, a value closer to 0 signifies a more diverse combination of exports (Al-Marhubi 2000; Naqvi and Morimune 2005).

A third method to measure export diversification is by the absolute deviation of the region's share of the country's total exports (e.g. Al-Marhubi, 2000). This can be calculated as in (6.3):

$$S_{jt} = \frac{\sum_i \left|h_{ijt}\right| - \left|h_{it}\right|}{2} \tag{6.3}$$

Where h_{ijt} is the share of industry i in total exports of region j and h_{it} is the share of industry i in country exports in a given year t. Again this measure ranges from 0 to 1 where 1 represents total concentration and 0 total diversification (Al-Marhubi 2000).

6.5 EXPORT DIVERSIFICATION AND SPECIALISATION IN THE NORTH WEST PROVINCE

In this section the extent of export diversification and specialisation in the North West Province is determined, and changes therein since 1995. The reason for this is twofold. First to assess, using a long time span of data and various measures, the degree to which the diversity of the North West Province's export basket changed over time, and to relate this broadly to changes in per capita GDP (as a measure of development). Second, this assessment of the diversification of the North West Province's exports is provided in order to create a benchmark against which the economy-wide impact of changes in the extent of diversification can be modelled using a RAGE model (see Chapter 5). In this section, the method (Section 6.5.1), the data (Section 6.5.2) used and the results (Section 6.5.3) are described.

6.5.1 Method

In section 6.4 the most common methods used to calculate the extent of diversification or specialisation in a country/region's export basket were described. In this section these will be applied. They are first the Herfindahl Index (SPEC-measure) as described in equation (6.1), second the normalized-Hirschmann index (H_{jt} in equation 6.2). And third the absolute deviation of the region's share of total South African exports (S_{jt} in equation 6.3).

6.5.2 Data

The main source on data on the North West Province's exports used is the data obtained from the Quantec Easydata's Standard Regional Dataset. This database contains South African national and regional export data with the rest of the world on 34 SIC[24] sectors and covers the period 1995-2006. Further data,

[24] In South Africa, contrary to most other countries, a slightly different version of the International Standard of Industrial Classification of All Economic Activities (ISIC) code is used to classify different types of manufacturing, called the Standard Industrial Classification of all economic activities (SIC). The Standard Industrial Classification of all Economic Activities (SIC) is based upon the latest (third revision which appeared in 1990) International Standard Industrial Classification of all Economic Activities (ISIC) with suitable adaptations for local conditions. However, the third revision of the ISIC differs in various respects from the previous edition so that the fifth edition of the SIC also differs from previous editions.

on GDP per capita, were sourced from both the Quantec Easydata's Standard Regional Dataset and Global Insight Southern Africa's Regional Explorer.

The main source of data on South African exports used is the World Export and Import Data which was constructed from United Nations data by Robert Feenstra and Robert Lipsey for the National Bureau of Economic Research (NBER) (see http://cid.econ.ucdavis.edu/data/undata/undata.html and Feenstra *et al.*, 2004). This database contains South African trade data with 140 countries on 1042 SITC sectors and covers the period 1962-2000. Further data, on GDP per capita, were sourced from the World Bank's World Development Indicators (Available at: http://go.worldbank.org/3JU2HA60D0).

6.5.3 Results

This section will focus mainly on the regional results and, where necessary refer to or compare with the findings at national level. The empirical findings are reported on in three subsections below. Subsection 6.5.3.1 sets out the trends in export diversification/specialisation in the North West Province between 1995 and 2006 showing that the region's export basket became both more and less diversified during the period. Subsection 6.5.3.2 discusses the North West Province's export diversification trends in comparative perspective, showing that the region's export basket is relatively specialised compared to that of the other regions in South Africa, but that it is less diversified when compared to the South African average. Subsection 6.5.3.3 relates export diversification to GDP per capita, finding from a cross-region sample an inverse U-shaped relation between export specialisation and GDP per capita. Over time evidence of a similar relationship in the North West Province is found. In this subsection Granger causality tests are also performed between various measures of export diversification, but only at national level. No evidence is found that higher GDP per capita levels lead to changes in export diversification, but some evidence (not robust) is found that export diversification Granger causes GDP per capita.

6.5.3.1 Trends in export diversification (specialisation)

Table 6.5 below contains the four export diversification (specialisation) measures for the North West Province over the period 1995 to 2006, comparing these to the average of all 9 provinces in South Africa.

Table 6.5: Export diversification (specialisation) measures for the North West Province, 1995 – 2006

Measure: Herfindahl (SPEC) index		
	North West	**South Africa Average**
1995 - 1997	0.61	0.28
1998 - 2000	0.63	0.31
2001 - 2003	0.49	0.32
2004 - 2006	0.37	0.31
Measure: Absolute Deviation of Share of North West Exports		
	North West	**South Africa Average**
1995 - 1997	0.66	0.54
1998 - 2000	0.56	0.55
2001 - 2003	0.63	0.58
2004 - 2006	0.53	0.52
Measure: normalised-Hirschmann Index H_{jt}		
	North West	**South Africa Average**
1995 - 1997	0.73	0.39
1998 - 2000	0.75	0.42
2001 - 2003	0.61	0.43
2004 - 2006	0.53	0.43

(Source: Authors' calculations based on Quantec Easydata, RSA Regional Market Indicators, 2007)

From Table 6.5 can be seen that over the period 1995-2006, there have been changes within the period coupled with a significant difference in the degree of export diversification at the start and end of the period. Comparison of the various time periods suggests that diversification levels first increased, where after it declined again, with the economy becoming relatively more concentrated in its exports between 1998 and 2000. This was followed by an increase in export diversification during the period 2004-2006.

The noted increase in export diversification in the aggregate measures as contained in Table 6.5 above may reflect a growing vertical diversification in the region's export basket, rather than horizontal diversification within the manufacturing sector. Evidence in this regard comes from Edwards and Alves (2006). They use Lall's (2000) classification of exports into its technological sophistication and present

evidence that would suggest some degree of vertical diversification of South Africa's export structure between 1995 and 2006, but suggest relatively little horizontal diversification with manufacturing exports. Table 6.6 below shows the extent of diversification in the North West Province's exports between 1995 and 2006.

Table 6.6: Export diversification in the North West Province (sectoral composition of exports) in 1995 and 2006

Goods	SIC Sectors	1995	2006
Primary products		22.0%	16.5%
Manufactured products		77.6%	83.6%
TOTAL		**100%**	**100%**
Manufacturing:			
Resource based		**23.7%**	**16.1%**
-Agro processing		7.5%	4.0%
-Minerals based		16.2%	12.1%
Low technology		**8.6%**	**4.4%**
-Fashion cluster		1.8%	1.0%
-Other		6.9%	3.4%
Medium technology		**65.1%**	**76.0%**
-Automotive		4.2%	11.3%
-Process		53.8%	56.2%
-Engineering		7.1%	8.5%
High technology		**2.6%**	**3.5%**
-Electronic		1.0%	2.1%
-Other		1.6%	1.4%

(Source of data: Authors' calculations based on Quantec Easydata, RSA Regional Market Indicators, 2007)
(Source: adapted from Edwards and Alves, 2006:475,477)

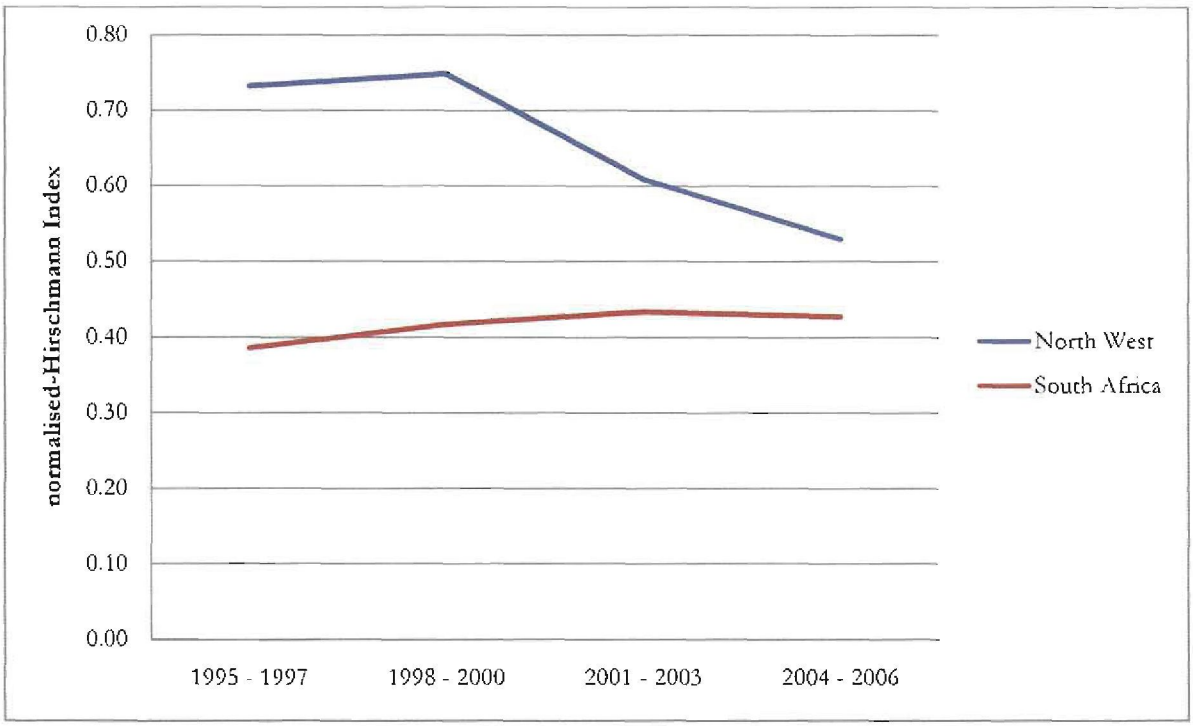
Table 6.6 shows that there has been significant vertical export diversification in the North West Province since 1995 with the share of primary commodity exports declining from 22.0 per cent to 16.5 per cent in 2006. Within manufacturing, resource-based and low-technology manufacturing's share in exports declined from respectively 23.7 per cent to 16.1 per cent and 8.6 per cent to 4.4 per cent. In contrast the share of medium-technology products increased from 65.1 per cent to 76.0 per cent between 1995 and 2006. Changes in these relative shares can be due to either increased exports of non-traditional (manufactured goods) or due to reduced exports of primary commodities (Petersson, 2005:785). The table shows that only a small portion of the North West Province's manufactured exports are high-technology goods (3.5 per cent in 2006). According to Edwards and Alves (2006:477) the low share of high-technology goods is a weakness in the country/region's export structure, since worldwide growth in exports of high-technology goods has been the fastest of any other goods, at an annual average of 11.7 per cent between 1988 and

2002. In contrast exports of primary products grew on average by only 2.4 per cent per annum over this period.

6.5.3.2 Export diversification/specialisation in comparative context

Figure 6.5 depicts the trends in export diversification in the North West Province over the period. It shows that compared the average country (South African average) the North West Province's export basket is relatively specialised, but that whereas average country exports became consistently more specialised during the period, the North West Province experienced a period from 1998 to 2006 when exports became more diversified. This period generally corresponds to the period when varying fluctuations were experienced in the international gold price. Also, the period after 1996 is marked by growing international integration and trade liberalisation in terms of the South Africa's membership of and commitments to the World Trade Organisation (WTO) (Naudé and Coetzee, 2004).

Figure 6.5: Export diversity in the North West Province according to the normalised-Hirschmann Index, 1995 – 2006



(Source: Authors' calculations based on Quantec Easydata, RSA Regional Market Indicators, 2007)

In Figure 6.5 above the diversity of the North West Province's export basket is compared with that of the average for South Africa. This may mask regional and country-level differences. Table 6.7 below compares the various measures of export diversification of the North West Province with that of the other 9 Provinces and the South African Average.

Table 6.7: Comparison of export specialisation in the North West Province and selected regions

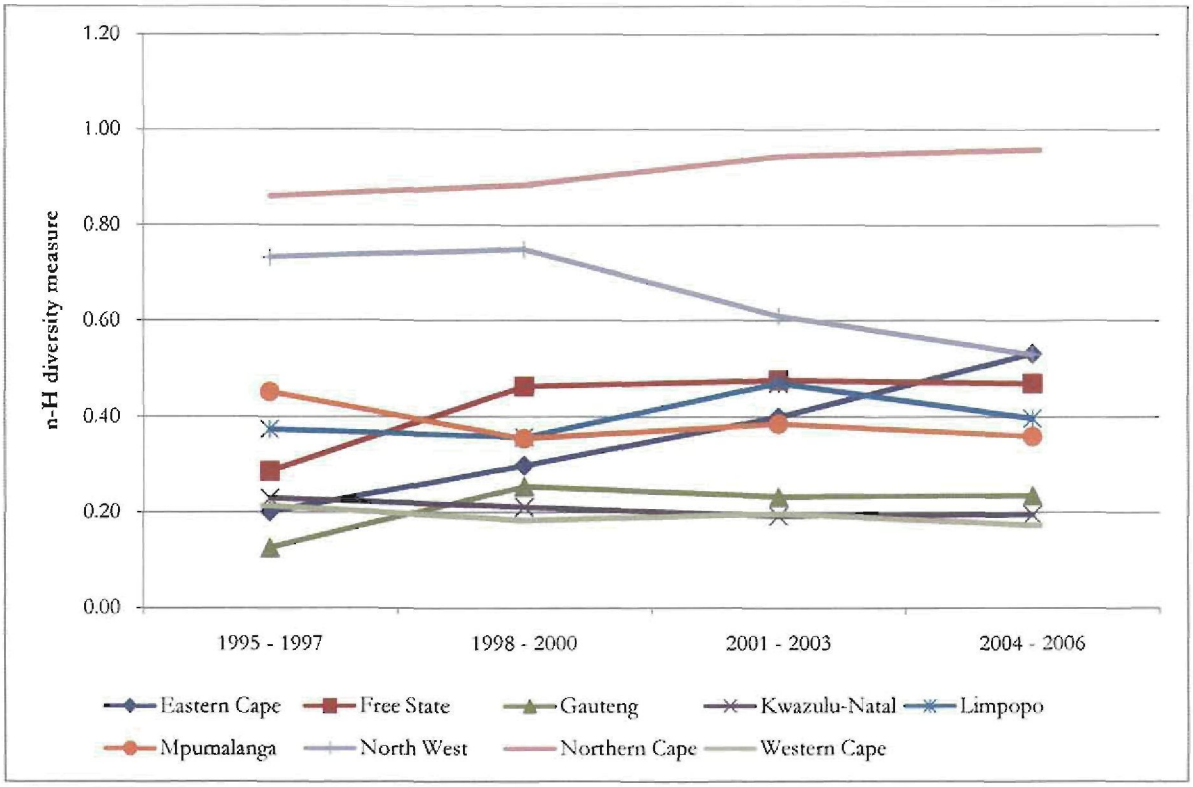
Herfindahl (SPEC) diversity measures for the North West Province, multi- year averages, 1995-2006				
Region	**1995 - 1997**	**1998 - 2000**	**2001 - 2003**	**2004 - 2006**
South Africa	0.28	0.31	0.32	0.31
Eastern Cape	0.11	0.18	0.25	0.37
Free State	0.17	0.31	0.32	0.32
Gauteng	0.08	0.15	0.13	0.14
Kwazulu-Natal	0.13	0.12	0.11	0.11
Limpopo	0.23	0.22	0.32	0.25
Mpumalanga	0.31	0.22	0.24	0.22
North West	0.61	0.63	0.49	0.37
Northern Cape	0.78	0.82	0.91	0.93
Western Cape	0.12	0.10	0.11	0.10
The absolute deviation export diversity measures for the North West (S_{it}), multi- year averages, 1995-2006				
Region	**1995 - 1997**	**1998 - 2000**	**2001 - 2003**	**2004 - 2006**
South Africa	0.54	0.55	0.58	0.52
Eastern Cape	0.66	0.68	0.69	0.70
Free State	0.54	0.62	0.73	0.56
Gauteng	0.15	0.15	0.18	0.15
Kwazulu-Natal	0.40	0.46	0.36	0.24
Limpopo	0.55	0.53	0.61	0.51
Mpumalanga	0.50	0.55	0.58	0.53
North West	0.66	0.56	0.63	0.53
Northern Cape	0.81	0.85	0.88	0.88
Western Cape	0.58	0.56	0.56	0.53
The normalised-Hirschmann index (H_{it}) for the North West, multi- year averages, 1995-2006				
Region	**1995 - 1997**	**1998 - 2000**	**2001 - 2003**	**2004 - 2006**
South Africa	0.39	0.42	0.43	0.43
Eastern Cape	0.20	0.30	0.40	0.53
Free State	0.29	0.46	0.48	0.47
Gauteng	0.13	0.25	0.23	0.23
Kwazulu-Natal	0.23	0.21	0.19	0.19
Limpopo	0.37	0.36	0.47	0.40
Mpumalanga	0.45	0.35	0.38	0.36
North West	0.73	0.75	0.61	0.53
Northern Cape	0.86	0.88	0.94	0.96
Western Cape	0.21	0.18	0.20	0.17

(Source: Authors' calculations based on Quantec Easydata, RSA Regional Market Indicators, 2007)

Table 6.7 above shows that most measures of export diversity suggests that for most of the period 1995 to 2006, that the North West Province's export basket was more specialised than that of the majority of province/region's in the rest of South Africa, but more diversified than that of the Northern Cape. The indices in Table 6.7 also suggests that there was marked improvement in the export diversity in the North West Province over the period (the exception is the absolute deviation measure which indicates a slight decrease in export diversity over the period 2001 to 2003). In this relative improvement of the diversity of its export basket the North West Province is more comparable to Mpumalanga, than for instance the Eastern Cape, which has experienced significant decreases in export diversity according to all measures.

When the export diversity of selected individual regions was compared with that of the North West Province over the period, relative changes can be even more pronounced. Figure 6.6 below compares the diversity of the North West Province's export basket with that of the other 8 provinces in South Africa.

Figure 6.6: Normalised-Hirschmann Index for selected regions, 1995 – 2006



(Source: Authors' calculations based on Quantec Easydata, RSA Regional Market Indicators, 2007)

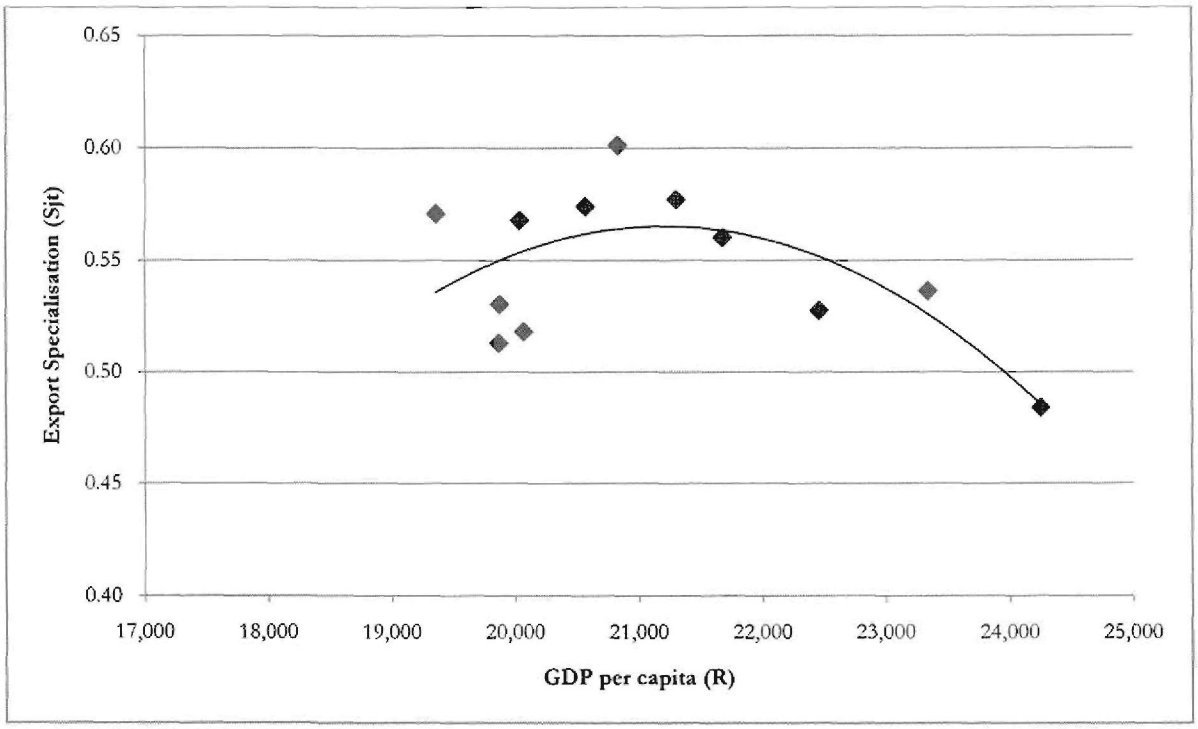
Figure 6.6 shows that ever since 1998, all but one of these selected regions, who import from the North West Province, had export baskets that were more diversified than that of the North West Province. Between 1998 and 2006 the differences became less pronounced due to the North West Province's export basket becoming much more diversified and that of Northern and Eastern Cape becomes less so. The figure shows the significant degree of export diversification that has taken place in the North West Province since 1998.

6.5.3.3 Export diversification/specialisation and level of economic development

In making these comparisons of export diversity between the North West Province and the other provinces/regions in South Africa, the discussion in Section 6.4.1 should be kept in mind. There it was pointed out that the degree of export diversification may be related to a region's stage of economic development (see .e.g. Imbs and Wacziarg, 2003). Thus, the faster growth in export diversification in the North West Province that is reflected in Table 6.7 above may reflect that this region is overall starting out from a lower base of diversification, as well as per capita income, than other regions in South Africa are. In order to explore this further and thus put the cross-region comparisons in perspective, the measures of export diversification were plotted against per capita income in the sample of regions. The resulting scatter plot is contained in Figure 6.7. The figure also contains a regression line depicting the estimated relationship between real per capita GDP and level of export diversification[25]. It is clear that this relationship is non-linear and inversely U-shaped, in contrast to theory (see Section 6.4.1).

[25] For the 9 provinces the estimated relationship between Sjt and real GDP per capita over the period 1995-2006 was estimated using OLS to be $S_j = 0.88$ *(51.2)* $- 0.00$ *(-5.90)*GDPPC $+ 4.3$ *(3.07)*GDPPC^2 where the t-ratio's in brackets are all significant at the 5% level, and the adjusted $R^2 = 0.44$.

Figure 6.7: Relationship between export specialisation and real GDP per capita across South Africa

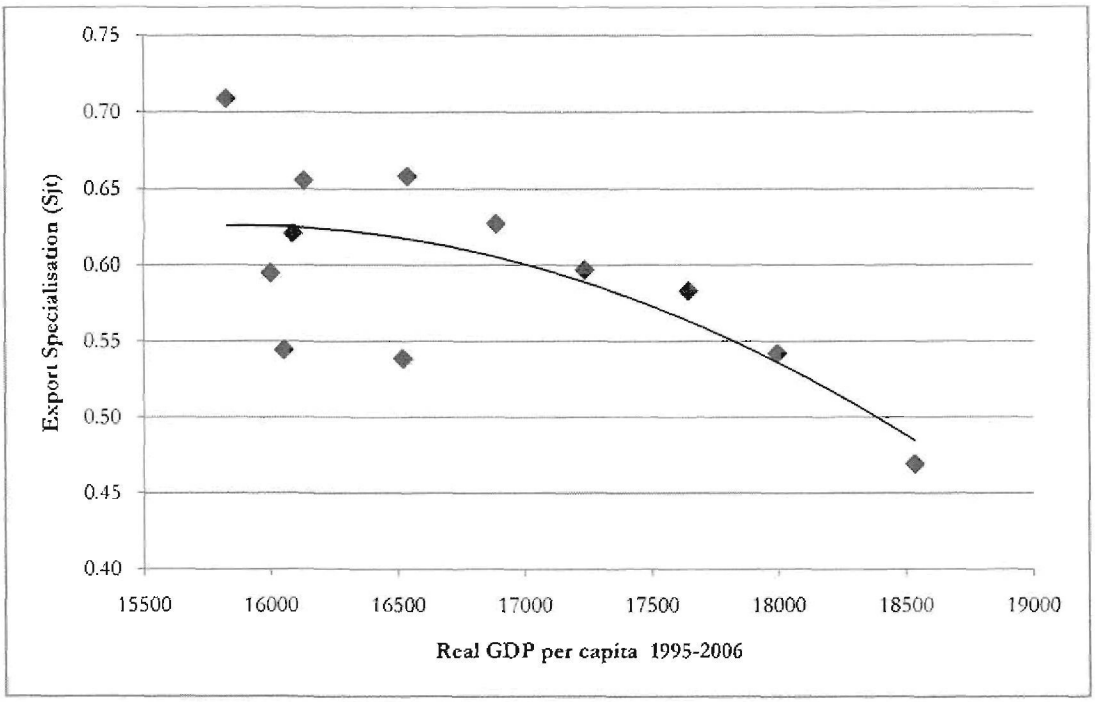


(Source: Authors' own calculations)

It was found that the same relationship exists in the North West Province when the results were compared over time with the extent of export diversification with per capita GDP. Figure 6.8 plots the absolute deviation measure (S_{it} as in equation 6.4) against real per capita GDP in the North West Province over the period (similar results are obtained using the other measures). The figure also includes a fitted regression line of the relationship between S_{it} and real GDP per capita[26]. It can be seen from the figure that this relationship is significantly non-linear (inversely U-shaped). This is inconsistent with the observation that as an economy develops from lower levels of per capita GDP, it would first become more diversified, and after a certain level of GDP is reached, it would again become more specialised in production and exports.

[26] The estimated relationship between S_{it} and real GDP per capita over the period was estimated using OLS to be S_{it} = 2.16 *(4.42)* – 0.01 *(-3.02)*GDPPC + 1.75 *(3.11)*GDPPC^2 where the t-ratio's in brackets are all significant at the 5% level, and the adjusted R^2 = 0.17.

Figure 6.8: Relationship between export specialisation and real GDP per capita in the North West Province, 1995 – 2006



(Source: Authors' own calculations)

The question is whether this relationship is indicative of changes in export diversification/specialisation inducing changes in GDP per capita, or vice versa. Thus, does export diversification or specialisation matter for GDP per capita, or does changes in GDP per capita drive the degree of export diversification/specialisation?

To answer this Granger causality tests were performed on the relationship between export diversification/specialisation and GDP per capita at the national level[27] (using the NBER data for South Africa mentioned in subsection 6.5.2). This entailed running the following two regression equations using the various measures of export diversification.

$$X_t = a_0 + b_i \sum_{i=1}^{n} X_{t-i} + c_i \sum_{i=1}^{n} Y_{t-i} + e_t \qquad (6.4)$$

and

[27] Due to a lack of sufficient data observations, this test could not be performed on the data for the North West Province.

$$Y_t = d_0 + \delta_i \sum_{i=1}^{n} Y_{t-i} + \gamma_i \sum_{i=1}^{n} X_{t-i} + \varepsilon_t \quad (6.5)$$

Where X_t = a measure of export diversification, alternatively the Herfindahl (SPEC) index, normalized-Hirschmann (H_{it}) index and absolute deviation (S_{it}) index and Y_t = GDP per capita and e_t and ε_t random errors. To test whether Y 'Granger-Causes' X or vice versa we test for the joint significance of the c_i and γ_i coefficients in (1) and (2) under the null of no causality. The results of these tests, with n (the lag length) equal to 4 and 8, are contained in Tables 6.8 and 6.9 below.

Table 6.8: Granger causality tests: dependent variable export diversification measure, 1962 – 2000

Test	Herfindahl Index	Normalized Hirschmann Index	Absolute Deviation Index (S_{it})
F-test for joint significance of c_i with F(4,26)	0.50 (0.73)	0.83 (0.51)	2.20 (0.09)
F-test for joint significance of c_i with F(8,14)	0.54 (0.81)	0.73 (0.66)	1.60 (0.21)

(Prob > F in brackets)

Table 6.9: Granger causality tests: dependent variable GDP per capita, 1962 – 2000

Test	Herfindahl Index	Normalized Hirschmann Index	Absolute Deviation Index (S_{it})
F-test for joint significance of γ_i with F(4,26)	3.00 (0.03)*	3.70 (0.01)*	0.42 (0.79)
F-test for joint significance of γ_i with F(8,14)	2.15 (0.09)*	1.93 (0.13)	0.95 (0.51)

(Prob > F in brackets. An asterisk denotes significance at the 10% level)

The results in Table 6.8 indicate that we cannot reject the null of no Granger causality from GDP per capita to export diversification. The results are robust for different lag lengths and different export diversification measures. The results in Table 6.9 however indicate some evidence, at the 10 per cent level of significance, for Granger causality from export diversification to GDP per capita. The results are not however, robust with respect to lag length or export diversification measure. It provides only tentative evidence that causality runs from export diversification to GDP per capita. These results are consistent with Hausmann and Klinger's (2006:9) argument that a lack of export diversification is a constraint on South Africa's growth.

6.6 SUMMARY

This chapter has shown that the North West Province economy is characterised by high levels of unemployment, poverty, low literacy rates and an increasingly high level of HIV/Aids prevalence rate (Statistics South Africa, 2001). These issues have placed increased pressure on the provincial government to play a more active role in addressing these issues by promoting the provinces economic potential.

One approach to increase the region's economic growth is through export-led growth, through a greater diversity in manufacturing exports. This led to the question, should regions in developing countries focus on diversifying their export basket or should they rather specialise their exports according to their existing comparative advantage?

In this chapter an attempt was made to answer this question by reviewing the literature on export diversification and specialisation, by investigating the extent of export diversification and specialisation in the North West Province over the period 1995-2006 and its relationship to GDP per capita.

It was found that although the North West Province has a relatively specialised export basket when compared to averages for the other 8 provinces in South Africa, its export basket has become more diversified than any of the other provincial economies in the country.

Over time, there have been quite significant changes in increasing the extent of export diversification. Over the period 1995 to 1998 export diversification first decreased, after which it started to increase to end of 2006.

Evidence was also found that the relationship between export specialisation and GDP per capita in the North West Province is inversely U-shaped, similar to what we find for a cross-section of regions. This is inconsistent with the theoretical relationship between a region's level of development and export diversification as put forward in the literature.

Furthermore, at national level, increased export diversification may be good for development in South Africa in that export diversity was found to Granger-cause GDP per capita over the period.

Further evidence of the impact of export diversity/specialisation may be obtained through simulation of the effects of greater export diversification versus greater export specialisation on the North West Province and South African economies. Chapter 7 sets out to investigate the economy-wide impacts

of the degree of export diversification on the North West Province and South African economies by using a RAGE and AGE model respectively to simulate four scenarios.

CHAPTER 7: SIMULATION SET-UP AND RESULTS

7.1 INTRODUCTION

In Chapter 6 it was pointed out that diversification of a country/region's export basket is often seen as desirable for stabilisation of export earnings and for stimulating export-lead growth by allowing a region to benefit from growth in different sectors of the South African and world economies. It was noted that the North West Province is a case in point where export-lead growth remains elusive, possibly due to limited diversification of the provinces' export basket (Hausmann and Klinger, 2006). In section 6.5.3.3 in chapter 6 tentative evidence was presented that greater export diversity Granger-cause GDP per capita at the national level.

This chapter will investigate the economy-wide impacts of the degree of export diversification on **the North West Province and South African economies** by using a **RAGE** model to simulate four scenarios and **compare** this with the same simulations performed at national level using an **AGE** model.

The RAGE and AGE models implemented are described in subsection 6.2.1 below. The scenarios are described in subsection 6.2.2 and it is shown that in the first two scenarios it is assumed that the region/country further diversify its export basket, to a level that is more diversified than that of the Free State/China. In the second two scenarios, it is assumed that the region/country increases its specialisation of exports, to a level significantly more concentrated than at present. In subsection 6.2.3 the national and regional results are set out and compared. In section 6.3 the economy-wide impacts on exports of an exchange rate devaluation/appreciation is modelled. Section 6.4 is the summary.

7.2 SIMULATING THE ECONOMY-WIDE IMPACTS OF EXPORT DIVERSIFICATION / SPECIALISATION

7.2.1 Modelling Approach

Since policy makers are interested in the economy-wide impacts, and in particular the impact on household welfare, inequality and unemployment of export diversification and specialisation (and in this case at both national and regional level), the most appropriate modelling tools are a RAGE model (to model the regional impact) and AGE model (to simulate the scenarios at national level).

As a preamble to the discussion of the simulation results in subsection 7.2.3, it may be useful to highlight the underlying structure of the regional economy within the NWPGEM to better understand and explain the simulation results. The NWPGEM database was created and compiled for use with the NWPGEM for this thesis. Thus far, no program for econometric estimation of the elasticities required for the model has been undertaken. Elasticities for the first version of the model were assigned on the basis of literature reviews or guestimations. "Armington" elasticities of substitution between domestically produced commodities and imports, the elasticity of substitution between primary factors in non-mining industries, the elasticity of substitution between occupations and the elasticities in the household demand system were all adapted from the ORANI-G data files (see e.g. Horridge *et al.*, 1993). The labour sigma was set at 0.243 across all sectors. Export demand elasticities were set at -100 for gold and platinum mining and at -3 for all other sectors. For all industries, the elasticity of substitution between primary factors in short run simulations was set at 0.5.

The national model is applied (or computed) using economy-wide consistent data on a particular economy as is normally contained in a Social Accounting Matrix (SAM). In the present case the most recent published SAM for South Africa (Statistics South Africa, 2004; 2002) is used. A South African adaptation of ORANI-G is used to solve the national model. It is known as the UPGEM and was developed for South Africa by the University of Pretoria. The UPGEM[28] used in these simulations

[28] An overview of the UPGEM falls outside the scope of this thesis. For a more detailed discussion of the UPGEM, see e.g. http://www.monash.edu.au/policy/oranig.htm.

distinguishes 32 sectors, 6 household types and 4 ethnic groups (Horridge, 2000). For a more detailed exposition of the modelling approach followed in UPGEM and NWPGEM, see Horridge *et al.* (1993). A recent application of the UPGEM model to environmental economics in South Africa is contained in Van Heerden *et al.* (2006).

Table 7.1 below summarises the main differences between the NWPGEM (regional) and UPGEM (national) models.

Table 7.1: NWPGEM vs. UPGEM: Main features of the models

Model	Country/Region	Base year	Elasticities	Base-year data	Demand side		Production side	
					Demand functions	**Disaggregation**	**Production functions**	**Disaggregation**
NWPGEM; Rossouw (2007)	North West Province	2004	Export demand elasticities, CES between imported and domestic goods, CES between capital, labour and land, CES between labour skill groups	North West Province SAM developed by Conningarth Consultants	Derived from nested CES utility functions	27 consuming groups comprising households, government, investment	Derived from two nested CET aggregation functions	27 commodities/ production sectors in the regional model
UPGEM02; de Wet and van Heerden (2002)	South Africa	1998	Export demand elasticities, CES between imported and domestic goods, CES between capital, labour and land, CES between labour skill groups	South African National SAM published by Statistics South Africa	Derived from nested CES utility functions	32 consuming groups comprising households, government, investment	Derived from two nested CET aggregation functions	32 commodities/ production sectors in the national model

(Source: framework adapted from Shoven and Whalley, 1992:82-84)

7.2.2 Scenarios

Four different scenarios are simulated. In the first two scenarios it is assumed that the country/region further diversify its export basket, to a level that is more diversified than that of the Free State Province/China. There are two means by which to diversify or concentrate the composition of an export basket — (a) through generating non-traditional exports and decreasing the level of traditional exports, and (b) by generating non-traditional exports and keeping traditional exports fixed/constant. These two methods are used to perform two alternative scenarios for both diversification and specialisation[29]. In the final two scenarios, it is assumed that the country/region increases its specialisation of exports, to a level significantly more concentrated than at present. Finally, a specialisation in exports is modelled without reducing any sectors output adversely, by simply increasing the export shares of mining and agriculture (resource-based specialisation). In essence, the implementation of the scenarios requires that a quantity adjustment be specified to the current levels of sector exports as is reflected in the SAM. This can be explained with the help of Table 7.2 and 7.3 below.

Key features to keep in mind when running a short-run comparative static closure are:

- Capital stock is fixed within each industry;
- Slack labour markets for all labour categories; and
- Household consumption moves with disposable income for all households.

[29] With greater specialisation the focus will be more on generating traditional exports and either (a) decreasing non-traditional exports, or (b) keeping non-traditional exports fixed/constant.

Table 7.2: Specification of simulations in NWPGEM

SAM Sector	V4BAS (Exports)	Current S_{jt} in NWPGEM	Greater Diversification (a)	New S_{jt}	Alternative Diversification Scenario (b)	New S_{jt}	Greater Specialisation (a)	New S_{jt}	Alternative Specialisation Scenario (b)	New S_{jt}
AgricFrstFsh	2702.027	0.016	0.040	0.019	0.046	0.016	0.066	0.006	0.076	0.001
PlatnmMining	24101.148	0.205	0.369	0.184	0.412	0.205	0.547	0.273	0.554	0.276
GoldUranMing	4659.758	0.031	0.071	0.026	0.080	0.031	0.100	0.041	0.110	0.046
OtherMining	2044.323	0.015	0.035	0.015	0.035	0.015	0.045	0.020	0.045	0.020
Food_Bev_Tbc	776.346	0.003	0.021	0.007	0.018	0.006	0.008	0.001	0.013	0.003
TextClLtFtwr	448.313	0.002	0.014	0.005	0.009	0.002	0.008	0.002	0.008	0.002
Wood_Prodcts	501.230	0.002	0.014	0.005	0.014	0.005	0.009	0.002	0.009	0.002
PetrChemRub	893.094	0.014	0.020	0.011	0.045	0.001	0.010	0.016	0.015	0.014
OthNonMetMin	819.343	0.006	0.014	0.006	0.014	0.006	0.009	0.003	0.014	0.006
MetalProdcts	2185.576	0.014	0.029	0.010	0.037	0.014	0.047	0.019	0.037	0.014
ElctrMachnry	604.688	0.004	0.018	0.000	0.020	0.001	0.008	0.005	0.010	0.004
ElcSndMedEqp	56.582	0.009	0.001	0.009	0.001	0.009	0.001	0.009	0.001	0.009
TranspEquipm	399.205	0.001	0.007	0.001	0.012	0.002	0.007	0.001	0.007	0.001
FrntPpPr_NEC	71.635	0.051	0.001	0.051	0.002	0.050	0.001	0.051	0.001	0.051
ElctGasSteam	5.037	0.004	0.000	0.004	0.000	0.004	0.000	0.004	0.000	0.004
Water	0.000	0.011	0.000	0.011	0.000	0.011	0.000	0.011	0.000	0.011
Construct	2.072	0.003	0.000	0.003	0.000	0.003	0.000	0.003	0.000	0.003
TradeRetWS	4329.764	0.022	0.074	0.022	0.074	0.022	0.074	0.022	0.074	0.022
Accom	958.140	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
TransptServ	4882.500	0.012	0.084	0.012	0.084	0.012	0.084	0.012	0.084	0.012
PostTelec	960.713	0.101	0.016	0.101	0.016	0.101	0.016	0.101	0.016	0.101
Finance_Ins	4726.383	0.021	0.081	0.021	0.081	0.021	0.081	0.021	0.081	0.021
RealEstate	657.912	0.051	0.011	0.051	0.011	0.051	0.011	0.051	0.011	0.051
OtherBus	1009.271	0.009	0.017	0.009	0.017	0.009	0.017	0.009	0.017	0.009
GenGovnmt	495.526	0.004	0.008	0.004	0.008	0.004	0.008	0.004	0.008	0.004
HealthSocial	43.667	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000
OtherNEC	112.121	0.001	0.002	0.001	0.002	0.001	0.002	0.001	0.002	0.001
Total	**58446.371**	**0.624**	**0.967**	**0.562**	**1.057**	**0.562**	**1.178**	**0.700**	**1.212**	**0.700**

(Source: Authors' calculations from data in the 2004 North West Province Social Accounting Matrix)

Table 7.3: Specification of simulations in UPGEM

SAM Sector	V4BAS (Exports)	Current S_{jt} in UPGEM	Greater Diversification (a)	New S_{jt}	Alternative Diversification Scenario (b)	New S_{jt}	Greater Specialisation (a)	New S_{jt}	Alternative Specialisation Scenario (b)	New S_{jt}
1 Agriculture	6,630	0.025	0.008	0.035	0.028	0.025	0.048	0.015	0.048	0.015
2 Goldmining	26,303	0.054	0.040	0.019	0.110	0.054	0.116	0.057	0.175	0.086
3 OtherMining	41,176	0.077	0.081	0.032	0.171	0.077	0.181	0.082	0.241	0.112
4 FoodPrcsing	7,664	0.013	0.032	0.013	0.032	0.013	0.027	0.011	0.032	0.013
5 Beverages	369	0.003	0.003	0.002	0.004	0.002	0.002	0.003	0.002	0.003
6 Tobacco	335	0.001	0.002	0.001	0.003	0.000	0.001	0.001	0.001	0.001
7 Textiles	2,366	0.003	0.008	0.002	0.010	0.003	0.005	0.000	0.010	0.003
8 Clothing	2,084	0.017	0.014	0.014	0.017	0.013	0.009	0.017	0.009	0.017
9 Leather	1,429	0.001	0.006	0.002	0.006	0.002	0.006	0.001	0.006	0.001
10 Footwear	205	0.005	0.001	0.004	0.002	0.004	0.001	0.005	0.001	0.005
11 Wood	2,972	0.003	0.012	0.003	0.018	0.000	0.007	0.006	0.012	0.003
12 Paper	6,143	0.003	0.024	0.002	0.026	0.003	0.026	0.003	0.026	0.003
13 PrintPublsh	633	0.003	0.005	0.002	0.007	0.001	0.003	0.003	0.003	0.003
14 Chemicals	25,152	0.001	0.039	0.032	0.105	0.001	0.171	0.034	0.105	0.001
15 Rubber	1,073	0.002	0.007	0.000	0.008	0.000	0.004	0.002	0.004	0.002
16 Plastic	1,209	0.008	0.008	0.007	0.014	0.004	0.005	0.008	0.005	0.008
17 NMtlMinrals	1,916	0.001	0.008	0.001	0.008	0.001	0.008	0.001	0.008	0.001
18 BasMetalPrd	29,597	0.046	0.053	0.011	0.123	0.046	0.189	0.079	0.123	0.046
19 FabMetalPrd	4,328	0.015	0.023	0.013	0.048	0.000	0.013	0.018	0.018	0.015
20 Machinery	12,321	0.028	0.051	0.028	0.051	0.028	0.051	0.028	0.051	0.028
21 ElecMchinry	6,922	0.094	0.029	0.094	0.083	0.067	0.029	0.094	0.029	0.094
22 TranspEquip	18,580	0.022	0.077	0.022	0.077	0.022	0.077	0.022	0.077	0.022
23 OthManufact	7,992	0.040	0.033	0.040	0.093	0.010	0.033	0.040	0.033	0.040
24 Electricity	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25 Building	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26 CivilEngrng	1,701	0.004	0.007	0.004	0.008	0.004	0.002	0.001	0.007	0.004
27 Trade	294	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
28 AccommCater	9,909	0.021	0.039	0.020	0.041	0.021	0.041	0.021	0.041	0.021
29 Transport	1,682	0.004	0.007	0.004	0.007	0.004	0.002	0.001	0.007	0.004
30 Communcaton	149	0.000	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.000
31 FinancServs	12,491	0.026	0.050	0.025	0.052	0.026	0.052	0.026	0.052	0.026
32 CommunServs	6,569	0.014	0.025	0.013	0.027	0.014	0.022	0.011	0.027	0.014
Total	**240194.406**	**0.533**	**0.695**	**0.444**	**1.182**	**0.444**	**1.134**	**0.590**	**1.155**	**0.590**

(Source: Authors' calculations from data in the 1998 Social Accounting Matrix)

Table 7.2 and 7.3 show the various sectors' exports in the 2004 North West Province SAM and 1998 StatsSA national SAM in column 2. Based on these a measure of export diversification, S_{jt} (see equation 6.3) was calculated which is shown in column 3. Column 4 shows the situation under the first scenario where the export basket is now more diversified. The corresponding S_{jt} (diversification measure) is calculated in column 5 and shows that export diversification has improved as the S_{jt} measure decline in overall value from 0.624 in the base year to 0.562 in the simulation at the regional level, and from 0.533 in the base year to 0.444 at the national level. This is a level below that of the Free State Province/China and would be reflective of significant export diversification for the region/country. An alternative diversity scenario is shown in column 6 where export diversity is modelled with no negative demand shocks applied to any of the sectors in the model. The corresponding S_{jt} measure is calculated in column 7 and yields the same result as in the first scenario. In column 8 the situation with respect to export shares is shown where the export basket is now overall more specialised relative to the base year. Column 9 calculates the S_{jt} measure which indicates that export specialisation has increased overall with a S_{jt} of 0.700 compared to 0.624 in the base case at the regional level, and 0.590 compared to 0.533 at the national level. Columns 10 and 11 represent a more resource-based specialisation scenario. This is calculated as an alternative to the previous scenario.

A comparison of the four scenarios and the closure rules under which each are implemented are contained in Table 7.4 and 7.5 below.

The results of applying the shocks to exports implied in scenarios 1a, 1b, 2a, and 2b in Table 7.2 and 7.3 are discussed and compared in subsection 7.2.3 below.

Table 7.4: Differences between policy scenarios 1a, 1b, 2a, and 2b

Scenarios	Model	Policy interventions incorporated	Policy data used	Policy conclusions	Closure	Variable(s) shocked
Scenario 1a	NWPGEM	Simulation experiment to evaluate the economy-wide impacts on the North West of greater diversification by generating non-traditional exports and decreasing the level of traditional exports	Simulation experiments and alternative export demand scenarios (shown in table 5.1); no data required	Greater export diversity leads to a 0.13% increase in real GDP, a 0.21% decrease in total employment, a positive trade balance, and higher levels of productivity	DPSV standard shortrun	f4q("*AgricFrstFsh,…, FrntPpPr_NEC* ") = various shocks applied, both positive and negative to result in overall higher degree of export diversification
Scenario 1b	NWPGEM	Simulation experiment to evaluate the economy-wide impacts on the North West of (b) greater diversification by generating non-traditional exports and keeping traditional exports fixed/constant	Simulation experiments and alternative export demand scenarios (shown in table 5.1); no data required	Export diversity with no negative demand shocks leads to a 0.02% increase in real GDP, a0.15% increase in employment, and a positive trade balance	DPSV standard shortrun	f4q("*AgricFrstFsh,…, FrntPpPr_NEC* ") = only positive shocks applied to result in overall higher degree of export diversification.
Scenario 2a	NWPGEM	Simulation experiment to evaluate the economy-wide impacts on the North West of greater specialisation by generating traditional exports and decreasing the level of non-traditional exports	Simulation experiments and alternative export demand scenarios (shown in table 5.1); no data required	Greater specialisation brings about a 0.08% decrease in real GDP, increased employment, a positive trade balance, and lower inflation levels	DPSV standard shortrun	f4q("*AgricFrstFsh,…, FrntPpPr_NEC* ") = various shocks applied, both positive and negative to result in overall higher degree of export specialization.
Scenario 2b	NWPGEM	Alternative specialisation in exports by simply increasing the export shares of mining and agriculture (resource-based specialisation)	Simulation experiments and alternative export demand scenarios (shown in table 5.1); no data required	Resource-based specialisation brings about a 0.30% decrease in real GDP, along with slightly increased employment, higher inflation and a positive trade balance	DPSV standard shortrun	f4q("*AgricFrstFsh,…, FrntPpPr_NEC* ") = only positive shocks applied to result in overall higher degree of export specialization.

(Source: framework adapted from Shoven and Whalley, 1992:88-90)

Table 7.5: Differences between policy scenarios 1a, 1b, 2a, and 2b

Scenarios	Model	Policy interventions incorporated	Policy data used	Policy conclusions	Closure	Variable(s) shocked
Scenario 1a	UPGEM02; de Wet and van Heerden (2002)	Simulation experiment to evaluate the economy-wide impacts on South Africa of greater diversification by generating non-traditional exports and decreasing the level of traditional exports	Simulation experiments and alternative export demand scenarios (shown in table 6); no data required	Greater export diversity leads to a 0.43% increase in real GDP, a 0.67% increase in total employment, a positive trade balance, and higher levels of productivity	DPSV standard shortrun	f4q("*agriculture*,..., *Other manufac*") = various shocks applied, both positive and negative to result in overall higher degree of export diversification
Scenario 1b	UPGEM02; de Wet and van Heerden (2002)	Simulation experiment to evaluate the economy-wide impacts on South Africa of (b) greater diversification by generating non-traditional exports and keeping traditional exports fixed/constant	Simulation experiments and alternative export demand scenarios (shown in table 6); no data required	Export diversity with no negative demand shocks leads to a 1.16% increase in real GDP, increased employment, and a positive trade balance	DPSV standard shortrun	f4q("*agriculture*,..., *Other manufac*") = only positive shocks applied to result in overall higher degree of export diversification.
Scenario 2a	UPGEM02; de Wet and van Heerden (2002)	Simulation experiment to evaluate the economy-wide impacts on South Africa of greater specialisation by generating traditional exports and decreasing the level of non-traditional exports	Simulation experiments and alternative export demand scenarios (shown in table 6); no data required	Greater specialisation brings about a 0.08% decrease in real GDP, decreased employment, a negative trade balance, and higher inflation levels	DPSV standard shortrun	f4q("*agriculture*,..., *Other manufac*") = various shocks applied, both positive and negative to result in overall higher degree of export specialization.
Scenario 2b	UPGEM02; de Wet and van Heerden (2002)	Alternative specialisation in exports by simply increasing the export shares of mining and agriculture (resource-based specialisation)	Simulation experiments and alternative export demand scenarios (shown in table 6); no data required	Resource-based specialisation brings about a 0.21% decrease in real GDP, along with decreased employment, higher inflation and a negative trade balance	DPSV standard shortrun	f4q("*agriculture*,..., *Other manufac*") = only positive shocks applied to result in overall higher degree of export specialization.

(Source: framework adapted from Shoven and Whalley, 1992:88-90)

7.2.3 Results

The results are described and compared under the headings of macro-economic results, sectoral impacts and household impacts.

7.2.3.1 Macro-economic results

In the simulations that were implemented in scenarios 1a, 1b, 2a, and 2b (described in Table 7.4 and 7.5) by shocking the variable *f4q* in the NWPGEM and UPGEM models respectively. This alters the export basket in order to accurately simulate greater diversification and, alternatively, greater specialisation in the North West Province and South African exports. At national and regional level, both diversity scenarios (1a and 1b) result in an increase in real GDP growth, whereas the specialisation scenarios (2a and 2b) cause industries to contract, and imports to increase — with an overall negative impact on GDP.

Table 7.6 and 7.7 summarise the impacts of the four scenarios on the main macro-economic variables at both national and regional level. Columns two and four of the tables contain the results of greater diversification and greater specialisation in exports respectively, whereas columns three and five hold the results of both alternative scenarios for diversification/specialisation. It should be recalled, from the empirical evidence and argument put forward in section 6.4.1 in Chapter 6, that greater export diversification can be expected to be generally associated with faster growth. This is evident from the difference in the percentage change in real GDP of the diversity and specialisation scenarios (0.13 and 0.02 per cent increase regionally and 0.43 and 1.16 per cent increase nationally with greater diversity, compared to a decrease of 0.08 and 0.30 per cent regionally and 0.08 and 0.21 nationally with more specialisation). However, these simulations were performed using a short-run comparative static closure and do not imply that greater export diversity will improve long-term growth.

It should be noted that although the two export scenarios are implemented over a period of 1 year, the impact is simulated as a once-off event that plays itself out over a period of about 2-3 years. The results are then annualised and the impact can therefore be discounted back to reflect annual adjustments

over the 1-year period. From Table 7.6 and 7.7 it is evident that real GDP growth increases under both diversity scenarios on an annualised basis, though the increase is more significant under the scenario of greater export diversity including negative demand shocks at the regional level and, conversely under the scenario of greater export diversity with no negative demand shocks at the national level (regionally, 0.13 per cent compared to 0.02 and nationally, 1.16 per cent compared to 0.43 under scenario 1a).

Table 7.6: Impact on macro-economic variables (% change relative to the base case)

Annualised % Change	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
% Δ in real GDP* (x0gdpexp)	0.13	0.02	-0.08	-0.30
% Δ in aggregate employment (employ_io)	-0.21	0.15	0.20	0.01
% Δ in GDP price index (p0gdpexp)	0.53	1.00	0.45	1.22
% Δ in consumer prices (p3tot_h)	0.60	0.68	-0.07	0.61
% Δ in average nominal wage (avewage)	0.60	0.68	-0.07	0.61
% Δ in exports price index (p4tot)	0.10	0.53	0.71	1.09
% Δ in total supplies of imported goods (x0imp_c)	0.52	1.51	0.34	0.91
% Δ in export volume (x4tot)	0.95	1.73	0.04	0.48
% Δ in Import volume CIF (x0cif_c)	0.52	1.51	0.33	0.89
% Δ in competitiveness (p0realdev)	-0.52	-0.99	-0.45	-1.20
% Δ in (Balance of Trade)/GDP (change) (delB)	0.13	0.02	-0.08	-0.30
% Δ in the terms of trade (p0toft)	0.10	0.53	0.71	1.09

*(*Real GDP from expenditure side) (Source: NWPGEM model results)*

Table 7.7: Impact on macro-economic variables (% change relative to the base case)

Annualised % Change	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
% Δ in real GDP* (x0gdpexp)	0.43	1.16	-0.08	-0.21
% Δ in aggregate employment (employ_iop)	0.67	2.54	-0.28	-0.48
% Δ in GDP price index (p0gdpexp)	1.85	2.68	2.25	1.92
% Δ in consumer prices (p3tot)	2.76	2.17	1.66	1.00
% Δ in average nominal wage (p1lab_iop)	2.76	2.17	1.66	1.00
% Δ in exports price index (p4tot)	-1.53	2.15	2.56	3.22
% Δ in total supplies of imported goods (x0imp)	2.09	3.99	2.46	1.22
% Δ in export volume (x4tot)	3.19	7.03	1.94	0.45
% Δ in Import volume CIF (x0cif_c)	2.09	3.99	2.46	1.22
% Δ in competitiveness (p0realdev)	-1.81	-2.61	-2.20	-1.88
% Δ in contribution of balance of trade to real GDP (contBOT)	0.43	1.16	-0.08	-0.21
% Δ in the terms of trade (p0toft)	-1.53	2.15	2.56	3.22

*(*Real GDP from expenditure side) (Source: UPGEM model results)*

The reason for the more favourable effects of scenario 1a and 1b (greater export diversification) on GDP growth is due to higher overall exports and a more substantial improvement in the trade balance. Conversely, scenario 2a and 2b show less favourable effects on GDP growth resulting from deterioration

in the trade balance. In these results changes in relative consumer prices and their impacts on competitiveness are important. Changes in competitiveness will affect foreign export demands and domestic demands for imports. As can be seen from Table 7.6 and 7.7, an improvement in the terms of trade of 0.10 per cent (scenario 1a) results in an increase in consumer prices. Similar results are observed for the other scenarios. Together with the labour intensity of production in the resource based sectors relative to the traded-goods production which is crowded out through greater diversity, explains the decrease in employment under scenario 1 of the regional results.

In the simulated scenarios greater export diversification results in a more substantial increase in exports (3.19 and 7.03 per cent national and 0.95 and 1.73 per cent regional) than in the case of greater export specialisation (1.94 and 0.45 per cent national and 0.04 and 0.48 per cent). This requires a fall in export prices (*p4tot*) and leads to an increase in imports in scenario 1a, although the net result is of an improvement in the trade balance. Movements in the trade balance occur due to activity effects and relative price effects in the model.

If the North West Province were to specialise in mining exports, such exports would need to grow or increase from the base year by approximately 78 per cent (with no increase in the export demand for other sectors) to result in the same level of growth of total export volumes as under scenario 1a. If at the national level South Africa were to specialise in mining exports, the percentage increase from the base year would need to be approximately 300 per cent.

Another reason for the higher imports in scenario 1 is a substitution away from domestically produced goods and towards imports as consumer prices increase. In contrast, under scenario 2, with a fall in consumer prices and an increase in competitiveness, import levels fall.

The simulation results also indicate that employment levels will increase with greater diversity (with the exception of scenario 1a under the regional results – which may be explained through the adverse effects of greater diversity on the resource-based sectors) and decrease with more specialisation. Once again, the increase is more significant under scenario 1b, which can be attributed to the higher level of exports resulting from greater export diversity and because no negative demand shocks were applied.

Table 7.6 and 7.7 also show an increase in inflation under all scenarios, except for 2a, though the increase is more significant with greater export diversity at national level, whereas the increase is more or less the same in scenarios 1a, 1b and 2b at the regional level. The price increase experienced is due to increases in the average nominal wage. The price level of goods and services (*p3tot* and *p3tot_h*), and nominal wages (*p1lab_iop* and *avewage*) both increase by more than 2 per cent with greater diversification, and increases by less than 2 per cent with greater specialisation at the national level, but increase by approximately 0.60 per cent for scenarios 1a, 1b, and 2b at the regional level. The change in the general level of prices is mainly due to changes in the terms of trade, and the fact that real wages are held constant in the model closure, which forces nominal wages to decline with the same amount.

7.2.3.2 Sectoral impacts

Tables 7.8 – 7.15 set out the sectoral impacts for scenarios 1a, 1b, 2a, and 2b respectively at both national and regional level.

Production volumes under scenarios 1a and 1b are higher by approximately 1.62 and 2.82 per cent respectively for the North West Province and, by approximately 1.97 and 3.89 per cent respectively for South Africa, with increased production in most of the sectors (see Tables 7.8 – 7.11). The basis for the overall improvement in production levels throughout the economy is owing to greater overall export volumes resulting from the diversification of exports. Export growth was thus the main contributor to the biggest gainers, who also experienced an increase in employment levels resulting from greater diversity. With some exceptions, the most trade-exposed did best. Scenarios 2a and 2b result in decreased levels of production of -0.36 and 0.12 per cent respectively for the North West Province and, -1.53 and -0.59 per cent respectively for South Africa, mainly owing to decreased export volumes experienced by the majority of sectors resulting from greater specialisation in only a few sectors. The basis for slight increase of 0.12 per cent in production levels with greater specialisation is owing to fact that the increased production experienced in the resource based sectors has greater impact on overall productivity. This is mainly due to the larger contribution of the mining sectors in SAM database (contributing approximately 51 per cent of value added in 2004).

Table 7.8: Sector results for scenario 1a (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp_c)	Price (p0imp)	Volume (employ_o)	Price (p1lab_o)
1	AgricFrstFsh	-0.98	-3.32	-4.00	-3.22	-0.91	0.00	-4.18	0.60
2	PlatnmMining	-0.61	-0.18	-0.62	-0.10	0.96	0.00	-1.12	0.60
3	GoldUranMing	-0.50	-0.23	-0.64	-0.11	0.19	0.00	-0.95	0.60
4	OtherMining	-0.09	0.00	-0.08	0.03	0.85	0.00	-0.33	0.60
5	Food_Bev_Tbc	3.16	5.09	39.49	4.73	1.43	0.00	9.50	0.60
6	TextClLtFtwr	9.56	4.54	57.63	4.18	2.07	0.00	15.64	0.60
7	Wood_Prodcts	9.56	3.73	43.67	3.29	2.82	0.00	14.44	0.60
8	PetrChemRub	7.28	2.42	24.81	2.07	0.70	0.00	17.50	0.60
9	OthNonMetMin	-0.35	-0.07	-0.30	0.10	-0.16	0.00	-1.17	0.60
10	MetalProdcts	-7.27	-2.63	-15.87	-2.24	-1.83	0.00	-14.93	0.60
11	ElctrMachnry	11.90	6.34	47.70	6.28	1.70	0.00	18.93	0.60
12	ElcSndMedEqp	15.05	4.86	32.69	4.55	0.89	0.00	35.70	0.60
13	TranspEquipm	-0.41	0.07	-0.21	0.07	0.02	0.00	-0.74	0.60
14	FrntPpPr_NEC	-0.24	-0.02	0.05	-0.02	-0.01	0.00	-0.67	0.60
15	ElctGasSteam	-0.14	0.11	-0.33	0.11	-0.02	0.00	-0.36	0.60
16	Water	-0.15	-0.01	0.04	-0.01	0.09	0.00	-0.50	0.60
17	Construct	-0.64	-0.11	0.32	-0.11	-1.50	0.00	-1.19	0.60
18	TradeRetWS	0.07	0.66	-1.96	0.66	0.92	0.00	0.16	0.60
19	Accom	0.04	0.37	-1.10	0.37	1.15	0.00	0.19	0.60
20	TransptServ	-0.11	0.34	-1.02	0.34	1.49	0.00	-0.27	0.60
21	PostTelec	-0.15	0.19	-0.56	0.19	3.61	0.00	-0.49	0.60
22	Finance_Ins	-0.21	0.15	-0.44	0.15	0.04	0.00	-0.44	0.60
23	RealEstate	-0.06	-0.27	0.81	-0.27	1.04	0.00	-1.12	0.60
24	OtherBus	-0.25	0.33	-1.00	0.33	0.50	0.00	-0.50	0.60
25	GenGovnmt	-0.35	0.38	-1.14	0.38	0.70	0.00	-0.40	0.60
26	HealthSocial	-0.30	0.54	-1.59	0.54	1.10	0.00	-0.63	0.60
27	OtherNEC	0.06	0.05	-0.15	0.05	0.73	0.00	0.08	0.60
	Industry Average	**1.62**	**0.86**	**8.01**	**0.83**	**0.69**	**0.00**	**3.04**	**0.60**

(Source: NWPGEM model results)

Table 7.9: Sector results for scenario 1a (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp)	Price (p0imp)	Volume (employ_op)	Price (p1lab_op)
1	Agriculture	0.33	4.52	4.77	4.46	8.57	0.00	1.16	2.76
2	Gold mining	-19.40	-14.07	-19.44	-13.54	-29.96	0.00	-24.44	2.76
3	Other mining	-4.03	-10.50	-9.29	-10.10	-13.94	0.00	-8.95	2.76
4	Food processing	0.54	3.20	10.05	3.19	5.45	0.00	1.04	2.76
5	Beverages	1.08	3.88	78.14	3.68	9.51	0.00	4.22	2.76
6	Tobacco	1.10	3.90	81.81	4.19	11.02	0.00	4.29	2.76
7	Textiles	18.31	3.32	64.31	3.44	11.64	0.00	23.08	2.76
8	Clothing	12.14	2.94	75.18	2.93	8.99	0.00	13.99	2.76
9	Leather	6.42	2.81	11.72	2.80	7.43	0.00	10.27	2.76
10	Footwear	2.55	2.55	79.22	2.49	5.89	0.00	4.12	2.76
11	Wood	1.62	2.84	11.66	2.81	3.80	0.00	2.13	2.76
12	Paper	3.12	3.32	9.52	3.31	5.69	0.00	6.73	2.76
13	Printing and publishing	1.58	2.98	53.01	2.98	3.34	0.00	2.58	2.76
14	Chemicals	3.25	2.48	11.02	2.47	4.10	0.00	8.43	2.76
15	Rubber	8.60	4.74	50.02	4.75	4.37	0.00	18.11	2.76
16	Plastic	13.91	3.37	94.73	3.55	7.48	0.00	17.59	2.76
17	Non-metallic minerals	1.95	2.15	14.65	2.14	4.62	0.00	3.88	2.76
18	Basic metal products	-15.32	-4.55	-25.51	-4.49	-7.91	0.00	-30.90	2.76
19	Fabricated metal products	2.23	1.38	21.35	1.39	1.27	0.00	3.64	2.76
20	Machinery	5.93	2.25	14.10	2.26	0.85	0.00	8.85	2.76
21	Electrical machinery	5.23	2.32	17.79	2.32	1.92	0.00	9.27	2.76
22	Transport equipment	3.83	2.17	14.56	2.16	4.26	0.00	5.80	2.76
23	Other manufacturing	1.75	3.60	8.31	3.60	5.44	0.00	6.28	2.76
24	Electricity	-1.65	-0.45	0.00	0.00	0.00	0.00	-5.40	2.76
25	Building	0.12	1.96	0.00	0.00	0.00	0.00	0.19	2.76
26	Civil engineering	3.79	2.77	59.18	2.78	0.00	0.00	6.82	2.76
27	Trade	0.78	3.03	101.29	3.01	0.00	0.00	1.47	2.76
28	Accom and catering	0.81	4.11	5.75	4.22	3.54	0.00	3.36	2.76
29	Transport	-0.09	2.51	12.97	2.52	2.91	0.00	-0.20	2.76
30	Communication	0.81	3.08	99.60	3.06	0.00	0.00	1.86	2.76
31	Financial services	0.69	3.57	8.55	3.54	0.00	0.00	2.12	2.76
32	Communication services	1.18	2.74	12.01	2.73	4.47	0.00	1.40	2.76
	Industry Average	**1.97**	**1.72**	**30.34**	**1.71**	**2.34**	**0.00**	**3.21**	**2.76**

(Source: UPGEM model results)

Table 7.10: Sector results for scenario 1b (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp_c)	Price (p0imp)	Volume (employ_o)	Price (p1lab_o)
1	AgricFrstFsh	-0.15	0.14	-0.47	0.16	0.54	0.00	-0.64	0.68
2	PlatnmMining	-0.71	-0.07	-1.10	0.01	3.59	0.00	-1.30	0.68
3	GoldUranMing	-0.60	-0.12	-0.96	0.01	0.49	0.00	-1.14	0.68
4	OtherMining	-0.23	0.18	-0.62	0.21	2.73	0.00	-0.80	0.68
5	Food_Bev_Tbc	2.01	3.39	25.30	3.18	1.16	0.00	5.92	0.68
6	TextClLtFtwr	1.80	1.17	9.28	1.13	0.49	0.00	2.82	0.68
7	Wood_Prodcts	9.48	3.80	43.33	3.37	3.42	0.00	14.32	0.68
8	PetrChemRub	17.07	6.80	57.97	5.66	1.97	0.00	47.09	0.68
9	OthNonMetMin	-0.49	0.07	-0.75	0.25	0.04	0.00	-1.62	0.68
10	MetalProdcts	-0.89	0.42	-1.37	0.46	-0.02	0.00	-1.98	0.68
11	ElctrMachnry	13.94	7.60	50.11	7.54	5.64	0.00	22.42	0.68
12	ElcSndMedEqp	15.38	5.01	32.10	4.71	1.05	0.00	36.62	0.68
13	TranspEquipm	17.57	4.97	49.78	4.96	1.14	0.00	36.49	0.68
14	FrntPpPr_NEC	3.79	6.11	31.51	6.11	1.23	0.00	11.48	0.68
15	ElctGasSteam	-0.16	0.15	-0.45	0.15	-0.03	0.00	-0.42	0.68
16	Water	-0.07	0.31	-0.91	0.31	0.32	0.00	-0.22	0.68
17	Construct	-0.14	0.51	-1.50	0.51	0.87	0.00	-0.26	0.68
18	TradeRetWS	0.12	0.85	-2.50	0.85	1.66	0.00	0.26	0.68
19	Accom	-0.05	0.31	-0.92	0.31	1.10	0.00	-0.21	0.68
20	TransptServ	-0.14	0.49	-1.45	0.49	4.27	0.00	-0.34	0.68
21	PostTelec	-0.19	0.25	-0.76	0.25	4.27	0.00	-0.60	0.68
22	Finance_Ins	-0.25	0.17	-0.52	0.17	0.09	0.00	-0.53	0.68
23	RealEstate	-0.07	-0.27	0.80	-0.27	2.39	0.00	-1.31	0.68
24	OtherBus	-0.29	0.39	-1.16	0.39	1.00	0.00	-0.57	0.68
25	GenGovnmt	-0.41	0.46	-1.36	0.46	1.85	0.00	-0.48	0.68
26	HealthSocial	-0.35	0.61	-1.81	0.61	2.10	0.00	-0.73	0.68
27	OtherNEC	0.05	0.50	-1.49	0.50	1.87	0.00	0.06	0.68
	Industry Average	**2.82**	**1.64**	**10.37**	**1.57**	**1.68**	**0.00**	**6.09**	**0.68**

(Source: NWPGEM model results)

Table 7.11: Sector results for scenario 1b (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp)	Price (p0imp)	Volume (employ_op)	Price (p1lab_op)
1	Agriculture	-0.21	0.57	-2.42	0.61	1.19	0.00	-0.73	2.17
2	Gold mining	-1.27	0.27	-1.32	0.33	10.39	0.00	-1.88	2.17
3	Other mining	-0.47	0.10	-0.66	0.17	0.21	0.00	-1.18	2.17
4	Food processing	-0.75	1.27	-4.85	1.25	1.97	0.00	-1.44	2.17
5	Beverages	1.57	3.85	98.84	3.71	9.58	0.00	6.20	2.17
6	Tobacco	1.59	3.88	105.95	4.27	11.27	0.00	6.27	2.17
7	Textiles	0.27	1.66	-6.14	1.60	6.88	0.00	0.34	2.17
8	Clothing	13.01	2.34	74.70	2.42	7.63	0.00	15.01	2.17
9	Leather	-1.42	1.36	-2.09	1.36	5.62	0.00	-2.23	2.17
10	Footwear	2.45	1.95	68.87	1.87	4.80	0.00	3.95	2.17
11	Wood	12.67	2.96	33.11	2.77	10.79	0.00	16.90	2.17
12	Paper	-0.97	1.54	-5.78	1.50	3.07	0.00	-2.05	2.17
13	Printing and publishing	4.89	2.89	123.19	3.05	3.32	0.00	8.05	2.17
14	Chemicals	-0.81	1.26	-4.71	1.21	3.01	0.00	-2.05	2.17
15	Rubber	10.31	4.58	58.28	4.61	4.35	0.00	21.86	2.17
16	Plastic	22.08	3.31	145.78	3.20	8.38	0.00	28.12	2.17
17	Non-metallic minerals	-0.34	1.64	-0.41	1.64	3.44	0.00	-0.67	2.17
18	Basic metal products	-1.06	1.45	-5.53	1.43	10.69	0.00	-2.29	2.17
19	Fabricated metal products	18.55	4.94	118.66	5.07	10.85	0.00	31.45	2.17
20	Machinery	-3.97	1.43	-5.40	1.40	0.62	0.00	-5.81	2.17
21	Electrical machinery	35.95	7.61	113.68	7.69	7.17	0.00	68.82	2.17
22	Transport equipment	-3.47	1.30	-4.96	1.28	1.18	0.00	-5.18	2.17
23	Other manufacturing	13.87	16.20	54.66	16.03	21.62	0.00	55.77	2.17
24	Electricity	0.27	2.28	0.00	0.00	0.00	0.00	0.91	2.17
25	Building	0.03	1.98	0.00	0.00	0.00	0.00	0.05	2.17
26	Civil engineering	0.33	2.05	5.22	2.05	0.00	0.00	0.58	2.17
27	Trade	0.49	2.30	-8.69	2.30	0.00	0.00	0.93	2.17
28	Accom and catering	-0.74	0.79	-2.59	0.66	1.31	0.00	-3.03	2.17
29	Transport	0.55	2.21	-7.06	2.21	3.17	0.00	1.22	2.17
30	Communication	0.74	2.61	62.82	2.61	0.00	0.00	1.69	2.17
31	Financial services	0.02	2.18	-8.25	2.18	0.00	0.00	0.07	2.17
32	Communication services	0.38	2.13	-8.04	2.12	4.88	0.00	0.45	2.17
	Industry Average	**3.89**	**2.72**	**30.78**	**2.58**	**4.92**	**0.00**	**7.50**	**2.17**

(Source: UPGEM model results)

Table 7.12: Sector results for scenario 2a (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp_c)	Price (p0imp)	Volume (employ_o)	Price (p1lab_o)
1	AgricFrstFsh	2.04	9.75	9.14	9.49	2.95	0.00	9.73	-0.07
2	PlatnmMining	0.15	0.34	0.06	0.28	-0.32	0.00	0.28	-0.07
3	GoldUranMing	0.22	0.30	0.42	0.22	-0.09	0.00	0.43	-0.07
4	OtherMining	4.97	5.97	8.87	5.71	0.50	0.00	19.86	-0.07
5	Food_Bev_Tbc	-2.74	-3.36	-31.45	-3.11	-0.84	0.00	-7.38	-0.07
6	TextClLtFtwr	0.03	0.02	0.01	0.00	0.01	0.00	0.05	-0.07
7	Wood_Prodcts	0.06	0.03	0.04	-0.01	-0.25	0.00	0.08	-0.07
8	PetrChemRub	-8.59	-1.89	-29.42	-1.58	0.67	0.00	-17.11	-0.07
9	OthNonMetMin	-8.56	-7.92	-22.87	-5.87	1.75	0.00	-23.81	-0.07
10	MetalProdcts	6.92	3.85	14.82	3.35	4.83	0.00	16.93	-0.07
11	ElctrMachnry	-3.27	-1.47	-15.69	-1.46	0.34	0.00	-4.81	-0.07
12	ElcSndMedEqp	0.31	0.07	-0.15	0.05	0.04	0.00	0.63	-0.07
13	TranspEquipm	0.06	0.02	-0.05	0.02	0.00	0.00	0.11	-0.07
14	FrntPpPr_NEC	0.08	0.06	-0.19	0.06	0.02	0.00	0.23	-0.07
15	ElctGasSteam	0.32	0.76	-2.23	0.76	1.52	0.00	0.86	-0.07
16	Water	0.20	0.54	-1.59	0.54	0.50	0.00	0.65	-0.07
17	Construct	-1.38	-1.38	4.26	-1.38	1.71	0.00	-2.55	-0.07
18	TradeRetWS	-0.14	-0.30	0.92	-0.30	-0.72	0.00	-0.30	-0.07
19	Accom	-0.20	-0.35	1.07	-0.35	-1.01	0.00	-0.89	-0.07
20	TransptServ	-0.12	-0.14	0.44	-0.14	-1.37	0.00	-0.28	-0.07
21	PostTelec	0.00	-0.07	0.20	-0.07	-0.51	0.00	0.01	-0.07
22	Finance_Ins	0.01	-0.02	0.07	-0.02	-0.03	0.00	0.02	-0.07
23	RealEstate	0.00	-0.13	0.38	-0.13	-1.08	0.00	0.01	-0.07
24	OtherBus	0.03	-0.11	0.34	-0.11	-0.34	0.00	0.06	-0.07
25	GenGovnmt	0.02	-0.02	0.07	-0.02	-0.31	0.00	0.03	-0.07
26	HealthSocial	0.00	0.33	-0.98	0.33	-0.92	0.00	-0.01	-0.07
27	OtherNEC	-0.18	0.96	-2.83	0.96	-0.12	0.00	-0.22	-0.07
	Industry Average	**-0.36**	**0.22**	**-2.46**	**0.27**	**0.26**	**0.00**	**-0.27**	**-0.07**

(Source: NWPGEM model results)

Table 7.13: Sector results for scenario 2a (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp)	Price (p0imp)	Volume (employ_op)	Price (p1lab_op)
1	Agriculture	0.79	7.07	31.89	6.94	8.74	0.00	2.88	1.66
2	Gold mining	-0.10	1.47	-0.10	1.48	2.99	0.00	-0.15	1.66
3	Other mining	0.05	1.80	-1.44	1.79	8.69	0.00	0.14	1.66
4	Food processing	-3.67	2.44	-21.95	2.43	3.27	0.00	-6.97	1.66
5	Beverages	-0.42	1.28	-4.78	1.23	3.04	0.00	-1.63	1.66
6	Tobacco	-0.42	1.28	-5.09	1.31	3.24	0.00	-1.62	1.66
7	Textiles	-14.99	0.79	-51.82	0.55	-3.00	0.00	-18.31	1.66
8	Clothing	-1.36	1.14	-4.63	1.19	3.33	0.00	-1.55	1.66
9	Leather	-4.54	1.32	-5.12	1.32	0.22	0.00	-7.07	1.66
10	Footwear	-1.42	0.98	-3.84	0.98	2.20	0.00	-2.26	1.66
11	Wood	-14.80	0.52	-41.41	0.43	-2.65	0.00	-19.07	1.66
12	Paper	-2.05	1.12	-4.31	1.11	0.29	0.00	-4.33	1.66
13	Printing and publishing	-0.64	1.24	-3.99	1.02	0.66	0.00	-1.05	1.66
14	Chemicals	8.36	4.91	33.79	5.07	6.11	0.00	22.35	1.66
15	Rubber	-1.88	1.54	-5.77	1.50	0.99	0.00	-3.80	1.66
16	Plastic	-0.89	1.85	-6.91	1.81	2.89	0.00	-1.11	1.66
17	Non-metallic minerals	-1.98	0.87	-3.39	0.87	0.09	0.00	-3.89	1.66
18	Basic metal products	13.23	5.74	22.96	5.71	9.20	0.00	30.55	1.66
19	Fabricated metal products	-5.23	1.15	-30.89	1.12	2.76	0.00	-8.39	1.66
20	Machinery	-3.29	1.23	-4.78	1.23	0.65	0.00	-4.83	1.66
21	Electrical machinery	-2.44	1.11	-4.32	1.11	-0.02	0.00	-4.22	1.66
22	Transport equipment	-2.68	1.00	-3.88	0.99	0.87	0.00	-4.01	1.66
23	Other manufacturing	-0.90	0.62	-2.44	0.62	0.83	0.00	-3.14	1.66
24	Electricity	0.99	2.83	0.00	0.00	0.00	0.00	3.31	1.66
25	Building	-0.12	1.18	0.00	0.00	0.00	0.00	-0.19	1.66
26	Civil engineering	-4.69	0.36	-71.00	0.34	0.00	0.00	-8.24	1.66
27	Trade	-0.29	1.42	-5.49	1.42	0.00	0.00	-0.55	1.66
28	Accom and catering	-0.68	0.55	-1.96	0.50	0.70	0.00	-2.78	1.66
29	Transport	-0.51	1.43	-72.99	1.43	2.54	0.00	-1.13	1.66
30	Communication	-0.27	1.33	-5.16	1.33	0.00	0.00	-0.62	1.66
31	Financial services	-0.26	1.26	-4.91	1.27	0.00	0.00	-0.78	1.66
32	Communication services	-1.95	1.35	-22.44	1.32	1.77	0.00	-2.31	1.66
	Industry Average	**-1.53**	**1.69**	**-9.57**	**1.54**	**1.89**	**0.00**	**-1.71**	**1.66**

(Source: UPGEM model results)

Table 7.14: Sector results for scenario 2b (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp_c)	Price (p0imp)	Volume (employ_o)	Price (p1lab_o)
1	AgricFrstFsh	2.66	14.07	12.13	13.72	4.54	0.00	12.96	0.61
2	PlatnmMining	-0.18	0.31	-0.21	0.30	0.53	0.00	-0.33	0.61
3	GoldUranMing	-0.15	0.34	-0.14	0.32	0.05	0.00	-0.28	0.61
4	OtherMining	4.76	6.08	8.48	5.83	1.36	0.00	18.90	0.61
5	Food_Bev_Tbc	-0.24	0.36	-1.04	0.35	0.34	0.00	-0.69	0.61
6	TextClLtFtwr	-0.39	0.23	-0.68	0.23	0.08	0.00	-0.60	0.61
7	Wood_Prodcts	-0.33	0.28	-0.81	0.27	0.28	0.00	-0.48	0.61
8	PetrChemRub	0.06	0.33	-0.93	0.31	1.45	0.00	0.13	0.61
9	OthNonMetMin	0.02	0.53	-1.33	0.45	4.27	0.00	0.06	0.61
10	MetalProdcts	-0.06	0.31	-0.89	0.30	2.76	0.00	-0.14	0.61
11	ElctrMachnry	-0.37	0.29	-0.86	0.29	0.28	0.00	-0.55	0.61
12	ElcSndMedEqp	-0.15	0.06	-0.21	0.07	-0.01	0.00	-0.31	0.61
13	TranspEquipm	-0.27	0.12	-0.37	0.12	0.03	0.00	-0.48	0.61
14	FrntPpPr_NEC	-0.16	0.08	-0.25	0.08	0.02	0.00	-0.45	0.61
15	ElctGasSteam	0.19	0.93	-2.75	0.93	1.43	0.00	0.49	0.61
16	Water	0.08	0.68	-2.02	0.68	0.51	0.00	0.27	0.61
17	Construct	0.11	0.61	-1.82	0.61	1.55	0.00	0.20	0.61
18	TradeRetWS	-0.17	0.22	-0.65	0.22	-0.18	0.00	-0.38	0.61
19	Accom	-0.15	0.09	-0.27	0.09	0.06	0.00	-0.68	0.61
20	TransptServ	-0.35	0.26	-0.77	0.26	0.24	0.00	-0.84	0.61
21	PostTelec	-0.19	0.09	-0.26	0.09	-0.11	0.00	-0.62	0.61
22	Finance_Ins	-0.24	0.14	-0.42	0.14	-0.05	0.00	-0.51	0.61
23	RealEstate	-0.05	-0.30	0.90	-0.30	0.12	0.00	-1.00	0.61
24	OtherBus	-0.25	0.25	-0.76	0.25	-0.15	0.00	-0.49	0.61
25	GenGovnmt	-0.37	0.42	-1.26	0.42	0.12	0.00	-0.43	0.61
26	HealthSocial	-0.32	0.91	-2.68	0.91	-0.21	0.00	-0.67	0.61
27	OtherNEC	-0.19	1.87	-5.42	1.87	0.19	0.00	-0.23	0.61
	Industry Average	**0.12**	**1.09**	**-0.20**	**1.07**	**0.72**	**0.00**	**0.85**	**0.61**

(Source: NWPGEM model results)

Table 7.15: Sector results for scenario 2b (structural effects)

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp)	Price (p0imp)	Volume (employ_op)	Price (p1lab_op)
1	Agriculture	1.03	7.93	27.99	7.74	11.77	0.00	3.78	1.00
2	Gold mining	5.53	11.19	5.57	10.84	29.21	0.00	9.03	1.00
3	Other mining	1.44	7.76	5.31	7.54	7.50	0.00	3.88	1.00
4	Food processing	-2.27	2.64	-9.97	2.66	3.84	0.00	-4.35	1.00
5	Beverages	-0.31	0.93	-3.54	0.91	2.28	0.00	-1.18	1.00
6	Tobacco	-0.31	0.93	-3.69	0.95	2.38	0.00	-1.18	1.00
7	Textiles	-1.58	0.85	-3.35	0.85	0.24	0.00	-1.96	1.00
8	Clothing	-0.93	0.69	-2.74	0.70	2.07	0.00	-1.06	1.00
9	Leather	-3.05	0.91	-3.51	0.90	0.50	0.00	-4.77	1.00
10	Footwear	-0.64	0.58	-2.29	0.58	1.54	0.00	-1.03	1.00
11	Wood	-2.37	1.44	-5.61	1.45	2.52	0.00	-3.11	1.00
12	Paper	-1.33	0.67	-2.62	0.66	0.06	0.00	-2.81	1.00
13	Printing and publishing	-0.51	0.65	-2.55	0.65	0.37	0.00	-0.82	1.00
14	Chemicals	-1.21	0.73	-2.84	0.72	0.40	0.00	-3.05	1.00
15	Rubber	-0.91	0.78	-3.05	0.78	0.77	0.00	-1.85	1.00
16	Plastic	-1.26	0.66	-2.59	0.66	-0.08	0.00	-1.57	1.00
17	Non-metallic minerals	-1.03	0.80	-3.11	0.79	1.16	0.00	-2.04	1.00
18	Basic metal products	-1.98	0.57	-2.23	0.57	-0.23	0.00	-4.28	1.00
19	Fabricated metal products	-0.93	0.55	-2.17	0.55	0.59	0.00	-1.50	1.00
20	Machinery	-1.38	0.49	-1.92	0.49	0.16	0.00	-2.03	1.00
21	Electrical machinery	-0.89	0.43	-1.71	0.43	0.07	0.00	-1.55	1.00
22	Transport equipment	-1.29	0.47	-1.85	0.47	0.44	0.00	-1.93	1.00
23	Other manufacturing	-0.69	0.39	-1.59	0.40	0.53	0.00	-2.42	1.00
24	Electricity	-0.10	1.08	0.00	0.00	0.00	0.00	-0.32	1.00
25	Building	-0.03	0.76	0.00	0.00	0.00	0.00	-0.04	1.00
26	Civil engineering	-0.08	0.82	-3.26	0.83	0.00	0.00	-0.15	1.00
27	Trade	-0.32	0.74	-2.91	0.74	0.00	0.00	-0.60	1.00
28	Accom and catering	-0.42	0.38	-1.33	0.34	0.56	0.00	-1.73	1.00
29	Transport	-0.22	0.74	-2.89	0.74	0.85	0.00	-0.48	1.00
30	Communication	-0.19	0.71	-2.81	0.72	0.00	0.00	-0.44	1.00
31	Financial services	-0.27	0.58	-2.30	0.58	0.00	0.00	-0.82	1.00
32	Communication services	-0.46	0.84	-3.29	0.84	0.78	0.00	-0.55	1.00
	Industry Average	**-0.59**	**1.55**	**-1.34**	**1.47**	**2.20**	**0.00**	**-1.03**	**1.00**

(Source: UPGEM model results)

Table 7.8 and 7.9 show that under the scenario of greater export diversity, traditional export sectors in both the North West Province and South African economies such as platinum mining, gold mining, other mining, basic metal products, as well as some of the services sectors experience reductions in export volumes. These sectors experienced significant decreases in their export volume (see Table 7.2 and 7.3 for changes in diversification) which are a direct result of the exogenous shocks applied to the model.

The alternative export diversification scenario (see Table 7.10 and 7.11) shows a better overall improvement across all sectors. Once again the traditional export sectors, as well as some of the non-trading sectors, lose out under this scenario even though the overall effect is much more positive than that of scenario 1a.

Tables 7.8 - 7.11 also show that these are the sectors where most jobs are being lost. In the base case, these sectors were more specialised, but with increased diversity they have become less so. The lower levels of output in the electricity and transport sectors, in the national results, are mainly due to capacity constraints (since both sectors produce mainly for the domestic market and are thus less export oriented). Conversely, Table 7.12 - 7.15 show that agriculture, platinum mining, basic metal products, gold and other mining (the more traditional export sectors in both models) are the sectors that benefit the most from greater specialisation, whereas the majority of sectors experience decreased levels of output. This is a direct result of these sectors experiencing increased exports due to greater specialisation. The results in Table 7.8 - 7.11 thus show a more positive economy-wide effect than those in Table 7.12 - 7.15.

The changes in demand for the more traditional trading sectors were decomposed, under all scenarios, between (a) the local market effect (measured as the change in non-export demand for goods and other sectoral outputs), (b) domestic share effect (measured as the change in domestic use/import ratio for the sectors' output demand) and (c) the export effect (measured as a change in demand for goods and output exports). In tables 7.16 – 7.19 the results of this decomposition show that in the case of platinum, gold and other mining under scenario 1a and 2b, changes (negative or positive) in demand come primarily through a change in exports. Export demand changes as the export basket becomes more diversified/specialised.

Table 7.16: Decomposition of demand for locally produced goods (percentage change)

Fanexp (Export Effect)	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
AgricFrstFsh	-1.98	-0.23	4.61	6.14
PlatnmMining	-0.50	-0.88	0.05	-0.17
GoldUranMing	-0.51	-0.76	0.33	-0.11
OtherMining	-0.05	-0.38	5.42	5.18
Food_Bev_Tbc	5.02	3.20	-3.93	-0.13
TextClLtFtwr	17.26	2.72	0.00	-0.20
Wood_Prodcts	10.71	10.62	0.01	-0.20
PetrChemRub	8.13	19.06	-9.55	-0.30
OthNonMetMin	-0.13	-0.33	-10.03	-0.59
MetalProdcts	-6.54	-0.56	6.06	-0.36
ElctrMachnry	14.70	15.35	-4.74	-0.26
ElcSndMedEqp	16.10	15.77	-0.07	-0.10
TranspEquipm	-0.08	19.35	-0.02	-0.14
FrntPpPr_NEC	0.01	7.24	-0.04	-0.06
ElctGasSteam	0.00	0.00	-0.01	-0.01
Water	0.00	0.00	0.00	0.00
Construct	0.00	0.00	0.00	0.00
TradeRetWS	-0.39	-0.49	0.18	-0.13
Accom	-0.46	-0.38	0.45	-0.11
TransptServ	-0.26	-0.37	0.11	-0.20
PostTelec	-0.08	-0.11	0.03	-0.04
Finance_Ins	-0.19	-0.23	0.03	-0.18
RealEstate	0.14	0.14	0.07	0.15
OtherBus	-0.15	-0.17	0.05	-0.11
GenGovnmt	-0.07	-0.08	0.00	-0.08
HealthSocial	-0.01	-0.01	-0.01	-0.02
OtherNEC	0.00	-0.04	-0.07	-0.14

(Source: NWPGEM model results)

Table 7.17: Decomposition of demand for locally produced goods (percentage change)

Fanimp (Import Effect)	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
AgricFrstFsh	2.39	-0.33	-5.83	-8.08
PlatnmMining	-0.18	-0.36	0.13	-0.07
GoldUranMing	-0.10	-0.27	-0.05	-0.07
OtherMining	-0.30	-0.72	-2.40	-2.59
Food_Bev_Tbc	-5.90	-4.15	4.87	-0.31
TextClLtFtwr	-14.36	-2.78	-0.01	-0.03
Wood_Prodcts	-8.42	-8.61	0.12	-0.01
PetrChemRub	-5.95	-12.63	6.82	-1.40
OthNonMetMin	0.07	0.09	5.97	-1.94
MetalProdcts	4.86	0.20	-5.13	-1.00
ElctrMachnry	-9.87	-11.10	3.84	0.03
ElcSndMedEqp	-10.50	-10.71	0.06	0.06
TranspEquipm	-0.11	-11.69	0.03	-0.02
FrntPpPr_NEC	-0.01	-13.81	-0.10	-0.15
ElctGasSteam	0.01	0.02	-0.96	-0.91
Water	-0.09	-0.33	-0.52	-0.53
Construct	0.56	-0.32	-0.64	-0.57
TradeRetWS	0.35	0.43	-0.17	0.11
Accom	-0.05	-0.13	-0.07	0.02
TransptServ	-0.07	-0.53	0.14	0.06
PostTelec	-0.37	-0.43	0.03	0.02
Finance_Ins	0.09	0.09	-0.02	0.10
RealEstate	-0.21	-0.30	0.00	-0.17
OtherBus	0.05	0.01	-0.01	0.09
GenGovnmt	0.04	0.05	0.00	0.05
HealthSocial	-0.02	-0.05	0.03	0.02
OtherNEC	-0.16	-0.37	0.09	0.09

(Source: NWPGEM model results)

Table 7.18: Decomposition of demand for locally produced goods (percentage change)

Fanloc (Local Effect)	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
AgricFrstFsh	-1.34	0.42	3.59	5.21
PlatnmMining	0.06	0.54	-0.03	0.06
GoldUranMing	0.11	0.44	-0.06	0.03
OtherMining	0.26	0.87	2.02	2.24
Food_Bev_Tbc	4.40	3.12	-3.46	0.20
TextClLtFtwr	9.11	1.94	0.04	-0.16
Wood_Prodcts	8.06	8.29	-0.07	-0.13
PetrChemRub	5.49	12.54	-5.40	1.79
OthNonMetMin	-0.29	-0.25	-4.10	2.61
MetalProdcts	-5.38	-0.54	6.26	1.31
ElctrMachnry	8.24	11.12	-2.21	-0.14
ElcSndMedEqp	10.72	11.62	0.33	-0.12
TranspEquipm	-0.23	11.54	0.05	-0.11
FrntPpPr_NEC	-0.24	12.29	0.23	0.05
ElctGasSteam	-0.15	-0.18	1.31	1.11
Water	-0.06	0.26	0.72	0.61
Construct	-1.19	0.18	-0.74	0.69
TradeRetWS	0.11	0.18	-0.15	-0.15
Accom	0.55	0.47	-0.57	-0.06
TransptServ	0.22	0.76	-0.37	-0.22
PostTelec	0.30	0.36	-0.06	-0.18
Finance_Ins	-0.11	-0.11	-0.01	-0.15
RealEstate	0.02	0.10	-0.07	-0.03
OtherBus	-0.15	-0.13	-0.02	-0.23
GenGovnmt	-0.32	-0.38	0.02	-0.35
HealthSocial	-0.27	-0.29	-0.03	-0.33
OtherNEC	0.22	0.46	-0.21	-0.15

(Source: NWPGEM model results)

Table 7.19: Decomposition of demand for locally produced goods (percentage change)

SCENARIO 1a Fandecomp	LocalMarket	DomShare	Export	Total
Goldmining	0.01	0.00	-19.35	-19.34
OtherMining	-0.55	3.32	-6.86	-4.09
FoodPrcsing	0.10	-0.77	1.22	0.55
Beverages	-0.26	-0.87	2.13	1.00
Tobacco	-0.10	-0.83	2.19	1.26
SCENARIO 1b **Fandecomp**	**LocalMarket**	**DomShare**	**Export**	**Total**
Plastic	3.57	-1.07	19.24	21.74
NMtlMinrals	0.59	-0.88	-0.06	-0.35
BasMetalPrd	2.93	-0.41	-3.57	-1.06
FabMetalPrd	0.97	-2.40	19.88	18.45
Machinery	0.01	-0.91	-2.86	-3.76
SCENARIO 2a **Fandecomp**	**LocalMarket**	**DomShare**	**Export**	**Total**
Textiles	-2.08	0.10	-13.02	-14.99
Clothing	-0.01	-0.84	-0.88	-1.73
Leather	-0.47	-0.76	-3.33	-4.56
Footwear	0.15	-1.28	-0.29	-1.42
Wood	-2.28	-0.14	-12.44	-14.85
SCENARIO 2b **Fandecomp**	**LocalMarket**	**DomShare**	**Export**	**Total**
Agriculture	-1.51	-1.29	3.87	1.07
Goldmining	0.00	0.00	5.54	5.54
OtherMining	-0.28	-2.18	3.92	1.46
FoodPrcsing	-0.39	-0.62	-1.21	-2.22
Beverages	-0.02	-0.21	-0.10	-0.33

(Source: UPGEM model results)

7.2.3.3 Household impacts

Tables 7.20 and 7.21 summarise the differential impacts of export diversification/specialisation on households. The 2004 North West Province SAM used as basis for the model divides households into 12 income groups or deciles (see Chapter 5). Table 7.11 shows how these households' consumption (a rough measure of their welfare) is affected by either greater export diversification/specialisation. It shows the lower income households to suffer significantly reduced consumption under scenarios 1a, 1b and 2b, but increase their consumption levels significantly in scenario 2a which is a direct result of these households being employed in the more resource-based sectors and thus benefiting from the greater specialisation. The remaining households experience marginal changes in their consumption levels.

Table 7.20: Percentage change in real household consumption (percentage change)[30]

Households (x3tot)	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
P1	-38.30	-42.37	16.97	-15.87
P2	-0.38	-0.43	0.17	-0.16
P3	-0.54	-0.60	0.25	-0.21
P4	-0.51	-0.56	0.24	-0.20
P5	-0.60	-0.69	0.28	-0.23
P6	-0.55	-0.63	0.26	-0.21
P7	-0.52	-0.61	0.23	-0.20
P8	-0.43	-0.51	0.19	-0.17
P9	-0.26	-0.32	0.12	-0.10
P10	-0.23	-0.28	0.11	-0.09
P11	-0.69	-0.86	0.32	-0.25
P12	-0.13	-0.15	0.06	-0.04

(Source: NWPGEM model results)

In terms of nominal total consumption, table 7.21 shows that the poorer households, once again experience quite adverse changes in consumption.

Table 7.21: Percentage change in nominal total household consumption (1a)

w3tot (quintiles)	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
P1	-37.83	-41.87	16.32	-15.48
P2	0.60	0.54	-0.21	0.41
P3	0.47	0.34	-0.13	0.36
P4	0.42	0.32	-0.07	0.37
P5	0.27	0.17	0.02	0.35
P6	0.31	0.20	-0.01	0.34
P7	0.31	0.20	0.00	0.35
P8	0.36	0.27	-0.01	0.36
P9	0.43	0.40	-0.03	0.44
P10	0.39	0.38	-0.02	0.40
P11	-0.10	-0.18	0.16	0.22
P12	0.16	0.35	0.27	0.70

(Source: NWPGEM model results)

Table 7.21 shows that greater diversification has a large effect on the distribution of real consumption. This variation across households is explained primarily by the effect of the change in the employment prospects of these households. For example, low-income households, which experience the largest increases in consumption under both the greater diversity and specialisation scenarios, are relatively heavily concentrated in the agriculture and mining sectors, which are adversely affected under all 4 scenarios.

[30] All forecasts and predictions contained in this thesis are believed to be as accurate as the data and the methodologies will allow.

Conversely, the higher income households are less adversely affected, mainly due to these households not being affected by changes in the more resource based sectors.

Tables 7.22 to 7.26 summarise the differential impacts of export diversification/specialisation on households at the national level. The 1998 SAM used as basis for the model makes a distinction between White (W), Coloured (C), Asian (A) and Black (B) households (see Statistics South Africa, 2004; 2002). Table 7.22 shows how these households' consumption (a rough measure of their welfare) is affected by either greater export diversification/specialisation. It shows Black households to suffer somewhat reduced consumption under scenarios 1a, 1b, and 2a, but increase their consumption levels in scenario 2b which is a direct result of the large increase in employment in the more labour intensive sectors of agriculture and mining. White households suffer somewhat reduced consumption under scenarios 1b and 2b, whereas Coloured and Asian households increase their consumption levels with greater diversity, but experience decreased consumption with greater specialisation. These changes in consumption are mainly driven by changes in the consumer price index faced by each household (which depends on its consumption basket) and incomes, which result from its share of unskilled labour. White households experience increased consumption under a scenario with greater specialisation in exports, with Coloured, Asian and Black households experiencing reduced consumption. Conversely, these changes in consumption are driven by both changes in consumer prices as well as decreased levels of employment in the more labour intensive sectors.

Table 7.22: Percentage change in real household consumption by population group (percentage change)

	Households (x3tot_h)	SCENARIO 1a	SCENARIO 1b	SCENARIO 2a	SCENARIO 2b
1	White	0.02	-0.42	0.65	-0.03
2	Coloured	2.46	2.13	-1.08	-0.60
3	Asian	2.69	1.16	-0.70	-0.65
4	Black	-0.78	-0.08	-0.42	0.22

(Source: UPGEM model results)

In terms of nominal total consumption, table 7.23 and 7.24 show that Coloured and Asian households gain proportionally more than others from the greater export diversity. In contrast, in Table 7.25 and 7.26, White and Black households gain proportionally more than others from greater specialisation.

Table 7.23: Percentage change in nominal total household consumption (1a)[31]

w3totx (quintiles)	w	C	A	B
q1	2.76	5.34	5.56	1.98
q2	2.76	5.34	5.56	1.98
q3	2.76	5.34	5.56	1.98
q4	2.76	5.34	5.56	1.98
d9	2.76	5.34	5.56	1.98
d10	2.76	5.34	5.56	1.98

(Source: UPGEM model results)

Table 7.24: Percentage change in nominal total household consumption (1b)

w3totx (quintiles)	w	C	A	B
q1	1.86	4.27	3.33	1.99
q2	1.86	4.27	3.33	1.99
q3	1.86	4.27	3.33	1.99
q4	1.86	4.27	3.33	1.99
d9	1.86	4.27	3.33	1.99
d10	1.86	4.27	3.33	1.99

(Source: UPGEM model results)

Table 7.25: Percentage change in nominal total household consumption (2a)

w3totx (quintiles)	w	C	A	B
q1	2.23	0.70	0.91	1.32
q2	2.23	0.70	0.91	1.32
q3	2.23	0.70	0.91	1.32
q4	2.23	0.70	0.91	1.32
d9	2.23	0.70	0.91	1.32
d10	2.23	0.70	0.91	1.32

(Source: UPGEM model results)

Table 7.26: Percentage change in nominal total household consumption (2b)

w3totx (quintiles)	w	C	A	B
q1	0.80	0.53	0.29	1.37
q2	0.80	0.53	0.29	1.37
q3	0.80	0.53	0.29	1.37
q4	0.80	0.53	0.29	1.37
d9	0.80	0.53	0.29	1.37
d10	0.80	0.53	0.29	1.37

(Source: UPGEM model results)

[31] The reason for the percentage changes per group being the same across quintiles may be attributed to the x3tot (real private consumption expenditure), q (number of households), and a3_s (consumption preferences of households) variables being exogenous in the shortrun closure.

Tables 7.23 and 7.24 show that greater diversification has quite a large effect on the distribution of real consumption. Similarly, Tables 7.25 and 7.26, show that there is some variation across households in the effects of the increase in consumption price indices that comes with greater specialisation. This variation across households is explained primarily by the effect of the change in the employment prospects of the households. For example, low-income Asians, which experience the smallest increases in consumption under the specialisation scenarios, are relatively heavily concentrated in the textile sector, a sector which is adversely affected by greater specialisation. Conversely, with greater diversification, the opposite is true. On the other hand, with improved diversity, high-income Coloureds, which experience the largest increases in consumption (see Table 7.23 and 7.24), are relatively heavily concentrated in the former non-traded sectors which gain from greater diversity.

The following section explains the importance and impact of the exchange rate and trade policy on regional export performance.

7.3 IMPACT OF THE EXCHANGE RATE ON REGIONAL EXPORTS

In an increasingly globalised world, exports are an important component of a country/region's economic policy. For those active in designing policy it is important to understand how these exports respond to price and exchange rate changes. Knowing the magnitude of the response (or elasticity) of export quantity to price changes helps to identify potentially successful policies. For example, if exports are unresponsive to price changes (or inelastic), then policies which target prices in an attempt to encourage exports will fail to achieve their goal (Rankin, 2002).

As a small and open economy the North West Province is significantly affected by external influences. These external influences include world demand, the terms of trade, migration flows, and the exchange rate. With South Africa's exchange rate exhibiting fairly substantial cycles and with it being currently near its previous cyclical peak it is important to understand how the exchange rate will affect the future path of the economy. This section therefore examines how exports from the North West Province are affected by changes in the exchange rate.

Therefore, the question that is evaluated in this section is what would the impact be of an exchange rate devaluation/appreciation on various sectors of the North West Province economy, given the province's dependence on exported minerals? The simulations performed and discussed in this section are for illustrative purposes only.

7.3.1 Views and effect of exchange rates

There exist two different views of the determination of exchange rates that explain the roles that exchange rates play in the real economy and financial markets. The first is the elasticities view of the exchange rate and the second, the asset view of the exchange rate (Cameron, 1998).

In the elasticities view (or balance of payments approach) the exchange rate is determined by the flow of currency through the foreign exchange market with the focus on the trade account. It is assumed that home and foreign exporters are paid in their respective domestic currencies. "*Exports of the home goods give rise to a supply of foreign exchange as foreigners buy domestic currency in order to make payments to the home country's exporters. Imports by the home country give rise to demand for foreign exchange so as to be able to pay the foreign country's exporters in the exporters' own currency*" (Cameron, 1998:40).

The stability of the exchange rate depends on the elasticity of demand for goods in foreign trade. The Marshall-Lerner condition states that the foreign exchange market is stable if the sum of the export elasticities of demand (home and foreign) is greater than unity (Naudé, 2006). That means that if the Marshall-Lerner condition holds, there is excess demand for foreign exchange when the exchange rate is below the equilibrium value and excess supply when it is above the equilibrium rate.

The Marshall-Lerner case is one of infinite supply elasticities, but it is possible to generalise this to derive the conditions for trade balance improvement when supply elasticities are less than infinite. Assuming that trade is balanced to begin with, depreciation will improve the balance of payments (and the exchange market is stable) if,

$$\frac{s_x(d_x - 1)}{s_x + s_m} + \frac{d_m(s_m + 1)}{d_m + s_m} > 0 \qquad (7.1)$$

where s_x and s_m are, respectively, the home and foreign export supply elasticities and d_m and d_x are, respectively the absolute values of the home and foreign import demand elasticities. The first term measures the proportionate increase in the depreciating country's export earnings and the second term measures the increase in spending on imports. "*The more elastic the domestic supply of exports, the greater will be the improvement in export earnings and the payments balance following a depreciation. However, if the demand for exports is inelastic (which it may very well be in the short run) then depreciation reduces export earnings more, the more elastic is domestic supply*" (Cameron, 1998:42).

This shows the importance of the time path – while exchange rates adjust instantaneously, the price of goods and demand change only after a lag. Thus, if a country/region is running a trade deficit the first effect of a depreciation at time *t* may be to make the deficit larger.

Following a depreciation, if imports are bought at world prices and home demand is price inelastic, there will be little change in foreign currency expenditure in response to higher prices in terms of domestic currency. Export receipts in foreign currency may drop unless the home currency price of exports is raised by the full extent of the depreciation. If no such adjustment takes place, the price of exports in foreign currency will fall and if foreign demand is inelastic – which it may be on impact – receipts of foreign currency will fall. The combination of increased expenditure and reduced receipts will cause the trade balance to deteriorate. Short- and long-run price elasticities thus clearly play an important role in transmitting changes in exchange rates to the economy (Cameron, 1998).

This short overview of the elasticities view of the exchange rate shows how the exchange rate may be determined by the flow of currency through the foreign exchange market. Change is in the exchange rate affect the economy through changes in the prices of imports and exports. The impacts of such changes depend on the elasticities of demand for goods in foreign trade.

An alternative approach is the asset view of the exchange rate. In the more modern, asset view of the exchange rate, the exchange rate is treated as the price of an asset – the relative price of two monies. The exchange rate is determined at the level where wealth-holders with internationally diversified portfolios are willing to hold outstanding stocks of monies (Cameron, 1998). This view does not, however,

need to be discussed further at any length since RAGE models typically do not include a financial sector and rather subscribe to the elasticities view of the exchange rate.

7.3.2 Modelling the impact of exchange rate variations

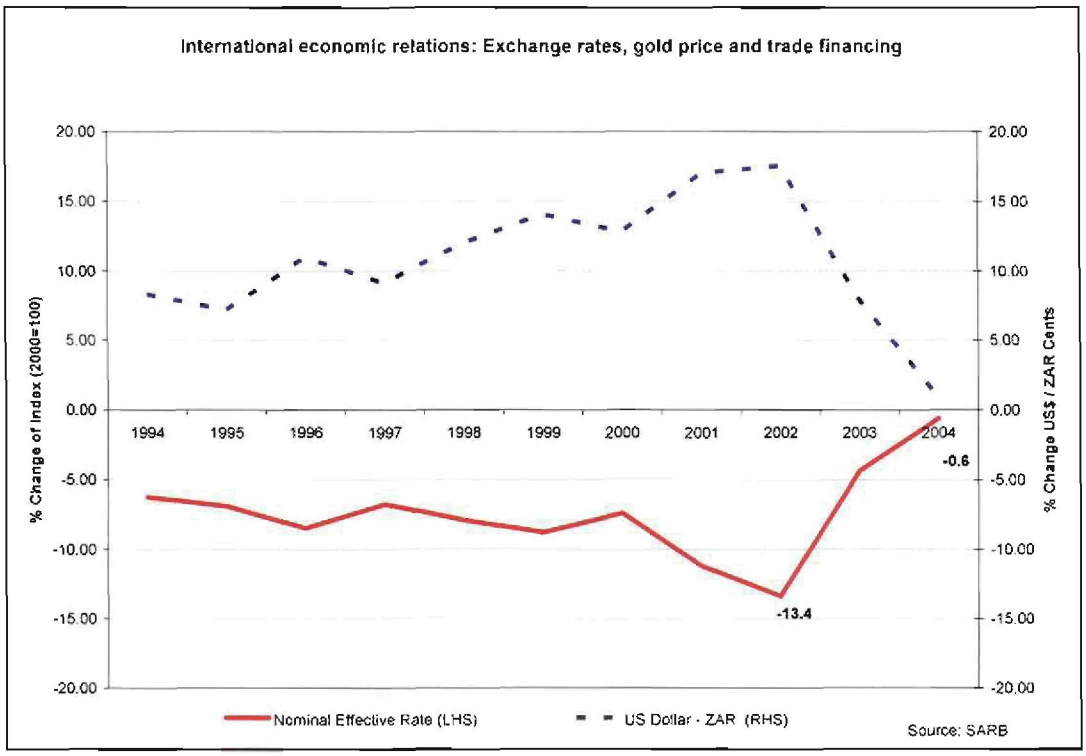
When modeling exchange rate fluctuations in a RAGE model it is important to remember that the exchange rate enters into the typical RAGE model in a straight-forward fashion – influencing the prices of imports and exports, but in that way impacting on production and consumption decisions and having distributional effects.

Though, while the mechanics may be simple, it is clear that the impacts depend crucially on the sensitivity (elasticity) of demand and supply of exports and imports to changes in price.

Finally it should be noted that in the typical AGE model the exchange rate is normally picked as the numeraire variable. This has to be taken into account when the model is used to answer specific exchange rate questions.

In order to determine what would be a possible sensible exchange rate scenario for illustrative analysis purposes it is necessary to evaluate the 3-year moving average percentage change of the annual nominal effective exchange rate (NEER) as reported by the South African Reserve Bank (SARB) over the period 1994 to 2004 and illustrated in Figure 7.1 below.

Figure 7.1: Exchange rate history



(Source of data: South African Reserve Bank (SARB) exchange rate data)

Evident from the graph and underlying calculations is that the NEER has declined by approximately -13.4% in the worst case over a rolling three year period, while never reaching a positive 3 year average period over the period in question. This actual appreciation and depreciation from the past is used to conduct an illustrative example of what the potential implication of such events could be, based on a RAGE model approach (Cameron, 1998).

The main mechanism, through which the effect of the exchange rate is modelled in this thesis, is through the exchange rate (*phi*). However, in most simulation closures phi serves as the numeraire. The closure therefore needs to be changed by using the domestic overall inflation variable (*p3tot_h*) as numeraire in order to express all other prices in the model relative to domestic inflation. This allows the modeller to simulate the potential impacts of changes to the exchange rate. This is achieved by swapping the previous numeraire (*phi*) with a so-called shift variable (*f4p_e*). This allows the modeller to have a different numeraire (*p3tot_h*) while also being able to change the exchange rate (*phi*).

7.3.3 Results interpretation

It should be noted that although the exchange rate devaluation/appreciation modelled in this thesis takes place over a period of 5 years, the impact is simulated as a once-off event that plays itself out over a period of about 2-3 years (refer to chapter 3 for an explanation of the interpretation of comparative static RAGE results). The results are then annualised and the impact can therefore be discounted back to reflect annual adjustments over the 5-year period. From Table 7.27 below it is evident that GDP growth decreases by 0.05 percent and 1.04 per cent respectively on an annualised basis.

Table 7.27: Impact on macro-economic variables (% change relative to the base case)

Annualised % Change	**0.6% NEER depreciation**	**13.4% NEER depreciation**
% Δ in real GDP* (x0gdpexp)	-0.05	-1.04
% Δ in aggregate employment (employ_io)	-0.07	-1.67
% Δ in Average real wage rate (avewage)	0.00	0.00
% Δ in domestic consumption (x3tot)	0.00	0.00
% Δ in consumer prices (p3tot)	0.00	0.00
% Δ in government consumption (x5tot)	0.00	0.00
% Δ in export volume (x4tot)	-0.40	-9.45
% Δ in export price index (p4tot)	-0.10	-2.34
% Δ in Import volume CIF (x0cif_c)	-0.23	-4.98
% Δ in import price index (p4tot)	0.24	5.16
% Δ in (Balance of Trade)/GDP (change) (delB)	-0.11	-2.55
Real exchange rate devaluation	0.30	6.50

*(*Real GDP from expenditure side) (Source: NWPGEM model results)*

The way to interpret this is as follows. Assuming the initial level of GDP is X and the initial growth rate g percent. The new level of GDP without the intervention would have been X(1+g). Assume that in terms of GDP, the CGE result is δg. The new level of GDP after the implementation of the Transport restructuring productivity increase is thus $X(1+g)(1+\delta g)$. The new growth rate can then be determined as:

$$g_{new} = \frac{X(1+g)(1+\delta g) - X}{X} = g + (\delta g) + g(\delta g) \qquad (7.2)$$

Essentially, the new GDP growth rate is the sum of the initial growth and the change in the growth rate plus their product. In other words, instead of for example GDP growth of say 2.5 percent over a period of 1 year we can now expect GDP growth of

$$2.5\% + (-0.05\%) + 2.5\% \times (-0.05\%) = 2.45\%.$$

If one were to relate these results to the real economy, the results point to the fact that as the exchange rate weakens, the impact on GDP is also negative as a result of the import intensity of the North West Province economy. As the exchange rate depreciates, the price of imported goods increase, negatively impacting on exports via production, ultimately resulting in overall employment losses.

7.3.4 Sectoral results

For the purposes of this analysis the following variables on a 27-sector level of detail is reported on. A detailed analysis of results of each of the sectors and other related variables is not conducted as part of this analysis, as this serves an illustrative purpose only. However, in practice depending on the level of detail required for the purposes of answering policy related questions much more detail can obviously be reported on.

From the tables below one can see that the agriculture and furniture and other manufacturing sectors are the biggest winners under both scenarios, with the mining and services sectors experiencing reduced productivity.

Table 7.28: Sectoral results for 0.6% NEER depreciation scenario

Sector		Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp_c)	Price (p0imp)	Volume (employ_o)	Price (p1lab_o)
1	AgricFrstFsh	4.40	16.58	84.66	13.91	20.07	0.00	16.66	2.98
2	PlatnmMining	-0.59	1.72	-0.61	0.21	-0.20	0.00	-1.16	2.98
3	GoldUranMing	-2.19	0.04	-2.39	0.02	-1.39	0.00	-3.79	2.98
4	OtherMining	-0.60	1.72	-0.60	0.20	0.01	0.00	-1.17	2.98
5	Food_Bev_Tbc	-2.76	6.01	-14.49	5.36	2.77	0.00	-4.77	2.98
6	TextClLtFtwr	1.29	3.11	22.25	2.86	6.47	0.00	1.77	2.98
7	Wood_Prodcts	-0.73	3.92	-9.69	3.46	7.43	0.00	-1.04	2.98
8	PetrChemRub	-0.47	1.37	-3.39	1.16	1.07	0.00	-0.90	2.98
9	OthNonMetMin	-0.55	2.10	-0.68	0.23	0.98	0.00	-0.89	2.98
10	MetalProdcts	-1.15	1.42	-3.18	1.08	0.33	0.00	-1.86	2.98
11	ElctrMachnry	4.81	3.80	85.07	3.54	3.02	0.00	7.33	2.98
12	ElcSndMedEqp	7.68	4.75	129.31	4.34	3.61	0.00	11.87	2.98
13	TranspEquipm	-0.84	0.16	-2.17	0.73	0.02	0.00	-2.56	2.98
14	FrntPpPr_NEC	12.08	19.80	162.32	16.68	24.54	0.00	28.75	2.98
15	ElctGasSteam	-0.38	1.11	-3.25	1.11	-1.39	0.00	-1.29	2.98
16	Water	-0.38	1.11	-3.25	1.11	-1.39	0.00	-1.29	2.98
17	Construct	-0.14	2.10	-6.04	2.10	-0.28	0.00	-0.17	2.98
18	TradeRetWS	0.47	3.30	-9.29	3.30	0.45	0.00	0.73	2.98
19	Accom	-1.46	3.40	-9.55	3.40	-0.53	0.00	-2.13	2.98
20	TransptServ	11.30	-12.05	46.99	-12.05	-8.93	0.00	-4.18	2.98
21	PostTelec	-0.45	2.07	-5.95	2.07	-0.32	0.00	-1.00	2.98
22	Finance_Ins	-0.50	2.42	-6.93	2.42	-0.21	0.00	-1.04	2.98
23	RealEstate	-0.50	2.42	-6.93	2.42	-0.21	0.00	-1.04	2.98
24	OtherBus	-1.98	3.02	-8.53	3.02	-2.03	0.00	-2.72	2.98
25	GenGovnmt	-1.39	2.68	-7.62	2.68	-1.39	0.00	-1.46	2.98
26	HealthSocial	-2.56	2.98	-8.42	2.98	-1.39	0.00	-2.56	2.98
27	OtherNEC	-0.05	2.59	-7.37	2.59	-1.39	0.00	-0.10	2.98
	Industry Average	**0.83**	**3.10**	**15.20**	**2.63**	**1.84**	**0.00**	**1.11**	**2.98**

(Source: NWPGEM model results)

Table 7.29: Sectoral results for 13.4% NEER depreciation scenario

	Sector	Value Added		Exports		Imports		Employment	
		Volume (x1tot)	Price (p1tot)	Volume (x4tot)	Price (p4tot)	Volume (x0imp_c)	Price (p0imp)	Volume (employ_o)	Price (p1lab_o)
1	AgricFrstFsh	4.86	17.23	86.99	13.43	21.56	0.00	18.63	1.84
2	PlatnmMining	1.05	2.65	1.35	-0.44	0.70	0.00	2.08	1.84
3	GoldUranMing	-1.41	0.04	-1.60	0.02	-0.64	0.00	-2.46	1.84
4	OtherMining	1.06	2.66	1.33	-0.44	0.99	0.00	2.09	1.84
5	Food_Bev_Tbc	-2.39	5.70	-12.68	4.62	2.88	0.00	-4.14	1.84
6	TextClLtFtwr	2.16	2.71	24.59	2.21	6.41	0.00	2.96	1.84
7	Wood_Prodcts	0.00	3.51	-7.62	2.68	7.30	0.00	0.00	1.84
8	PetrChemRub	0.39	0.88	-0.99	0.33	1.42	0.00	0.77	1.84
9	OthNonMetMin	0.35	1.71	6.04	-1.94	0.89	0.00	0.57	1.84
10	MetalProdcts	-0.16	1.15	-0.98	0.33	0.60	0.00	-0.25	1.84
11	ElctrMachnry	5.57	3.43	88.24	2.96	3.26	0.00	8.52	1.84
12	ElcSndMedEqp	8.47	4.38	133.14	3.76	3.86	0.00	13.15	1.84
13	TranspEquipm	-0.53	0.17	-1.52	0.51	0.32	0.00	-1.60	1.84
14	FrntPpPr_NEC	12.74	19.93	165.23	16.25	25.42	0.00	30.59	1.84
15	ElctGasSteam	0.10	1.66	-4.83	1.66	-0.64	0.00	0.33	1.84
16	Water	0.10	1.66	-4.83	1.66	-0.64	0.00	0.33	1.84
17	Construct	-0.06	1.30	-3.79	1.30	-0.09	0.00	-0.07	1.84
18	TradeRetWS	0.93	2.56	-7.29	2.56	1.01	0.00	1.46	1.84
19	Accom	-1.09	2.91	-8.24	2.91	-0.38	0.00	-1.60	1.84
20	TransptServ	29.74	-25.42	141.06	-25.42	-18.73	0.00	-4.31	1.84
21	PostTelec	0.02	1.93	-5.57	1.93	0.15	0.00	0.05	1.84
22	Finance_Ins	-0.11	2.12	-6.09	2.12	0.25	0.00	-0.22	1.84
23	RealEstate	-0.11	2.12	-6.09	2.12	0.25	0.00	-0.22	1.84
24	OtherBus	-1.46	2.44	-6.97	2.44	-1.55	0.00	-2.01	1.84
25	GenGovnmt	-0.64	1.81	-5.25	1.81	-0.64	0.00	-0.67	1.84
26	HealthSocial	-1.60	1.84	-5.32	1.84	-0.64	0.00	-1.60	1.84
27	OtherNEC	0.74	2.17	-6.24	2.17	-0.64	0.00	1.42	1.84
	Industry Average	**2.17**	**2.42**	**20.45**	**1.61**	**1.95**	**0.00**	**2.36**	**1.84**

(Source: NWPGEM model results)

This attempt at modelling the economy-wide effects of a realistic exchange rate appreciation/depreciation should be viewed as a cursory investigation only. In order to be in a position to evaluate this question in a more thorough fashion would require more research regarding the specific sensitivities and elasticities of other economic sectors – specifically the Armington elasticities and export demand elasticities. In the context of this analysis a current shortcoming of the model is that it currently does not differentiate between different import and export trading partners, for some more accurate sectoral behaviour might be obtained by refining this element of the model in future, and combining it with the GTAP set of models.

7.4 SUMMARY

In Chapter 6, the question was asked, should developing regions focus on diversifying their export basket or should they rather specialise their exports according to their existing comparative advantage?

Chapter 7 attempted to answer this question by using a RAGE model to investigate the economy-wide impacts of greater export diversification versus greater export specialisation on the North West Province economy.

The RAGE modelling results indicated that export diversification results in higher GDP growth and employment (with the exception of greater diversity under scenario 1a, where a decrease in employment was experienced. The main channel for this result is that in the database (SAM) of the model, natural resource based exports contribute more than 54 per cent of exports in the region and approximately 22 per cent to value added. In fact it was found that if the North West Province/South Africa were to specialise in mining exports, such exports would need to grow or increase from the base year by approximately 78/300 per cent (with no increase in the export demand for other sectors) to result in the same level of growth of total export volumes as we find under export diversification It was also established that changes in export diversification levels has implications for household inequality, with greater diversification likely to result in greater levels of inequality among the poorer households unless accompanied by measures (such as investment in expanding quality education) which would allow lower income households to upgrade their level of skills, which allows entry into the non-traditional sectors that benefit relatively more during diversification.

The policy implications from these findings suggest that an emphasis on diversifying exports in the North West Province's trade and industrial policies - as is currently the case – **cannot be fully justified.**

The policy implications for specialisation are that the downsides need to be addressed. These are that specialised economies are subject to fluctuations in prices (external shocks) which require use of insurance mechanisms (e.g. through hedging instruments), also the way in which the windfall gains from commodity price increases are invested is important: these should have the effect of increasing

government expenditure on infrastructure. Thirdly, economies with specialised structures are more prone to rent-seeking, and need to invest in good governance and other measures to strengthen institutions.

Next, Chapter 8 concludes this thesis and offers a number of recommendations for policy and future research.

CHAPTER 8: SUMMARY AND CONCLUSIONS

8.1 SUMMARY

This thesis made the initial observation in chapter 1 that South Africa's North West Province is significantly dependent on gold and platinum exports for its economic growth and employment. Whether this specialisation is optimal from an economic growth, employment creation and welfare point of view, or whether greater export diversification should be encouraged, can only be judged using a general equilibrium framework. This thesis set out to answer the question of how can a regional applied general equilibrium (RAGE) model be formulated and implemented for the North West Province of South Africa in order to study the differential impacts of greater export specialisation versus greater export diversification? For this the hypothesis was that a RAGE model can be usefully formulated and implemented for the North West Province of South Africa in order to distinguish between the optimal export strategies for the province.

The primary objectives of this thesis were (a) to formulate and implement a RAGE model for the North West Province of South Africa and (b) use this model to evaluate export specialisation versus export diversification as a trade and development strategy for the province.

The secondary objectives were to:

- Provide a discussion on the theoretical understanding of the relationship between international trade and regional development;
- Provide and assessment of the quantitative tools available to conduct assessments of regional policy issues;
- Identify the key sectors in the North West Province for export promotion;
- Determine whether the province can achieve export-led economic growth through either greater diversification or greater specialisation of manufacturing (non-traditional) exports;
- **Compare the simulation results** of the **RAGE** and **AGE** models in order to highlight the differences in impacts of policy/strategies on the national and regional (provincial) economies; and

- Determine the likely impact of an exchange rate appreciation/depreciation on the exports of the North West Province;

Chapter 2 reviewed the literature on regional economics, economic growth and the development economics literature. The focus was specifically in the areas of New Economic Geography, Regional Economics and Local Economic Development. Section 2.3 reviewed the state of regional economic development and thinking in South Africa. A number of conclusions were drawn from the literature assessment. The first was that although sub-national economic policy making and practice is at a more advanced stage, there is still some room for improvement to provide better answers to policy questions. Distinguishing between the available instruments to meet specific objectives or to carry out tasks was shown to remain a problem for many. Furthermore, it was shown that to bridge the gap in current provincial planning structures, government needs to analyse and quantify the relationships at sectoral level, in particular their effect on the potential for growth and employment creation, and the sectoral investment needs at provincial/regional level.

Chapter 3 reviewed economic development policy in the North West Province and provided some insight into the working of the provincial economy. This was done to better understand the region specific factors that drive growth in the North West Province and that should be captured in quantitative tools for policy assessment. Section 3.2 reviewed the provincial and national policies, their focus and the alignment between these policies. Following that, some evidence and motivation were provided to stress the importance of exports for improved growth and development in the province in Section 3.3. A number of conclusions were drawn from the literature assessment. The first was that given the unique economic structure of the North West Province, a particular blend of industrial policy under the broader national scope is required to assist the province in breaking into growth beyond the 3.1% average experienced over the past 10 years. A way in which to do this is through the stimulation of non-traditional (such as manufacturing) exports. Whether governments should be involved in the allocation of resources and encouragement of trade is no longer the main question, but rather how much and what kind of assistance is required. It was also emphasised that the development of manufacturing through the promotion of exports can be important for economic development and growth. Manufacturing can make important

contributions to the North West Province's economic development through added value to primary production, higher quality employment (schooling and on-the-job training adds to the stock of human capital), higher wages, and a smaller exposure to adverse external shocks.

Chapter 4 attempted to provide better understanding of the factors that drive regional growth and that should be captured in quantitative tools for policy assessment. Sections 4.2 and 4.3 reviewed the quantitative assessment tools of the past and present, which have stemmed from the development economics literature, due to the need for quality regional assessment tools. Following that, the development of AGE modelling, and specifically RAGE was presented in Sections 4.4 and 4.5. A number of conclusions were drawn from the literature assessment. The first was that applied general equilibrium modelling is a vibrant field of study in economics which can provide relevant and useful answers to policy related questions. Regional applied general equilibrium modelling, though still relatively new is positively related to increasing returns and negatively related to transport cost. The increasing returns are the result of scale and proximity that impart the efficiency benefits of mass production, specialised intermediate inputs, better alignment of workers and job opportunities, and the availability of public goods and services. Within this framework, the specialisation drives trade. Trade can also be positively related to increasing returns and negatively related to transport cost. Finally, the chapter showed that the contribution of this thesis is an important one seeing as most AGE modelling has been done on a national level and as it was noted in the first section of this chapter, problems and solutions differ from one region to the next and a national policy strategy might not be the correct one for any/all of the regions. Thus it can be concluded that although AGE has its role to fulfil, RAGE models are more important when it comes to the growth and development of a specific region since a unique policy strategy is needed.

Chapter 5 provided an overview of the RAGE model with particular reference to the structural features imposed to ensure adequate representation of the North West Province economy. In this chapter, this thesis focused on the method of applied general equilibrium modelling. The purpose of this chapter was therefore twofold: First, to describe the underlying framework of applied general equilibrium modelling and its application and value adding effect at regional level, and second, to describe the different role players and their influence on the regional economy. Also, the purpose of this chapter was to highlight

the usefulness of this modelling technique for policy evaluation and assessment at sub-national level. In doing so, this thesis extends the applied general equilibrium modelling approach in South Africa by implementing this technique at sub-national level. It was shown that the RAGE model requires a SAM as part of the data input. The North West Province SAM, commissioned by the Development Bank of Southern Africa, was used as data input into the RAGE model for the North West Province. The SAM is based on 2004 data and disaggregates activities into 46 separate activities, including informal sectors. Factors are divided into capital and labour. Labour in turn is divided into 11 occupational categories by 4 skill groups. Commodities are disaggregated into 46 commodities exactly according to the classification of activities. Households are divided according to the 12 deciles, as contained in the 1998 South African national SAM. This gives a total of 12 households. Furthermore, income and expenditure are linked to population group. Other institutions included are enterprises, the government and the rest of the world. Taxes are disaggregated to include the major sources of tax revenue for the provincial government. Taxes included are corporate taxes, personal income taxes, VAT, customs and excise, other indirect taxes on products, and other indirect taxes on production.

Where Chapters 2 to 5 put the matter of regional economic development and the quantitative modelling tools available to assist in the development of optimal policies, into perspective, Chapter 6 introduced the technique to South Africa's North West Province. This chapter showed that the North West Province economy is characterised by high levels of unemployment, poverty, low literacy rates and an increasingly high level of HIV/Aids prevalence rate (Statistics South Africa, 2001). These issues have placed increased pressure on the provincial government to play a more active role in addressing these issues by promoting the provinces' economic potential. One approach to increase the region's economic growth is through export-led growth, through a greater diversity in manufacturing exports. This led to the question, should regions in developing countries focus on diversifying their export basket or should they rather specialise their exports according to their existing comparative advantage? In this chapter an attempt was made to answer this question by reviewing the literature on export diversification and specialisation, by investigating the extent of export diversification and specialisation in the North West Province over the period 1995-2006 and its relationship to GDP per capita. It was found that although the North West

Province has a relatively specialised export basket when compared to averages for the other 8 provinces in South Africa, its export basket has become more diversified than any of the other provincial economies the country. Over time, there have been quite significant changes in increasing the extent of export diversification. Over the period 1995 to 1998 export diversification first decreased, after which it started to increase to end of the 2006. Evidence was also found that the relationship between export specialisation and GDP per capita in the North West Province is inversely U-shaped, similar to what we find for a cross-section of regions. This is inconsistent with the theoretical relationship between a region's level of development and export diversification as put forward in the literature. Furthermore, at a national level, increased export diversification may be good for development in South Africa in that export diversity was found to Granger-cause GDP per capita over the period. This led on to the investigation of the economy-wide impacts of the degree of export diversification on the North West Province and South African economies by using a RAGE and AGE model to simulate four scenarios.

Chapter 7 attempted to answer this question by using a **RAGE** and **AGE** model **to investigate and compare** the economy-wide impacts of greater export diversification versus greater export specialisation on the North West Province and South African economies. The RAGE modelling results indicated that export diversification results in higher GDP growth and employment (with the exception of greater diversity under scenario 1a, where a decrease in employment was experienced. The main channel for this result is that in the database (SAM) of the model, natural resource based exports contribute more than 54 per cent of exports in the region and approximately 22 per cent to value added. In fact it was found that if the North West Province/South Africa were to specialise in mining exports, such exports would need to grow or increase from the base year by approximately 78/300 per cent (with no increase in the export demand for other sectors) to result in the same level of growth of total export volumes as we find under export diversification It was also established that changes in export diversification levels has implications for household inequality, with greater diversification likely to result in greater levels of inequality among the poorer households unless accompanied by measures (such as investment in expanding quality education) which would allow lower income households to upgrade their level of skills, which allows entry into the non-traditional sectors that benefit relatively more during diversification. Table

8.1 shows a summary of the key (macro-economic, structural and household) impacts resulting from both the national and regional model.

Table 8.1: Summary of the RAGE and AGE model results

Scenario effects on the model economies	The RAGE model		The AGE model	
	Diversification	**Specialisation**	**Diversification**	**Specialisation**
Impact on real GDP	√	x	√	x
Impact on employment	x	√	√	x
Impact on domestic prices	x	x	x	x
Impact on exports	√	√	√	√
Impact on imports	x	x	x	x
Impact on trade balance	√	√	√	x
Impact on competitiveness	x	x	x	x
Impact on production	√	x	√	x
Overall impact on sectoral employment	√	x	√	x
Change resulting from Δ in exports/imports/domestic demand	exports	exports	exports	exports
Impact on household consumption	x	x	√	x
Overall effects	**-**	**x**	√	**x**

(Source: Authors' own assumptions based on the NWPGEM and UPGEM results)(x = bad; √ = good)

From Table 8.1 it seems as though greater diversity will have more positive effects at the national level, whereas, the effects at regional level are equally divided. Specialisation seems to be negative at both national and sub-national level.

The policy implications from these findings suggest that an emphasis on diversifying exports in the North West Province's trade and industrial policies - as is currently the case – **can not be fully justified from the results presented in this thesis.**

The policy implications for specialisation are that the downsides need to be addressed. These are that specialised economies are subject to fluctuations in prices (external shocks) which require use of insurance mechanisms (e.g. through hedging instruments), also the way in which the windfall gains from commodity price increases are invested is important: these should have the effect of increasing government expenditure on infrastructure. Economies with specialised structures are more prone to rent-seeking, and need to invest in good governance and other measures to strengthen institutions.

8.2 CONTRIBUTION AND POLICY RECOMMENDATIONS

Thus, this thesis has made three important contributions:

- First, it provides policymakers at regional/provincial level with access to an advanced modelling tool, through the RAGE model, to analyse regional economic issues. Through the use and implementation of this tool, a region can identify and develop policies and development programmes to enhance the region's economic potential.
- Second, it has contributed to better understanding the spatial concentration and spatial dynamics of economic activity at regional and national level in South Africa, more specifically in the North West Province. Here, Storper (2006) pointed out that with significant changes in the world economy, conditions for economic growth at regional, national, and international levels have been distorted. This has brought about the need to re-examine theories and models of the location of economic activity and the growth of territorial economies. This thesis investigated the extent of export diversification and specialisation in the North West Province of South Africa over the period 1995-2006 and its relationship to GDP per capita, and implements a RAGE and AGE model to investigate the economy-wide impacts of greater export diversification versus greater export specialisation on the North West Province and South African economies. In this province, exports have been dominated by mining. In contrast, the province has yet to increase its non-traditional exports, such as those of manufactured goods. Moreover, the necessity of RAGE modelling in South Africa was illustrated through a comparison of the varying economy-wide effects of policy/strategies at both national and regional (provincial) level. Policy makers would not have been aware of this were it not possible to build a RAGE model for the province.
- Finally, it has contributed toward the practical policy debate in South Africa. Sustaining decentralisation and creating a more equitable spatial economy may benefit from policies that are better informed and more region specific, in particular the ways in which specific regional qualities impact on their growth performance. The export success of the Asian "*tiger economics*", for example has been attributed to the active role played by their governments in the form of designing incentive programs for the promotion of specific domestic sectors (Glenday and Ndii, 2000).

Moreover, according to Perobelli and Haddad (2004:1) with the world economy continually changing, issues of globalisation receiving more attention and with the inherent assumption "*that a region's economic future is inextricably tied with its ability to compete in the international export market*", international trade has become a necessity for both regional analysts and policy makers alike as a means of achieving and sustaining long term economic growth. With the recent expansion in world trade brining about significant growth in countries/regions across the globe, other regions may be able to benefit from this expansion by means of greater diversification of their non-traditional exports (Osakwe, 2007).

8.3 FUTURE RESEARCH

Having constructed a basic RAGE model along the Monash approach, there still remain quite a number of research activities that need to be conducted in order to make sure that the coefficients and parameters in the model reflect the latest information for the North West Province economy in the current version of the NWPGEM, as the current information contained in the database for these topics are based on previous research conducted up to approximately 1998. Examples of such topics are:

- Intermediate Armington elasticities;
- Investment Armington elasticities;
- Households Armington elasticities;
- Export elasticities;
- Primary factor substitution coefficients;
- Labour types substitution coefficients; and
- Luxury expenditures coefficients.

Moreover, future expansions of the model will include an expansion of Transport Services (Sector 20) for more detailed analyses of the transport sector. Based on the 1996 expanded input-output table prepared by Transportek CSIR and Conningarth Consulting Economists from the 1989 input-output table an additional 9 modes can be distinguished:

- Total Freight (aggregate of road and rail);
- Passenger – Long Distance Rail;
- Passenger – Long Distance Road;
- Public passenger transport – Rail;
- Public passenger transport – Bus;
- Public passenger transport – Taxis;
- Sea (aggregate of freight and passenger – would not apply to the North West Province);
- Air (aggregate of freight and passenger); and
- Other transport.

However, a detailed study is required to update Transport sector data (especially for Freight by Road and Rail) otherwise this effort will be too outdated for practical application. Currently this expansion will be purely based on ratios from the old input-output table and will therefore in any event only have illustrative application value.

Scope for further research on RAGE models will depend greatly on the availability of reliable sub-national data. Where provincial-level data is available, future work should attempt further testing of the regional framework. In addition, future developments to further improve the current model could include the following activities:

- Update of the basic 2004 based database (I-O, SAM and RAGE database) to more recent levels;
- Integration with multi-regional trade-linked models such as the Global Trade Analysis Project (GTAP) from the University of Purdue. Also, further development of the trade pattern extensions could be included in the final model to allow for detailed analysis of trade responses to internal and external price changes (by partner region/country);
- Building and linking a more detailed Microsimulation model with the NWPGEM for measuring the impact of economic policy shocks on the incidence of poverty and on the distribution of income;
- Incorporating the Tourism Satellite Accounts into the main model in order to more interactively analyse policy impacts on the tourism sector; and

- Expand the dimensions of the model to contain a Small Medium and Micro Enterprise (SMME) dimension, as well as Black Economic Empowerment (BEE) aspects. However, the data requirements for this may prove to be prohibitive at this point in time. However, further theoretical work on this aspect should be conducted, to be followed by empirical applications once information has been collected in the future.

APPENDIX A: AGE MODELLING IN SOUTH AFRICA

A number of different AGE models and approaches have been used at national level in the South African context. The following table provides a brief overview of the contributions made.

Table A.1: Summary on the main AGE applications in South Africa [32]

Year	Model	Modellers/Authors	Publication
1993	Macroeconomic Forecasting Model (IDC CGE Model)	IDC with assistance from Impact Research Group of Monash University in Australia	IDC, Empirical Estimation of Elasticities in IDC's General Equilibrium Model (IDCGEM), Technical Series (TS2/1997), Industrial Development Corporation, Pretoria. JOUBERT, R. 1994. IDCGEM - A General Equilibrium Model of the South African Economy. Paper prepared for the EBM Research Conference, Johannesburg.
1993	Macroeconomic Forecasting Models (A Provisional CGE model for South Africa)	W.A. Naudé and P. Brixen	A Provisional CGE Model for South Africa. *South African Journal of Economic and Management Sciences*. 10: 22-33. On a Computable General Equilibrium Model for South Africa. *South African Journal of Economics*. 61(3): 153-165.
1994	Macroeconomic Forecasting Model (The National Institute for Economic Policy Model)	Peter Brain (NIEP Model – Original architects were S. Gelb, B. Gibson and L. Taylor, 1990)	Modelling the South African Economy – Real financial interaction. Working paper. Macroeconomic Research Group, University of Durban-Westville.
1995	Macroeconomic Forecasting Model (DBSA Model)	Development Bank of Southern Africa (DBSA) (built by B. Gibson and D. van Seventer)	The DBSA macro model, Development Bank of Southern Africa, Development Paper no 120, Halfway House.
1995	Macro, Sectoral Policy Models (Government Spending Programs)	J.M. Horridge, B.R. Parmenter, M. Cameron, R. Joubert, A. Suleman and D. de Jongh	The Macroeconomic, Industrial, Distributional and Regional Effects of Government Spending Programs in South Africa, General paper no. G-109, April.
1997	Macroeconomic Forecasting Model (Currency depreciation, trade liberalization and economic development)	W.A. Naudé, Z.R. Coetzee & K. Gwarada	Currency Depreciation, Trade Liberalisation and Economic Development. *South African Journal of Economics*. 65(2): 165-190.
2000	Macro, Sectoral Policy Models (Trade Policy Reform)	S. Devarajan and J. Lewis	Trade Reform in South Africa: Impacts on Households, Working paper: World Bank.
2000	Macro, Sectoral Policy Models (Poverty and income distribution)	N.M Humphreys	A Poverty Focused CGE Model for South Africa, May.
2000	Macro, Macroeconomic impact of HIV / Aids (The World Bank CGE Model)	Arndt, C. and Lewis, J.D.	The macro implications of HIV/AIDS in South Africa: A preliminary assessment. *South African Journal of Economics*, 68 (5): 856-887.
2001	Macroeconomic Forecasting	International Food Policy and Trade	Thurlow, J. 2003, A Dynamic Computable

[32] Because AGE analyses are used for policy making and private consultancies, information on AGE models is not freely available in the public sphere. Therefore, this table summarises at the models and work available as academic papers and publications. But even in this area all the unpublished work is not always accessible.

	Model (intended to reduce the initial cost of undertaking CGE analysis in South Africa)	and Industrial Policy (CGE modelling framework developed by Löfgren)	General Equilibrium (CGE) Model for South Africa: Extending the Static IFPRI Model, International Food Policy Research Institute Washington, D.C. Thurlow, J. (2003a) "Further Trade Liberalisation and Reform in South Africa: An Economy-wide Assessment". TIPS Discussion Paper. Thurlow, J. 2003b, "The Impact of Regional Trade Agreements on the South African Economy". TIPS Discussion Paper. Davies, J., 2004. Microsimulation, CGE and Macro Modelling for Transition and Developing Countries. Paper presented as WIDER conference on Inequality, Poverty and Human Wellbeing, 30-31 May, Helsinki, Finland.
2001	Walrasian, Environmental Model (Revenue neutral tax on coal)	T.J. de Wet and J.H. Van Heerden	The dividends from a revenue neutral tax on coal in South Africa, *The South African Journal of Economic and Management Sciences,* 6: 3, Pretoria.
2004	Macroeconomic Forecasting Models (Income inequality in South Africa)	W.A. Naudé and R. Coetzee	Globalisation and inequality in South Africa: Modelling the Labour Market Transmission, *Journal of Policy Modelling*, 2006.
2005	Macroeconomic Forecasting Model. The UPGEM CGE Model.	H.R. Bohlmann and J.H. van Heerden	The Impact of Hosting a Major Sport Event on the South African Economy, *Working paper*, November.
2006	Microeconomic Effects of Macroeconomic Policies or Shocks	N. Hérault	Building and Linking a Microsimulation Model to a CGE Model for South Africa, *South African Journal of Economics*, 74: 1, March.
2006	The PROVIDE Standard SAM-based Provincial CGE Model	S. McDonald, S. Reynolds and M. van Schoor	Economic Impact of a Provincial Fuel Levy: A CGE Analysis, *South African Journal of Economics*, 74: 3, September.
2006	The IFPRI Standard CGE Model	K. Pauw and L. Edwards	Evaluating the General Equilibrium Effects of a Wage Subsidy Scheme for South Africa, *South African Journal of Economics*, 74: 3, September.

(Source: Adapted from Rossouw, 2004:53)

APPENDIX B: QUANTITATIVE TOOLS FOR POLICY ANALYSIS

Table B.1: AGE, input-output (I-O) and econometric models

	I-O	AGE	Econometric model
Typical equation	$Q=[I-A]^{-1}F$	$E/D_s=((P_e/P_d)/(bt/(1-bt)))^{(1/(rr-1))}$	CCA = -1694.126 + 0.0089*(DP95*PDIIF) + e
Typical data requirements	Detailed sectoral flows. Base year data.	National accounts or SAM data. Base year data.	National accounts or/plus sectoral data. Time series data is required for estimation.
Variables	Quantity (Q) or real values per industry. In output/income multiplier models output per industry is expressed as a function of the final demand per industry. In the price model, industry prices are variable and Q is fixed.	Quantities (Q), relative prices (P), and values. The model specification includes exogenous and endogenous variables similar to econometric models. In large models the variables could relate to SAM flows.	Exogenous and endogenous variables. The values of the endogenous variables are determined within the model. The values of exogenous variables are determined outside the model.
Behavioural functions	Simple homogeneous linear production functions. No substitution. No error terms.	The functions typically define Q relationships in production & consumption which includes substitution possibilities; price equations; conversion of Q flows to values; flows between sectors; equilibrium conditions. Sectors: e.g. households, government, industries etc. Elasticities (parameters of functions) provide the quantitative direction of change. Standard type non-linear functions are mostly used. Error terms are not used.	A large econometric model usually includes demand and supply side equations per market. The parameters of the equations are estimated by econometric techniques using time series data. The estimated equations make up the model, together with identity equations. Usually on a macro level. Linear or non-linear functions. Includes error terms.
Solution	Unique. Solve a system of linear equations. The number of endogenous variables = number of equations.	Unique solution in case of small models; optimum solution in large models (vars > conditions), in this case a goal function is required which usually is some sort of social utility function of consumption.	Unique solution.
Software	Any that can handle a system of linear equations. E.g. Econometric packages or Excel.	Special software which can determine an optimum solution subject to constraints. E.g. GAMS, GEMPACK. These packages can handle very large models. The solve add-in within Excel can handle up to 32 variables.	Econometric software for estimation and simulations.
Complexity	Simple	Successful AGE models are the product of long years of research and development. They include country specific economic behaviour, that is, correct calibration of typical standard type equations.	Models may be large and complex. Model building and estimation is usually a time consuming and complex exercise.
Advantages and use	Simple to use. Simultaneous in nature, that is, captures both direct and indirect effects.	Simultaneous instead of partial approach thus including the indirect effects. Model is flexible; it can resolve impact of a various type of shocks. AGE models have been widely used in	Simultaneous instead of partial approach. Many types of models have been successfully used in policy analysis and forecasting.

		contemporary policy issues. AGE models provide useful frameworks for understanding structural change. It goes beyond qualitative insights of pure theory and adds quantitative significance.	
Disadvantages	May be too simplistic. Does not take account of the effect of changes in relative prices, or of structural change.	AGE models are cumbersome to build. Require extensive data & model calibration. Must learn difficult programming language in case of large models. Software is expensive.	Requires ongoing effort to build and to maintain. Requires specialised skills.

(Source: Cameron, 1998:x)

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