Potential bilateral trade between South Africa and Angola in the agricultural sector: A gravity model approach

J.L. Erero, M.Com. (Statistics)

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Supervisor: Dr. R. Rossouw

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ABSTRACT

This study applies the gravity trade model to assess South Africa-Angola trade potential in the agricultural sector. A step-by-step example of the model's empirical implementation is also provided. It is found that the gravity model, with foundations in the physical sciences, is a useful instrument for the analysis of bilateral trade flows. A panel data analysis is used to disentangle the time invariant country-specific effects and to capture the relationships between the relevant variables over time. The study also finds that the fixed effects model is to be preferred to the random effects gravity model. Furthermore, a number of variables, namely, size of the economies, the oil price and exchange rates added to the standard gravity equation, are found to be important determinants of bilateral trade flows. Overall, the simulation results indicate that there is a potential for trade in the agricultural sector between these two countries.

Key words:

South Africa, Angola, gravity model, agricultural sector, exchange rate, oil price, trade potential

OPSOMMING

Hierdie studie implimenteer die gravitasie model om die handelspotensiaal in die landbousektor tussen Suid-Afrika en Angola te assesseer. 'n Stap-vir-stap voorbeeld van die model se empiriese implementasie is ook voorsien. Dit is gevind dat die gravitasie model, met fondasies in die fisieke wetenskappe, 'n handige instrument is vir die analisering van bilaterale uitruil vloei. 'n Paneel data analisering is gebruik om die tyd onverandelike land-spesifiek effekte te ontknoop en om oor tyd die verhoudings tussen die toepaslike veranderlikes te vang. Die studie vind ook dat die vaste effek model verkieslik is bo die lukraak effek gravitasie model. Bowendien, is gevind dat 'n aantal veranderlikes, naamlik, grootte van die ekonomieë, die olieprys en wisselkoerse, bygevoeg tot die standaard gravitasie vergelyking, belangrike determinante van bilaterale uitruil vloei blyk te wees. In geheel, dui die simulasie resultate dat daar wel 'n potensiaal is vir handel in die landbousektor tussen hierdie twee lande.

Sleutelwoorde:

Suid-Afrika, Angola, gravitasie model, landbousektor, wisselkoers, olieprys, handelspotensiaal

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

The purpose of this study is to evaluate the potential for bilateral trade between South Africa and Angola in the agricultural sector through the use of the gravity model and to provide a step-by-step example of its empirical implementation. Through this, and other studies, opportunities for potential future trade between South Africa and other nations may be identified.

This chapter first gives some background to the gravity model and the economic sector to be analysed, then defines the problem statement, and provides some motivation for the study. Furthermore, the chapter defines the aims and objectives derived from the problem statement and discusses the methodology to be applied. To finish, a framework as well as an outline of the remainder of the study is given.

1.2 BACKGROUND

In the last decade, agricultural exports have grown significantly in importance. They represent 37 per cent of the total value of production, whereas imports represent approximately 23 per cent. As an agricultural exporting country, South Africa has a positive trade balance with regards to agricultural goods. However, there are many challenges, such as unstable macro-economic policies, that the sector faces with regards to trade even though this sector has potential to generate more employment (Annual report, Department of Agriculture, 2005).

Over the last decade to 2005, agricultural exports increased from R5 billion in 1990 to R25 billion in 2005, representing a 40 per cent increase in US Dollar terms. Export volumes increased by 25 per cent (regression trend) and 36 per cent (real values) over the past 15 years. With the strengthening rand at its peak in 2004, the export value only dropped by about 10 per cent, although the export volumes have dropped by half. These volatilities do have implications for the transport infrastructure. Although the

agricultural sector's direct contribution to the Gross Domestic Product (GDP) seems insignificant, it plays an important role in the global economy. For most developing countries, such as South Africa and Angola, exports are an important source of income (World Bank, 2005).

The agricultural sector is not performing well compared to the rest of the economy in terms of output growth, exports, and employment demand (see Table 1.1). Especially after 1997, the real output growth of the Agricultural sector amounted to only 1.6 per cent compared to a real GDP growth of 3.2 per cent. It is also clear that the growth in the dollar value of agriculture exports has remained relatively constant over the whole period since 1994, whereas agriculture imports increased since 1999, as the domestic economic growth rate reached an average level of more than 3.0 per cent.

Table 1.1: Real average annual growth rates in the agricultural sector

	Average growth rate 1994-1998	**Average growth rate 1999-2005**	**Average growth rate 1994-2005**
Real GDP (%)	2.7	3.2	3.0
Agriculture output (%)	1.5	1.6	1.5
Agriculture exports (% growth in$)	9.3	8.8	9.0
Agriculture imports (% growth in $)	1.8	11.9	7.3
Agriculture labour demand (%)	0.5	-1.70	-1.77
Average share in total labour market (%)	11.0	10.4	10.7
Rank in total labour demand (46 industries)	3	3	3

Source: Quantec Easydata, 2007

Table 1.1 shows that in the agricultural sector, the total demand for labour dropped from 0.5 per cent between 1994 and 1998 to –1.70 per cent between 1999 and 2005. This means that the total amount of labourers employed in the agricultural sector decreased from 93 000 workers in 1994 to 81 500 workers in 2005 (Quantec Research, 2007). Despite this deprived performance, the agriculture sector is still ranked number 3 in the economy with regard to its average share in the job market. Given the labour intensity of the agricultural sector, trade agreements that could improve its export's performance will definitely contribute to job creation (Harmse, 2004).

In this study an attempt is made to test whether the agricultural sector still enjoys a comparative advantage in the world market. This study also illustrates the extent to which this sector has become more

integrated into the world economy when the traditional concepts of inter-industry trade are taken into consideration.

The instrument used to evaluate this sector is the gravity model. By analogy to Newton's gravity law, the application of the gravity model to trade flows states that trade increases with the dimension and proximity between trade partners (Sargento, 2006:2). A more detailed discussion regarding the gravity model is provided in chapter 3. Furthermore, in this study, attention will be given to the econometric application of the gravity model to explain bilateral trade flows between South Africa and Angola.

Persistent societal changes in the local and global economic scene have impacted positively on agricultural trade and the production environment. However, at the same time, deregulation, changes in policy and trade flows have resulted in a multitude of uncoordinated initiatives, opportunities and challenges. Considering external changes and a desire for stronger coordination and alignment between government departments, there is a need to renew the existing policy for agricultural trade for the purpose of stimulating growth, employment and income in the agricultural sector (Department of agriculture, 2006).

The export trend from South Africa to Angola shows that the real exports in agricultural sector increased from 8.2 million in 2000 to 13.1 million in 2006 (Department of agriculture, 2006). This trend highlights the need to focus on new markets and products that show potential for future growth. Angola relies heavily on South Africa's agricultural sector. In 2001 for instance, the simulation result shows that actual exports from South Africa to Angola exceeded potential exports in the agricultural sector. The changes in social and economic conditions in Angola and South Africa are causing significant shifts in global food markets. In particular, the world's prosperous consumers are forecast to increase by 850 million by 2010. These consumers will be demanding more specialised, high quality products and services (World Bank, 2005).

The estimation of potential trade between South Africa and Angola can be done through application of the gravity model, and the results then compared to actual bilateral trade. Therefore, the actual trade can be disaggregated per sector providing areas that South Africa can exploit. The reasons why

potential trade is not realised then have to be investigated. This might assist government in both its bilateral trade negotiations and identify areas of possible government intervention.

1.3 PROBLEM STATEMENT

Export promotion policies are instrumental in triggering economic growth of nations in a global world economy (World Bank, 2005). However, as resources for public export promotion activities are scarce, it is of critical importance to allocate the limited resources to activities which will generate the highest contribution to exports. Although the direct contribution of the agricultural sector to the economy of South Africa is less than 5.0 per cent, this sector has managed to provide food to its population, which has grown from a mere 4 million in the early 1900's to more than 44 million in 2007. Besides, agricultural exports from South Africa to the Angolan market are growing rapidly. The average annual growth in dollar exports to Angola in the agricultural sector between 1994 and 2004 was approximately 9 per cent (Harmse, 2004).

The essential question is thus: Is there any potential for bilateral trade in the agricultural sector between South Africa and Angola? The answer to this question is important, for if this study does confirm the relevance of this sector as an important export industry, it might have significant implications for policy efforts such as the Customised Sector Program, a program implemented by the South African government. Besides, this might strengthen the use of the gravity model to scientifically justify export promotion activities in the future.

1.4 MOTIVATION OF THE STUDY

In recent years, significant changes have occurred in the economic policy environment of South Africa. In fact, these changes have contributed to a remarkable growth in trade between Angola and South Africa, especially in the agricultural sector. The agricultural sector has moved rapidly from protectionist statutory involvement and support of agriculture prior to the mid nineties, to deregulation and liberalization and an

open economy in recent years. The devaluation of the rand, by approximately 3.5 percent during the 1990s contributed partially to the growth in exports. Furthermore, the successful political transition in 1994 has contributed to a relatively easy shift to a more open economy (World Bank, 2005).

The current funding of export promotion activities in South Africa to Angola rely on historical export performance trends. Little, if any, scientific justification could be given for the current funding of export promotion activities, which do not take into consideration new export opportunities in unexploited markets or opportunities for new products in existing markets (Harmse, 2004).

Given this shortcoming, the gravity model may aid policymakers in identifying realistic export opportunities in Angola especially and generally in the rest of the world for South Africa. By combining this information with data on the planned export promotion activities of the dti, an assessment can be made of these activities in the past, present and future, with the aim of improving the success ratio of such activities in terms of generating exports. Furthermore, the dynamic analysis of the agricultural sector between Angola and South Africa will measure the importance of this sector compared to others in terms of the current world market situation, its export and import performance and contribution to total production. This might help address some of the pressing issues currently being faced in this sector such as allocation of resources and maximising trade potential.

The results from this study might also lead to the optimal use of financial and human resources in government to promote exports and might be introduced into the Customised Sector Program, which may enhance the implementation of this program.

1.5 AIMS AND OBJECTIVES

The primary objective is to perform empirical analyses, using the dti gravity model, for the purpose of analysing the potential for bilateral trade between South Africa and Angola in the agricultural sector.

This may be achieved by reaching a number of secondary objectives:

- Applying shocks to the agricultural sector in view of analysing the potential and actual exports between South Africa and Angola.

- Using the gravity model to perform a number of simulations. Specific interest is given to the shocks applied to the variables such as GDP, exchange rates and the price of oil for the purpose of this study.

1.6 METHODOLOGY

The literature review will focus on the gravity approach as a method for the South African government to address the shortcomings of their export promotion schemes as well as discuss some of the earlier work done regarding the gravity model. Due to the model's simplicity and capacity to produce reasonable results, it tends to be the most attractive among spatial interaction models, especially in trade empirical applications.

In this study, an attempt is made to apply the gravity model to the annual bilateral trade between South Africa and Angola in the agricultural sector. The study focuses on the methodology used in Cheng and Wall (2005), which aims to estimate fixed effects and variables such as distance and dummies for language which do not change over time.

Following the literature review, the empirical analyses and simulations are performed using the dti gravity model. The simulation results are interpreted and closely linked to the practical analyses of the agricultural sector which are performed in details in chapter 5. The empirical methods used are explained in greater detail in Chapters 3 and 5.

1.7 RESEARCH FRAMEWORK

The tabulation of trade potential is a popular research topic that has been studied extensively by economists, such as Evans (2000) and Feenstra (2002), who showed that trade flows follow the physical theories of gravity where two opposite forces influence the capacity of trade involving two countries. The first step is to consider, through a symmetric manner, the bilateral trade flows between South Africa and Angola.

It should be noted that the purpose of this study is not to construct a new model, but to apply an existing model. The dti gravity model will be applied for this purpose in order to perform the simulations. The dti gravity model will be explained in detail and used for to perform the various analyses. Trade between South Africa and Angola is estimated in the model.

Given the availability of data on distance, GDP and population indicators for South Africa and Angola, the gravity equation is applied in simulation exercises to determine the existence of trade potential for the abovementioned countries. Therefore, in order to surmise bilateral export potential, the second step is concerned about the simulation results, which will be compared with the initial data. The model will be structured within the following framework: a gravity equation will be developed based on South Africa and Angola. Macroeconomic variables, such as GDP, exchange rates and the price of oil, are considered as independent variables in determining trade between both countries (Harmse, 2004).

1.8 OUTLINE OF THE STUDY

The remainder of this study is organised as follows: chapter 2 reviews the gravity model's basic specification and its extensions in recent trade flows applications. Chapter 3 will provide some plausible elements of the gravity model as well as a detailed description on the workings of the model. Chapter 4 reviews the various elements of the agricultural sector as seen today. Chapter 5 describes the empirical use of the gravity model in this study, as well as the various simulations performed and the interpreted results. Chapter 6 summarises the main conclusions that were drawn from the various simulations and provides some avenues for further research.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Limited work has been done on gravity modelling for South Africa, which makes the dti gravity model unique. This model was developed for the dti by the Investment and Trade Policy Centre (ITPC) based at the University of Pretoria. The model is mainly used for analysing international trade flows between South Africa and its 154 trade partners (the dti gravity model, 2004). This study aims to promote the use of the gravity model in the South African government.

This chapter reviews the gravity model's basic specification and its extensions in recent trade flows applications. In Section 2.2 the theoretical foundation is explained. Section 2.3 reviews the methodology of the gravity model. Section 2.4 presents the sectoral analysis. Section 2.5 describes the way in which trade potential is calculated on the basis of the parameter estimated. Section 2.6 portrays the restrictions of the model followed by a summary of the chapter.

2.2 THEORETICAL FOUNDATION AND EXTENSIONS TO TRADE APPLICATIONS

The gravity model is based on the theory developed by the physicist, Isaac Newton. As described by Karemera (1999), Newton (1642-1727) originally constructed the model to describe gravitational forces in the universe, theorising the attraction regarding two earthly objects without neglecting their distance.

There is a substantial amount of literature pertaining to the gravity model, including work done by Evans (2000) and Feenstra (2002), who showed that trade flows follow the physical theories of gravity where two opposite forces influence the capacity of trade involving two countries. However, most of these studies have been undertaken in the USA, UK and Canada. Among the UK and US based studies, Anderson (1979) examined the theoretical and practical groundwork of the gravity equation. He found that where there is trade flow between two countries, potential and actual trade can be evaluated through the

gravity model. Such trade potential can be disaggregated per sector, which can then be used to indicate potential areas that a country can exploit.

The gravity model has over time proved itself to be a useful instrument for the analysis of bilateral trade flows. The first implementation of the gravity model to analyse international trade was performed by Tinbergen (1962). Kimura (2006) later confirmed that Pöyhönen (1963) was the first to use the gravity model in social sciences.

During the 1980s this model was used to determine migration and other social flows regarding capacities of human interaction. Matyas (1998) investigated the gravity model and proposed the introduction of a new variable, such as the language used in trade, to make the model more credible and practical. Real exchange rates were first introduced in the gravity model by Bergstrand (1985, 1989). However, the incorporation of price effects in a cross-section analysis does not provide enough information regarding the value of a currency as confirmed by Soloaga and Winters (2001). Exchange rate movements become significant only when the time dimension is incorporated in the analysis. Soloaga and Winters (2001) also included real exchange rate variables into the gravity equation. They averaged their variables over several three year periods and obtained Tobit estimates on single regressions as declared by Martinez-Zarzoso *et al.* (2001).

Despite its widespread potential for use in empirical and policy analysis, the theoretical foundation of the model has been somewhat controversial. This is because, as declared by Leamer (1994), the basic theory of the gravity model was not scientific but rather intuitive. However, during the last two decades, many scientific contributions have been made in an attempt to sustain the credibility of this model (Oguledo, Victor Iwuagwu, Macphee and Craig, 1994).

One of the first scientific theoretical justifications for the gravity model emanates from gravitational forces in physics, which states that:

$$P_{grav} = \frac{G * C_1 * C_2}{s^2} \qquad (2.1)$$

where P_{grav} represents the force of gravity between two objects and **G** represents the universal gravitational constant. C_1 and C_2 represent the mass of objects 1 and 2 respectively, whereas **s** represents the distance separating the two objects' centres.

According to this equation, the flow of commodities from one country (object 1) to another (object 2) involves two factors, namely the distance and the resistance to sustain trade. Some researchers, such as Sattinger (1978) and Anderson (1979), used this framework and found that distance played a significant role in trade flows (Micco, 2003).

The second justification for the gravity model can be found in the Walrasian general equilibrium model (Walras, 1877; Macco, 2003). Each country in this model has its own demand and supply functions for all commodities but aggregate income is substituted by importing country demand and exporting country supply. Using this approach, the gravity model is a reduced-form equation for trade volume in which prices do not appear because they are endogenous. Transport costs are proxied by geographic distance, which is in line with Newton's law (1667), and accommodates the relationship between demand and supply. This model was used by, among others, Bergstrand (1985, 1989), who modified the model to include the size of the economy for both countries.

The third justification for the gravity model is taken from the probability model developed by Sattinger (1978). In this model it was assumed that the customers who are importing goods are related directly to the suppliers from the exporting country. Therefore, they should be selected arbitrarily for the services which should be rendered. Sattinger (1978) rejected this view by saying that trade flows are treated as stochastic events in determining trade flows between countries.

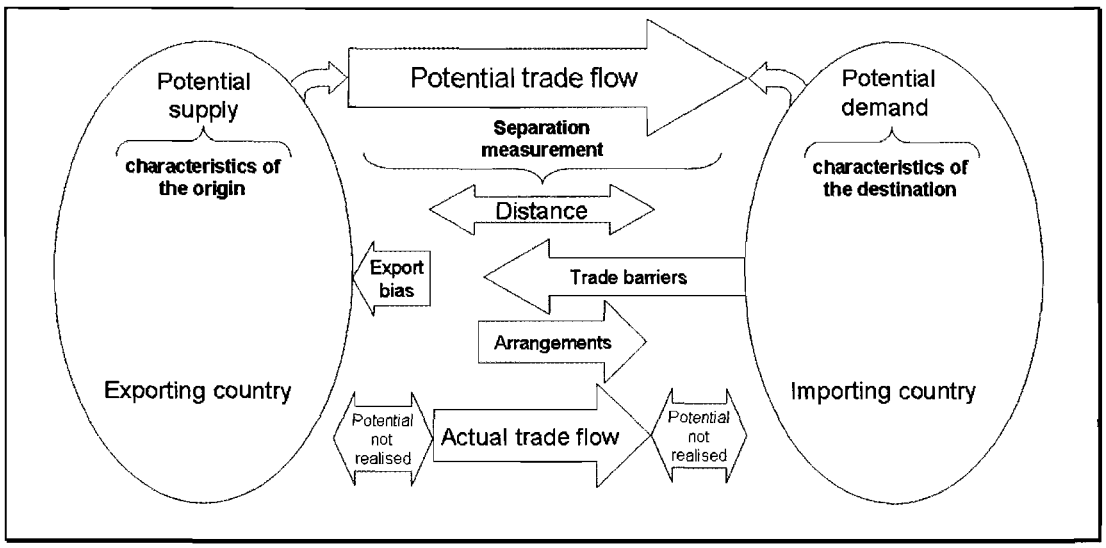
The fourth and final justification is based on the kind of goods required for importation. These goods can be substituted, since empirical evidence support goods differentiation on the basis of place of origin (Smarzynska, 2001). Therefore price variables should be included in the gravity model; otherwise it will lead to misspecification of the model equation. Oguledo and MacPhee (1994) developed the following gravity model:

$$M_{ij} = \frac{\gamma}{K} Y_i^{\alpha_1} N_i^{\alpha_2} P_i^{\alpha_3} Y_j^{\beta_1} N_j^{\beta_2} P_j^{\beta_3} TC_{ij}^{\varepsilon_1} t_j^{\varepsilon_2} d_{ij}^{\varepsilon_3} U_{ij} \qquad (2.2)$$

where M_{ij} is the foreign price value (e.g. US dollars) of imports of commodities to destination i from origin j. Y_i is the importer and Y_j is the exporter. N_i and N_j represent the population in the importing and exporting countries respectively. P_i and P_j are the price levels in the importing and exporting countries respectively. TC_{ij} is the distance between the trading partners, d_{ij} is the preferential dummy variables and U_{ij} is a log-normal white noise error[1] term.

Figure 2.1 provides a graphical representation of the gravity equation. It can be seen that potential supply and demand is determined by the sizes of the economies and these in turn predict the potential trade flows between the two countries. Therefore, trade flow depends on trade resistance factors, such as tariffs, that are mitigated by trade arrangements (the dti gravity model, 2004).

Figure 2.1: The gravity model



Source: the dti

[1] The white noise error is a statistical variable. It has a zero mean, constant variance and is serially uncorrelated.

2.3 GRAVITY MODEL: METHODOLOGY

The stationary and active movement of each sector is analysed in this section. Stationary investigation consists of a description of the agricultural sector in terms of the current world market situation, its export and import performance and contribution to total production.

The dynamic analysis measures the importance of the agricultural sector in this study compared to others. This methodology is spelled out for the purpose of testing the dynamic effects of trade for the agricultural sector. The Revealed Comparative Advantage (RCA) also covers provincial exports of certain sectors, which are related to South Africa's total exports (the dti gravity model, 2004).

The OLS regression method was used to estimate the dti gravity model. Variables such as GDP, the exchange rate and oil price were estimated in natural logarithms. This regression method was preferred as the suitable econometric technique because of the linear model to be estimated. In addition, OLS is a standard linear regression procedure that attempts to find a best fit to a set of data by attempting to minimize the sum of the squares of the differences called residuals between the fitted function and the data. The panel data used for the model application was for the period 1994 to 2003. The use of panel data methodology has numerous advantages over cross-section analysis. Firstly, panel data makes it feasible to establish relationships between regressors for a period of time. Secondly, panel data has the capability to examine the potential unnoticeable trading per individual effects. When individual effects are omitted, OLS estimates will be biased if individual effects are correlated with the regressors.

2.4 SECTORAL ANALYSIS

2.4.1 Trade within industry

The exchange of differentiated agricultural products between these two countries is called intra-industry trade. In recent years, an enormous fraction of productivity regarding trade has given more importance to the variety of products instead of the unique type of products (Venables, 2001).

The mathematical representation of trade taking place in the agricultural industry is described in equation 2.3 (Grubel and Lloyd, 1993):

$$T = 1 - \frac{|X - M|}{X + M} \tag{2.3}$$

where M represents imports in value and X denotes exports. T represents the level of intra-industry trade. The value of T is always positive and varies from 0 to 1. When T=0 it means that there is no intra-industry trade in the agricultural sector in this case. The best example can be taken from the communication sector in South Africa, where cellular phones have a T-value equal to 0, whereas the motor industry sector has a T value for automobiles equal to 1.

T is also known as the Grubel and Lloyd index. The T-index was developed by Grubel and Lloyd (1993) for the purpose of measuring the degree of intra-industry trade. The T-index, nevertheless, is the most commonly used index for measuring differences in various industries related to intra-industry trade. Furthermore, it indicates the changes that have occurred over the time during intra-industry trade. The focus is on the particular sector (Grubel and Lloyd, 1993).

2.4.2 Trade representation and facilitation

As mentioned above in the first stage of estimation, equation 2.3 is estimated for the agricultural sector. It was also mentioned in section 2.2 that the gravity model can be used to infer bilateral export potential. Usually, a gravity equation is estimated, which explains bilateral trade flows between specific countries where trade should reach its potential.

The issue regarding factors such as tariffs, which still limits trade, is resolved by using dummy variables. Yeyati (2003) confirms that with declining traditional barriers to trade — falling tariff barriers and attempts to reduce non-tariff barriers — attention is now being shifted to other obstructions to trade, such as trade negotiation or facilitation. As a result, trade facilitation is an issue which need more investigations. It consists of addressing transport cost, customs clearance, inventory, communications, and standards.

Generally, as analysed by Loungani, Mody and Razin (2002) in the gravity model, transaction costs and transportation are defined by the variables such as the common boundary and the real distance between exporting and importing countries. In fact, the distance is the great sphere distance between *i's* and *j's* capital of the two countries. The formula developed for calculating the distance between the exporting and importing countries is given below:

$$D_{ij} = Arc\cos\left[\sin\varphi_i \sin\varphi_j + \cos\varphi_i \cos\varphi_j \cos\Delta_{ij}\right] z \qquad (2.4)$$

with z= km or miles as a unit. The latitude is represented by φ and the longitude λ is converted into radians (΄P / 360).

2.4.3 Revealed comparative advantage

In view of testing the revealed comparative advantage of the South African agricultural sector against Angola and the rest of the world, it is important to calculate an index which can compare the share of the agricultural sector in national exports with the share of this sector in the world export. In 1965, Bela Balassa was the first to publish the measure Revealed Comparative Advantage (RCA) (Balassa, 1965: 99-123). Since then, various researchers (Aquino, 1981; Crafts and Thomas, 1986; UNIDO, 1986; World Bank, 1994; etc.) have used the RCA as a measure of trade specialisation. The RCA is described in equation 2.5 below:

$$RCA_{ij} = \frac{X_{ij} / \sum X_{ij}}{\sum_j X_{ij} / \sum_i \sum_j X_{ij}} \qquad (2.5)$$

The numerator, which is the formula above the line in equation 2.5, indicates the contribution of a specific industry *i* which is exported from country *j* within a national system of exports — X_{ij}. The denominator represents the sum of exports of the sector or industry of all the countries in the world (total world exports). For example, if the RCA equals 1 for a given sector and country, then the share should be identical to the contribution of that specific sector in the entire world exports (Yeyati, 2003). When RCA

has a value of greater than one (RCA>1) then the country specialises in that sector and when RCA has a value of less than one (RCA<1), the country has little or no outputs of that product or industry. To strengthen the dynamic analysis of each sector's RCA, the change in RCA (RCA_t - RCA_{t-1}) can also be measured.

2.5 TRADE POTENTIAL

Trade potential is evaluated on the basis of the available information on trade between two countries (Hummels, 2001). In most cases, the formula is applied to a wide range of countries commonly grouped according to their level of development. For each exporting country *i* from a particular group, it is possible to calculate the $\hat{X}_{ij}$ for each of its partner countries according to the gravity specification. To adjust the trade potential from systematic effects, the "a posterior"[2] (which is the empirical fact deduced from the effects to causes) fixed effect F_i is given as follows:

$$F_i = \sum_j X_{ij} \Big/ \sum_j \hat{X}_{ij} \tag{2.6}$$

The trade potential TP_{ij} is calculated as: $TP_{ij} = F_i$. This procedure calculates trade potential using "fixed effects" for countries not used in the estimation. These systematic effects capture factors such as customers who are assigned to suppliers in a random manner which would explain why a country would get more or less involved with worldwide trade than if it were based solely on the factors which determine trade according to the gravity equation (Harmse, 2004).

Similarly, the fixed effects are now specific to the importing country *j*. The "a posterior" fixed effect F_j is formally defined as:

[2] Which is the empirical fact deduced from the effects to causes.

$$F_j = \sum_i X_{ij} \Big/ \sum_i \hat{X}_{ij} \qquad (2.7)$$

Accordingly, the trade potential TP_{ij} is calculated as: $TP_{ij} = F_j$. The trade potential calculated with a fixed effect for the importer (TP_{ij}) is different from the trade potential calculated with a fixed effect for the exporter (TP_{ji}), because the fixed effects for an importer and exporter are dependant on variables such as the size of the economy of both countries. The size of the economy of the exporting country is not equal to the size of the economy of the importing country. Therefore the gravity model evaluates the potential for bilateral agricultural trade flows between South Africa and Angola. The agricultural sector is one of the priority sectors identified by the South African government because of its potential to increase exports.

2.6 RESTRICTIONS OF THE GRAVITY MODEL

Regardless of its experimental achievements, many criticisms have been raised against the gravity model. The biggest objection, though no longer prevalent, concerns the lack of theoretical foundations (Leamer, 1994). Even though, at times, the gravity model has been challenged for its lack of sufficient economic theory, researchers regard this tool as an 'intuitive' model (Kalirajan, 1999).

2.6.1 Restrictions for small and diversified economies

The gravity model actually reflects the trade potential of a country when relatively diversified. Trade specialisation and trade complementarity between the countries is not taken into account in an aggregated gravity approach and essentially explains the large residuals. This is particularly true for small or weakly diversified economies, with one or two major export commodities. The trade potential is only indicative for poorly diversified countries. If such an economy had been more diversified, it would have traded more with its "natural trading partners", as predicted by the gravity specification, than with countries that have a need for its products (Harmse, 2004).

2.7 THE MODEL DATA

The set of data used in this study up to 2003 was extracted from the Standard Industrial database and used to test all 154 countries as mentioned in Section 2.1 above. Export data were collected from the dti statistical portal[3] while distance data were collected from Indo.com[4]. GDP, population, oil and exchange rate figures were collected from International Financial Statistics (IFS).

2.8 SUMMARY

The purpose of this chapter was to review the gravity model's basic specification and its extensions in recent trade flows applications. The literature review indicated that the gravity model is constructed through the use of a gravity equation which can be used to measure the potential for bilateral trade. It determines the potential for trade by making use of variables such as the size of the economy, income, prices and exchange rates between trading partners. Transportation fees and market access elements are also important and are therefore added to the gravity equation.

The gravity model, with foundations in the physical sciences, has consistently proved to be a useful instrument for the analysis of bilateral trade flows. Isaac Newton originally devised the model to explain gravitational force in the world, theorising that the gravitational pull between two earthly bodies is positively related to the product of their masses and inversely related to their distance apart. Respectively, in its simplest form, the gravity model as applied to trade, predicts that the amount of trade between two economies will be positively related to the product of their outputs, a measure of size or mass, and negatively related to the distance between them.

[3] See http://www.thedti.gov.za

[4] See http://www.indo.com/distance/

The importance of exchange of differentiated products of the same industry between countries was noticed in Section 2.4. In recent years, an enormous fraction of productivity regarding trade has given more importance to the variety of products instead of the unique type of products.

The following chapter provides some credible elements of the gravity model as well as a detailed description on the workings of the model.

CHAPTER 3: THE GRAVITY MODEL

3.1 INTRODUCTION

As explained in chapter 2, the gravity model is a tool with the ability to perform dynamic analyses of bilateral trade between the export destination countries and South Africa. A range of explanatory variables are used in the gravity model, of which some are likely to remain relatively unchanged, such as cultural difference, language, distance and other geographic variables.

This chapter provides some credible elements of the gravity model as well as a detailed description on the workings of the model. The empirical estimation of total exports is discussed in section 3.2. Section 3.3 considers the model specification, which is mathematical represented and decomposed in the system. Section 3.4 describes the estimation of the equation, followed by a summary of the chapter.

3.2 EMPIRICAL ESTIMATION OF TOTAL EXPORTS

Figure 2.1 from the above section 2.2 provided a graphical representation of the gravity equation, which shows that potential supply and demand is determined by the size of each respective economy. Figure 2.1 also presents the potential trade flows between various countries.

The mathematical representation of a generalised gravity model is shown in equation 3.1 (the dti gravity model, 2004):

$$\ln X_{ijt} = C_0 + \beta_1 \ln EX_{jt} + \beta_2 \ln GDP_{jt} + \beta_3 \ln GDPSA_{it} + \beta_4 \ln Pop_{jt} + \beta_5 \ln PopSA_t + \beta_6 \ln oil + \varepsilon_{ijt} \quad (3.1)$$

where:

X_{ijt} = Total export for the exporting country (SA) to destination j such as Angola

C_0 = Intercept

EX_{jt} = Exchange rate related to exporting country and importing country j. The exchange rate is used as a proxy for relative prices.

GDP_{jt} = Gross Domestic Product from destination j

$GDPSA_{it}$ = Gross Domestic Product of the country exporting goods to SA

Pop_{jt} = Population of country j

$PopSA_{it}$ = Population of South Africa

Oil = Oil price

The error term, ε_{ijt}, is decomposed as a single error component model i.e.

$$\varepsilon_{ijt} = \mu_j + \nu_{ijt}. \tag{3.2}$$

with μ_j as the country-specific effects while ν_{ijt} is a white noise residual[5]

The country-specific effects (μ_j) are time-invariant characteristics of the different countries. These include all the factors that are unique to each country but not included in the gravity model. Examples include:

(i) The unobservable time-invariant political characteristics.

(ii) The unobservable time-invariant entrepreneurial and managerial skills of the firms' executives in the different countries.

(iii) The time-invariant political economy issues in each country.

Various motivations can be given as to why the gravity model can be estimated using a panel data framework. Firstly, panel data makes it feasible to establish relationships between regressors for a period of time. Secondly, panel data has the capability to scrutinize the probable unnoticeable trading per individual effects. In the case where there is a correlation between individual effects and regressors in the model, the

[5] The white noise error is a statistical variable. It has a zero mean, constant variance and is serially uncorrelated

OLS estimates are not recommended, especially when the individual effects are not taken into consideration (Harmse, 2004).

The choice between fixed and random individual effects must be done by the modeller before performing the regressions. Theoretically, the use of the random effects model (REM) is advised when the samples are taken from a large population for analysing trade flows. Another option is given by using the FEM when the selection of countries is done in advance (the dti gravity model, 2004).

The problem with the FEM occurs when the modeller is unable to evaluate the variables which remain unchanged for a period of time. Additionally, by using the least squares dummy variable (LSDV) method, there will be accurate co-linearity between the variables and dummy variables used within the fixed effects (Venables, 2001). There are, however, studies in which these variables were estimated after performing more than one regression (Cooke, 2002). In other words, a two step-estimation procedure is implemented. In the first step, a standard gravity model, specified in Equation 3.1, is estimated. The second step involves a process where the estimation of the fixed effects is regressed on variables such as distance, dummies for language and FTAs. This is depicted in the equation 3.3:

$$\hat{\mu}_{ij} = \alpha_0 + \alpha_1 Dis_j + \alpha_2 Lang_j + \alpha_3 EU_j + \alpha_4 AFR_j + \alpha_5 NAFTA_j + \alpha_6 MERC_j + \beta_7 Mide + \beta_8 Asia + u_i \quad (3.3)$$

where:

$\hat{\mu}_{ij}$ = denotes the estimated country-specific effects

Dis_j = Distance in kilometre between Pretoria and trading partner's capital city e.g. London for the UK

$Lang_j$ = Language dummy for trading partner. The coding used is English = 1, other = 0

EU_j = European Union dummy. The coding used is EU member = 1, other = 0

AFR_j = African dummy. The coding used is African country = 1, other = 0

$NAFTA_j$ = North Atlantic Free Trade Agreement dummy. The coding used is NAFTA member = 1, other = 0

$MERC_j$ = Mercosur FTA dummy. The coding used is Mercosur member = 1, other = 0

$MIDE_j$ = Middle East dummy. The coding used is Middle East member = 1, other = 0

$Asia_j$ = Asian country. The coding used is Asian member state = 1, other = 0

3.3 MODEL SPECIFICATION

The mathematical representation in equation 3.4 embodies the specification of the gravity model. The model developed by Oguledo and MacPhee (1994) and Cheng and Wall (2005) is taken into consideration in this study. The model specifies the generalised gravity panel model that can be written as follows:

$$\ln X_{ijt} = C_0 + \beta_1 \ln EX_{jt} + \beta_2 \ln GDP_{jt} + \beta_3 \ln GDPSA_{it} + \beta_4 \ln Pop_{jt} + \beta_5 \ln PopSA_t + \beta_6 \ln oil + \varepsilon_{ijt} \quad (3.4)$$

where X_{ijt} refers to South Africa's exports to country j and EX_{jt} the exchange rate between South Africa and country j (Rand/foreign currency). The exchange rate is used as a proxy for relative prices and *oil* represents the oil price. GDP_{jt} is the gross domestic product for the importing country such as Angola, $GDPSA_{it}$ is South Africa's GDP, Pop_{jt} is the importer's population size and $PopSA_{it}$ is South Africa's population size.

The error term, ε_{jt}, is decomposed as a one-way error element in the system and can be written as follows:

$$\varepsilon_{jt} = \mu_j + \nu_{ijt}. \quad (3.5)$$

where μ_j is the country-specific effect and time-invariant characteristics of the different countries, and ν_{ijt} is the white noise residual. These include all the factors that are unique to each country, but which are not included in the gravity model.

3.4 ESTIMATION

Cheng and Wall (2005) suggested that the gravity equation should be estimated by following two stages. In the first stage, equation 3.4 is estimated for the agricultural sector. A fixed effects model (FEM) is used, given that the interest pertains to estimating trade flows between two countries (Klasen, 2004).

The first stage concerns the evaluation of the fixed properties. These are then regressed on variables such as distance, dummies for language and Foreign Trade Agreements (FTAs). This can be seen in equation (3.6).

$$\hat{\mu}_{ij} = \alpha_0 + \alpha_1 Dis_j + \alpha_2 Lang_j + \alpha_3 EU_j + \alpha_4 AFR_j + \alpha_5 NAFTA_j + \alpha_6 MERC_j + u_i \qquad (3.6)$$

where:

- $\hat{\mu}_{ij}$ represents the estimated country-specific effects from Equation 3.4;
- Dis_j represents the distance, in kilometres, between Pretoria and the trading partner's capital city;
- $Lang_j$ represents the English language dummy. Trading partners, whose official language is English, are coded 1 and if not, they are coded 0;
- EU_j represents the European Union dummy (EU members are coded 1 and others 0);
- AFR_j represents the African dummy (African countries are coded 1 and others 0);
- $NAFTA_j$ represents the North Atlantic Free Trade Agreement dummy (NAFTA members are coded 1 and others 0);
- $MERC_j$ represents the Southern Common Market (MERCOSUR[6]) Free Trade Agreement (FTA) dummy (MERCOSUR members are coded 1 and others 0).

[6] The Southern Common Market (MERCOSUR) was created by Argentina, Brazil, Paraguay and Uruguay in March 1991. The European Commission and the European Union have supported MERCOSUR from the very beginning. Since 1991, EU-MERCOSUR relationship consists of three elements: political dialogue, co-operation and trade issues. Since 1999, the EU and MERCOSUR are negotiating an Interregional Association Agreement.

The second stage is concerned with the fixed effects model. In the fixed effects model, it is not possible to estimate directly variables that do not change over time because the inherent estimation transformation wipes out such variables. These variables can also be easily estimated when performing another regression with the individual effects accepted as the dependent variable while distance and dummies variables are considered as explanatory ones. Furthermore, the use of the least squares dummy variable (LSDV) method shows that the variables are entirely collinear with dummy variables used in the fixed effects.[7]

The majority of researchers use Ordinary Least Squares (OLS) estimates for the equation of the gravity model and ignore possible data collection requirements for the regression analysis (Anselin, 1998). According to Deardorff (1998), income and distance are the most important regressors of gravity models. Likewise, Keller and Evenett (1998) proved that the success of the gravity equation depends on increasing-returns-to-scale-based theories of trade. In their empirical investigation, the focus was on the proportionality of the volume of trade to the trading countries' incomes and not on its relationship to trade resistance. Rose, Feenstra and Markusen (2001) do not agree that practical gravity models can be applied to differentiate other theories of trade since a good relationship between trading partners prevents resistance to trade.

In his research, Polak (1996) shows that natural favouritism is important factor. When the distance is further between two countries, then natural favouritism is reduced compared to the short distance. Hamilton and Winters (1992) also call for a "more differentiated measure of distance." Brulhart and Kelly (1999), include a distance measurement based on the GDP of the country's partner in their OLS estimation. Concerned with the uncertain situation, Mulligan (1998) recommended that "Box-Cox transformations[8]" be applied so that the linear model becomes more appropriate to the data. Therefore the estimation of the equation and the agricultural sector is necessary for analysing the potential bilateral trade

[7] Variables are collinear if they lie on the same line

[8] In statistics, the Box-Cox transformation of the response variable Y is used to make the linear model more appropriate to the data. It can be used to attempt to impose linearity, eliminate skew or stabilize the residual variance. The Box-Cox transformation, can be applied to a regressor, a combination of regressors, and/or to the dependent variable in a regression. The objective of doing so is usually to make the residuals of the regression more homoskedastic and closer to a normal distribution.

between South Africa and Angola. The simulation results show that profitability in the agricultural sector is sustainable if its benefits result in greater access of the agricultural sector in the global competitiveness.

3.5 SUMMARY

The purpose of this chapter was to describe the dti gravity model. Throughout the chapter, various reasons have been given as to why the gravity model can be estimated using a panel data framework. Firstly, panel data makes it feasible to establish relationships between regressors for a period of time. Secondly, panel data has the capability to examine the potential unnoticeable trading per individual effects.

Section 3.2 showed that the choice between fixed and random individual effects must be done by the modeller before performing the regressions. Theoretically, the use of the REM is advised when the samples are taken from a large population for analysing trade flows. Another option is given by using the FEM when the selection of countries is done in advance. The coefficients are used to build a baseline gravity model for total exports. The model is solved to provide fitted export values to different countries, which are treated as potential exports.

The estimation and specification of the model was performed in two stages in Sections 3.3 and 3.4. The first stage focused on the fixed properties while the second stage was concerned with the fixed effects model where it was not possible to estimate directly variables that do not change over time.

Given that Chapters 2 and 3 have set the scene for the empirical evidence from South Africa, the next chapter will discuss the overview of the South African agricultural sector. Thereafter, in Chapter 5, the results from the application of the gravity model are presented.

CHAPTER 4: SOUTH AFRICA'S AGRICULTURAL SECTOR

4.1 INTRODUCTION

This chapter presents an overview of the South African agricultural sector. It gives a general understanding within government and the agricultural industry on the South African agricultural trade policy. Besides, it elaborates the challenges that the sector faces with regard to trade and the application of policy instruments. An attempt is made in giving the strategic policy direction that can form part of governments' plans of action and be monitored to measure progress. Therefore, the use of the gravity model as an instrument becomes necessary in evaluating progress made.

The remainder of this chapter is organised as follows. Section 4.2 considers the importance of trade in the agricultural sector, after which, Section 4.3 presents the trends in South African agricultural trade. Section 4.4 shows the constraints between government and industry. Section 4.5 contributes towards strategic objectives of trade policy, followed by a summary of the chapter.

4.2 IMPORTANCE OF TRADE IN THE AGRICULTURAL SECTOR

Given the role that the agricultural sector plays in South Africa's economy, it is imperative, from a trade policy perspective, to determine the potential for trade of agricultural goods between South Africa and Angola. The gravity model is the reliable instrument to be used for analysing the potential for trade between the two countries.

In recent years, significant changes have occurred in the economic policy environment of South Africa. In fact, these changes have contributed to a remarkable growth in trade. The agricultural sector moved rapidly from protectionist statutory involvement prior to the mid nineties, to deregulation, liberalization and an open economy. The devaluation of the rand during the 1990s contributed partially to the growth in exports. However, the successful political transition in 1994 contributed to a relatively easy shift to a more open economy (TIPS, 2005).

There has been a considerable increase in trade in the agricultural sector which is important for South Africa's welfare. In the last decade or so, agricultural exports have grown significantly in importance. They represent 37 per cent of the total value of production, whereas imports represent only 23 per cent. As an agricultural exporting country, South Africa has a positive agricultural trade balance. The agricultural exports contribute on average a steady 8 percent of total South African exports while the agricultural imports for 2005 accounted for 5 per cent of total imports (World Bank, 2005).

4.3 IMPLICATIONS AND TRENDS IN SOUTH AFRICAN AGRICULTURAL TRADE

The political adjustment in South Africa and policy changes in the agricultural sector contributed to a remarkable increase in the role of trade in the agricultural economy since 1994. Globalisation influenced and impacted changes in consumer preferences, food safety considerations, social and technical conditions and intellectual property. This has affected government trade diplomacy, industry positioning, educational levels and the scale of investment for producers and exporter businesses (the dti gravity model, 2004).

4.3.1 Export trends

Agricultural exports contributed 8 per cent to the total exports on average in 2005. Edible fruit, beverages, prepared vegetables, sugars, cereals, tobacco and wool were the main agricultural exports (World Bank, 2005).

Agricultural exports, over the past decade, have increased from R5 billion in 1990 to R25 billion in 2005, representing a 40 per cent increase in US Dollar terms. Export volumes increased by 25 per cent (regression trend) and 36 per cent (real values) over the past 15 years. With the strengthening rand at its peak in 2004, the export value only decreased by about 10 per cent, although export volumes have dropped by half. Nonetheless, the share of agricultural exports in the total value of agricultural production made a considerable improvement. It increased gradually since the mid nineties from 20 per cent to 30 per cent in 2005 (World Bank, 2005).

The largest contributor to export growth over the past five years was the value addition. The composition of agricultural exports has moved extremely towards processed products. In 1995 it was up to 33 per cent of the export value and increased to 56 per cent in 2004. In terms of regulatory requirements, processed product exports are less restricted. Therefore it would be easier to enlarge first when new markets and opportunities open up. The reliance of the agro-processing sector on a competitive primary sector should not be under evaluated in the context of total value chain competition in foreign markets (the dti gravity model, 2004).

South Africa's largest single export market for agricultural products, although its share of exports has dropped from 61 per cent in 1988 to 42 per cent in 2005, is the European Union. South Africa's second largest agricultural export market is the Southern Africa Development Community (SADC), accounting for 17 per cent of exports (EU annual report, 2005).

Since the mid-nineties, agricultural export markets have diversified to new, faster growing, developing and non-traditional markets of Africa. The most attractive markets are found in West Africa, Eastern Europe, Asia, Middle East and North America. The non-traditional markets have almost tripled, since the mid-nineties with its share of the South African agricultural export basket increasing from 15 per cent to 41 per cent (World Bank, 2005).

In the fast-growing priority markets, South African agricultural exports continue to be under-represented. Structural analysis shows that predominantly the US market is considerably under represented, partly as a result of the rigorous import ban of the past. Although agricultural exports to the US market are growing rapidly, it may take a long time to obtain broad based access for fresh produce (TIPS, 2005).

Based on the export trends presented above, the practical estimation of the potential for agricultural exports will be evaluated in the next chapter.

4.3.2 Import trends

Despite structural deficits in some products, South Africa imports mostly products such as cereals, fats & oils, animal feed, meat, miscellaneous food and dairy products, beverages (spirits and vinegar), tobacco, cotton, spices, tea and coffee.

Over the past decade, agricultural imports increased sharply from R2 billion in 1991 to R16 billion in 2005, representing a 40 per cent increase in US dollar terms. Agricultural imports for 2005 accounted for 5 per cent of total imports. The world's principal agricultural suppliers are Argentina, Brazil, Thailand, United States, United Kingdom, China, Germany, India, Australia and Malaysia (World Bank, 2005).

In the South African market, African suppliers are underrepresented. Generally South African agricultural exports to African countries are in the ratio of about eight or nine to one in South Africa's favour. South Africa is in a strong position in Africa as a supplier of managerial services, food distribution outlets, productive inputs and investment and financial services to African countries (TIPS, 2005).

As mentioned in Section 4.2 above, the share of the import of agricultural products to total imports must be increased. Both imports and exports of various products are important for the agricultural sector. The potential trade and the fluctuation of the coefficient for the agricultural sector will be tested through the application of the gravity model in chapter 5.

4.3.3 Trends, Opportunities and Strategic commitments

There is a need for South Africa to be globally competitive in the agricultural sector because of the integration pressure in the world economy today. Failure to do so will lead to marginalisation (World Bank, 2005). World trade has accelerated over the last decade, growing faster than the world GDP. This means that growth opportunities are typically greater for agricultural exports and imports than they are for domestic sales, a trend that could be exploited by developing countries (World Bank, 2005).

The export trend in South Africa highlights the need to focus attention on new markets and products that show potential for future growth. The changes in social and economic conditions are causing significant shifts in global food markets. In particular, the world's prosperous consumers are forecast to increase by 850 million by 2010. These consumers will be demanding more specialised, high quality

products and services. Currently 65 per cent of affluent consumers live in the developed world, but by 2010, it is estimated that around 60-70 per cent will live outside the United States, the European Union and Japan (World Bank, 2005).

Globalisation, however, is not limited to governments or multinationals. Small and medium sized companies are creating global networks of customers and they use the latest technology to overcome geographic and cultural barriers. For many small and medium sized operators co-manufacturing and strategic alliances with overseas companies offer a preferred strategic option for market entry in agricultural sector. Foreign direct investment (FDI), the formation of strategic international partnerships and supply chain management are becoming more important drivers of export growth (EU annual report, 2005).

High levels of domestic support, paid by developed countries to their agricultural sectors, are a major concern for the agricultural development in developing countries. This support, estimated at US $1 billion a day, distorts markets and production and makes it impossible to compete fairly in affected markets. Export subsidies continue to negatively influence international competition and world prices (World Bank, 2005). Nonetheless, tariff peaks and tariff escalation hamper the export of agricultural products value added while import duty levels in developing countries impact on market access opportunities.

The coefficients obtained from the gravity equations will be used to evaluate bilateral trade flows between South Africa and Angola. Therefore, growth opportunities for both exports and imports could be identified and developed through the use of the gravity model.

4.4 CONSTRAINTS BETWEEN GOVERNMENT AND INDUSTRY

Persistent changes in the local and global economic scene have impacted on agricultural trade and the production environment. However, at the same time, deregulation, global and domestic societal changes, and policy and trade flow changes have resulted in a multitude of uncoordinated initiatives, opportunities and challenges. Considering the external changes and the need for stronger coordination and alignment

between government departments, there is a need to renew the existing policy for agricultural trade for the purpose of stimulating growth, employment and income in the agricultural sector (Department of agriculture, 2006).

The new policy will align government policy between departments on trade in agriculture. The policy will also broadly align government actions and stakeholder expectations with respect to bilateral trade. In fact, the tariff application and investment promotion instruments will benefit government and industry (the dti gravity model, 2004).

4.5 STRATEGIC OBJECTIVE OF TRADE POLICY

The strategic objective is directed at "*eventual multilateral free trade in agricultural goods on the basis of fairness and equity taking sustainable development and sustainability of resources into account*" (the dti gravity model, 2004).

Until multilateral free trade can be achieved, the South African government will provide a balance of protection and support to domestic agriculture. This support is related to subsidies and unfair trade practices applied by some countries (World Bank, 2005).

This policy draws upon the initial Global Economic Strategy of the South African government and emanates from the Strategic Plan for South African Agriculture. It will be pursued along a number of axes, namely in domestic policies and in *bilateral*, regional and multilateral trade agreements.

4.5.1 Global Economic Strategy

Globally, the economy of South Africa is in a transitional and developing stage (World Bank, 2005). There are challenges which hinder the access to sustainable economic activity and employment of South African citizens. According to the Global Economic Strategy the challenges are the following:

- contribute to poverty alleviation;
- enhance job creation;
- achieve sustainable integration into the global economy;

- increase opportunities for black economic empowerment and Small Medium and Micro Enterprises (SMMEs); and
- contribute to the development of Africa.

These concerns need to be resolved in the context of globalisation. Therefore, efforts must be made in increasing changes in investment and trade flows, changes in global production patterns and the formation of trade networks, and rapid changes and advances in information exchange, communications and technical advances. Africa finds itself increasingly marginalized and excluded from the benefits of globalization and the benefits of trade. This will require an African Development Strategy that also addresses Africa's trade with the world and with itself (World Bank, 2005).

Stable macro-economic policies, access to key markets and the main poles of economic growth, the development of technical capacities in partnership with the private sector, sufficient human capital and a skills base, low cost, and transparent economic governance are the crucial requirements identified by the South African government to compete in this dynamic and evolving global environment (the dti gravity model, 2004).

4.5.2 Tariffs and other implementation strategies

Regarding the strategic intervention in trade and competitiveness, the South African government recognises the lack of a tariff policy or directives that can guide consistent and rational application of liberalization or protection of trade across all sectors. The purpose of this strategic intervention is to use resources optimally and to sustain long-term productivity. As a result, there is lack of policy guidance on the role of liberalization and protection in sustainable development in rural areas and sustainable natural resource utilization in agriculture (the dti gravity model, 2004).

The South African government should therefore attempt to establish further detail on the policy directives with scientific and rational basis and could give guidance to the International Trade Administration Commission (ITAC).

The South African government is concerned that there are various adverse policy effects that ad hoc government intervention, such as the application of liberalization or protection and the timing thereof,

may have on the agricultural sector. On the one hand, high government intervention that is incorrectly applied can cause mono-crop expansion of production in marginal areas and distort investment. On the other hand, wrongly timed liberalization without integration with an economic development plan can cause de-industrialization and economic decay in rural areas, soil degradation and degradation of renewable resources and failure of land reform and black economic empowerment in the agricultural sector (Department of Agriculture, 2005).

Thus, there is a need to formulate guidelines for the application of import tariffs to agricultural products to ensure efficient implementation with limited negative disruption for the agricultural industry and limiting the welfare loss to consumers. These guidelines should under the International Trade Administration Act (Act No. 71 of 2002) be the principles under which ITAC will consider tariff applications from the agricultural industry. This procedure will prevent the ad hoc nature of agricultural tariff decisions (the dti gravity model, 2004).

4.6 SUMMARY

The underlying principle of this chapter was to present an overview of the agricultural sector. The chapter gives a general understanding of the South African agricultural trade policy. Besides, it elaborates the challenges that the sector faces with regard to trade and the application of policy instruments.

An attempt is made in giving the strategic policy direction that can form part of South African governments' plans of action and be monitored to measure progress. Therefore, the use of the gravity model as an instrument becomes necessary in evaluating the progress.

Section 4.3 shows that, over the last decade, agricultural exports have increased from R5 billion in 1990 to R25 billion in 2005, representing a 40 per cent increase in US Dollar terms. Export volumes increased by 25 per cent (regression trend) and 36 per cent (real values) over the past 15 years. With the strengthening rand at its peak in 2004, the export value only decreased by about 10 per cent, although export volumes have dropped by half. Nonetheless, the share of agricultural exports in the total value of

agricultural production has made a considerable improvement. It increased gradually since the mid nineties from 20 per cent to 30 per cent in 2005.

In fact, there is a need for South Africa to be globally competitive due to integration pressure in the world economy today. Failure to do so will lead to marginalisation. World trade has accelerated over the last decade, growing faster than the world GDP. This means that growth opportunities are typically greater for exports and imports than they are for domestic sales, a trend that could be exploited by developing countries.

This chapter sets out the agricultural sector explicitly and the impact of agricultural trade policy. The following chapter describes the empirical use of the gravity model in this study, as well as the various simulations performed, the interpreted results, and provides evidence regarding the potential for trade between South Africa and Angola in the agricultural sector.

CHAPTER 5: EMPIRICAL APPLICATION: AN EXTENSION TO TRADE FLOWS BETWEEN SOUTH AFRICA AND ANGOLA

5.1 INTRODUCTION

This chapter explores the potential for bilateral agricultural trade flows between South Africa and Angola. A gravity model is empirically tested to investigate the trade potential. Emphasis is placed on the real economic situation of these two countries and RCA coefficient to be measured. The actual and potential level of trade for the agricultural sector will then be measured. In addition, the standard gravity model is augmented with a number of variables to test whether they are relevant in explaining trade. These variables are GDP, real exchange rates and the oil price. Finally, this chapter analyses to what extent potential for trade between these two economies are important.

The remainder of this chapter is organised as follows. The current evaluation of the sector is offered in Section 5.2. Section 5.3 considers the practical evaluation of the agricultural sector. Section 5.4 exposes the outcome of the practical application followed by a summary of the chapter.

5.2 CURRENT EVALUATION OF THE AGRICULTURAL SECTOR

The agricultural sector is one of the priority sectors identified by the South African government because of its potential to increase exports. The trade balance for priority sectors, as evaluated by the dti, is given in Table 5.1 below. In the agricultural sector, the trade balance increased constantly from 3,255 million in 1997 to 5,385 million in 1999, a massive increase of approximately 65 per cent. A slight decrease occurred in 2000 (from 5,385 million to 4,625 million), after which, a sharp increase is registered from 7,149 million in 2001 to 8,310 million in 2003. Although another rise had been expected for the following year, the decrease had come as a surprise from 8,310 million to 7,850 million in 2004. Nonetheless, it is observed

that after every three years of increase the trade balance is doomed to decrease.[9] One of the reasons for this trend could be the application of import tariffs to agricultural products. This could ensure efficient implementation with limited negative disruption for the agricultural sector.

Percentage share in the agricultural sector has been positive from 1997 (4.5 per cent) to 2004 (6.3 per cent). Growth in the agricultural sector has been strong, with exceptions in 2000 (-14.1 per cent) and in 2004 (-5.5 per cent). The considerable decrease in 2000 can be explained by the severe drought experienced during that year (see Table 5.1). For example, the percentage growth in the agricultural sector in 2004 decreased by 5.5 per cent compared to the manufacturing sector, which increased sharply by 36.9 per cent, even though the mining sector performed badly, with a decrease of 14.5 per cent during the same period.

The estimation of the agricultural sector and its equation from the gravity model is necessary for analysing the potential bilateral trade involving South Africa and Angola. In fact, the assessment of the potential trade can be done through the application of the gravity model, and the results can be compared to the actual bilateral trade. Therefore, the reasons why potential trade is not realised have to be investigated. This might assist the government in both its bilateral trade negotiations and identify areas of possible government intervention.

[9] Once again proving the economists' belief that the economy moves in cycles.

Table 5.1: South Africa's trade balance

	Trade Balance Rand million								
	1997	1998	1999	2000	2001	2002	2003	2004	2004/2005
Total	**3,596**	**782**	**18,199**	**22,765**	**35,297**	**38,674**	**16,742**	**-10,681**	
Agriculture	3,255	4,053	5,385	4,625	7,149	7,996	8,310	7,850	
Mining	34,595	45,063	46,085	49,247	62,808	79,337	57,177	48,897	
Manufacturing	-34,741	-48,881	-34,021	-31,643	-34,965	-48,377	-48,908	-66,965	
Other Trade	487	548	750	537	305	-282	164	-462	
	Percentage Share								
Agriculture	4.45	4.11	6.24	5.37	6.79	5.88	7.25	6.32	
Mining	47.34	45.73	53.44	57.23	59.69	58.34	49.91	39.38	
Manufacturing	-47.54	-49.6	-39.45	-36.77	-33.23	-35.57	-42.69	-53.93	
Other Trade	0.67	0.56	0.87	0.62	0.29	-0.21	0.14	-0.37	
	Percentage growth								
Total	**-5.3**	**34.85**	**-12.49**	**-0.22**	**22.28**	**29.24**	**-15.76**	**8.39**	**9.6**
Agriculture	6.9	24.51	32.88	-14.12	54.58	11.84	3.93	-5.53	14.14
Mining	-3.41	30.26	2.27	6.86	27.54	26.32	-27.93	-14.48	-0.18
Manufacturing	-7.85	40.7	-30.4	-6.99	10.5	38.36	1.1	36.92	20.61
Other Trade	-19.35	12.48	36.96	-28.46	-43.19	-192.43	-158.24	-381.76	

Source: the dti database

5.2.1 *Trade turnover for the dti priority sectors*

Table 5.2 and Figure 5.1 below present the trade turnover for the period 1992 to 2004. In the agricultural sector, a slight increase occurred from 3.2 million in 1994 to 4.1 million in 1996. There has been no improvement from 1997 (3 million) to 2004 (3 million). Nevertheless, the manufacturing and mining sectors performed well during the same period.

Among the priority sectors, the agricultural sector plays an important role in South Africa. However, the trade turnover remained constant (3 million), especially for the last three years from 2002 to 2004. As mentioned in chapter 4, the South African government should stimulate this sector through applying a tariff policy. The purpose of this strategic intervention is to use resources optimally and to sustain long-term productivity. As mentioned in Section 4.5.2 above, the South African government should therefore attempt to establish further detail on the policy directives that is scientifically and rationally based. This can ensure therefore, efficient implementation with limited negative disruption for the agricultural sector.

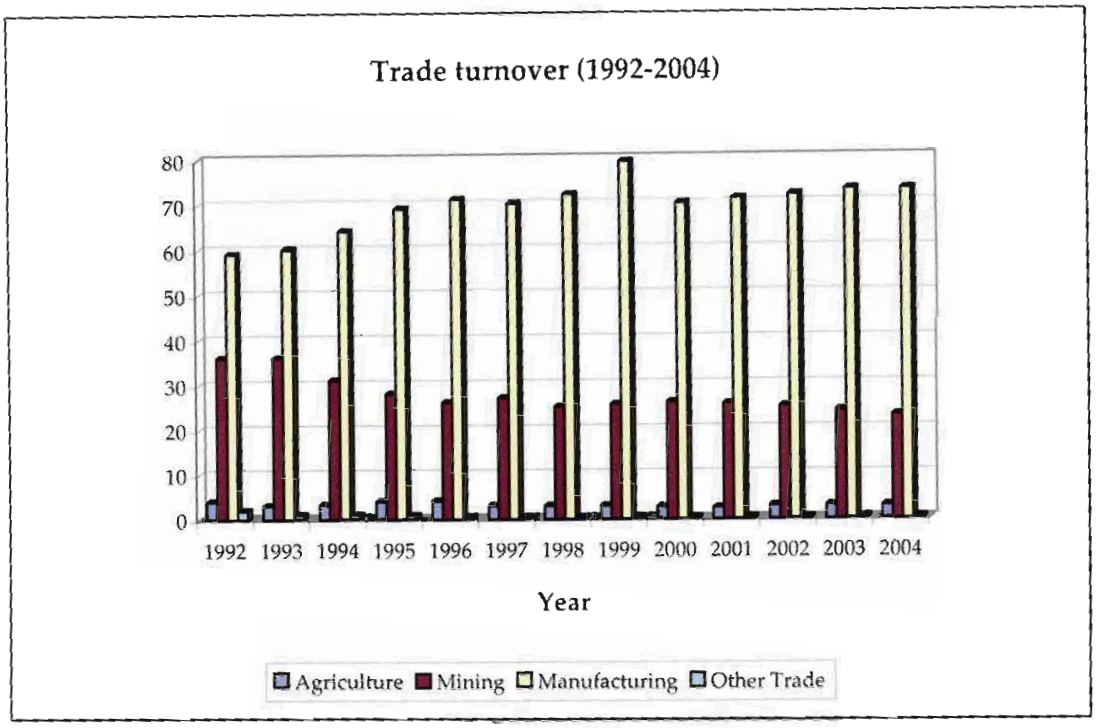
Table 5.2: Trade turnover for the period 1992 to 2004 (R million)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Agriculture	4	3.1	3.2	4	4.1	3	3	3	2.7	2.6	3	3	3
Mining	36	36	31	28	26	27	25	25.5	26	25.6	25	24	23
Manufacturing	59	60	64	69	71	70	72	79.3	70	74	71.8	73	73
Other Trade	2	1	1	1	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Source: the dti database

Furthermore, from Table 5.2 above and Figure 5.1 below, it can be seen that growth in agricultural trade has been relatively stable over the period 1992 to 2004. Accordingly, there is room for improvement in trade in this specific sector.

Figure 5.1: Trade turnover for the period 1992 to 2004 (R million)



Source: the dti database

5.2.3 Employment per sector

Employment figures contained in Table 5.3 indicate that more people were employed in 2006 (834,239) than in 2005 (832,507) in the agricultural sector. The projected figures for the agricultural sector show that in 2007, 835,341 people will be employed while 837,123 and 838,253 people will be employed in 2008 and 2009 respectively.

The weighted annual percentage change for the period 1980 to 2003 gives a negative percentage of –0.78 per cent. The same pattern is noticed with –1.58 per cent for the period between 1994 and 2003. Nonetheless, the figures show a slight increase of 0.15 per cent for the projected period from 2004 to 2009.

The weighted annual percentage change for the period 2004 to the projected year 2009 shows that the agricultural sector will perform better than the mining sector (-1.05 per cent), construction sector (-1.01 per cent) and the transport sector (-0.37 per cent).

Table 5.3: Employment data and projections up to 2009

						Weighted annual % change		
Description	**2005**	**2006**	**2007**	**2008**	**2009**	**1980-2003**	**1994-2003**	**2004-2009**
Agriculture, forestry and fishing	332,507	834,239	835,341	837,123	838,253	-0.78	-1.58	0.15
Mining and quarrying	413,987	411,756	409,064	404,907	397,490	-2.86	-4.86	-1.05
Manufacturing	1,288,008	1,310,947	1,333,868	1,355,610	1,376,820	-1.07	-1.94	1.7
Electricity, gas and water	44,372	44,524	44,661	44,779	44,860	-2.78	-1.58	0.27
Construction (contractors)	327,028	322,422	319,345	317,661	316,755	-1.54	-5.23	-1.01
Wholesale and retail trade	1,354,548	1,387,740	1,417,868	1,448,043	1,476,714	0.89	2.13	2.27
Transport, storage and communication	201,100	199,918	199,213	198,988	199,093	-4.34	-4.33	-0.37
Financial services	1,264,468	1,312,568	1,362,511	1,407,112	1,448,290	4.71	3.53	3.57
Community and other services	344,113	353,316	362,972	372,154	382,064	3.25	3.02	2.64
Community and other producers	1,046,167	1,049,549	1,053,948	1,057,677	1,062,025	-0.22	1.43	0.36
Community and government services	1,571,697	1,618,152	1,657,770	1,695,132	1,733,640	0.73	-1.12	2.68
Total	**8,687,997**	**8,845,133**	**8,996,561**	**9,139,186**	**9,276,003**	**-0.03**	**-0.41**	**1.69**

Source: the dti database

5.3 PRACTICAL EVALUATION OF THE AGRICULTURAL SECTOR

In this section, the gravity model is used to run various simulations for South Africa and Angola. The potential for trade between these two economies is then evaluated from the simulation results. Four simulations are performed in this section. The shock[10] applied to this model affects the macroeconomic variables. These variables are GDP, Exchange rates and the oil price. Each variable is shocked separately while other variables remain constant. For the purpose of the kind of scenarios performed in this study, 5 percent was chosen to shock all variables for illustrative purpose and consistency, even though several simulations could be performed using different percentages such as 5 percent, 10 percent and 15 percent from the gravity model. Regarding especially oil price variable, any positive or negative shock in oil price will affect both countries equally because of its international impact.

As mentioned in section 2.1 above, the dti gravity model was developed by ITPC for the purpose of analysing international trade flows between South Africa and its 154 trade partners. Scientific techniques were used to construct the model. Nevertheless, it must be noted that the numerical information applied in the model included data for the period 1994 to 2003 (the dti gravity model, 2004).

The variables used in the estimation of the model are the variables applied in many previously performed studies, and are considered as the core factors for determining trade. Based on this model, it is possible to calculate potential exports to an individual country such as Angola. Besides, given potential exports, the policymaker can compare this with actual exports, and determine where and to which country exports are under-performing.

The gravity model of trade between these two countries was estimated in a panel data framework. As mentioned in Section 3.4, the use of panel data methodology has numerous advantages over cross-section analysis. Firstly, panel data makes it feasible to establish relationships between regressors for a period of time. Secondly, panel data has the capability to examine the potential unnoticeable trading per

[10] A change in the base or original value of the specific variable.

individual effects. When individual effects are omitted, OLS estimates will be biased if individual effects are correlated with the regressors.

Regarding the individual effects included in the regression, a choice had to be taken either to treat them as fixed or random. Intuitively, the REM would be more suitable when estimating typical trade flows between a randomly drawn sample of trading partners from a larger population. Another possibility is that the FEM is more suitable than the REM when the interest is in estimating typical trade flows between ex ante predetermined selection on nations (Egger, 2000). In this study, the sample includes trade flows with all South Africa's trade partners. Therefore, the appropriate method from our intuition will be a fixed effect specification (Martinez-Zarzoso, 2001).

The concern regarding FME is that it cannot directly estimate variables that do not change over time because the inherent transformation wipes out such variables. Yet, these variables can be easily estimated in a second step, performing another regression with the individual effects as the dependent variable and with distance and dummies as explanatory variables.

Equation 3.1 was estimated for aggregate trade flows using several methodologies. Firstly, for quality control, OLS was used. The results are shown in Table 5.4. Secondly, the regression to cross-section means was applied between estimations obtaining similar results which are shown in Table 5.5. In both cases all the coefficients present the expected sign, apart from the oil price variable.

Table 5.4: OLS results for the basic gravity equation

	Coefficient	t-Statistic
Constant	-108.64	-3.11
Exchange rate of the Rand per unit of US dollar	0.33	0.59
Gross domestic product of countries importing goods from South Africa	0.42	2.83
Population size of countries importing goods from South Africa	1.42	2.89
International price of oil	-0.46	-4.39
Gross domestic product of South Africa	0.99	1.91
Population size of South Africa	3.66	1.37

Source: Regression results

The *t* test was performed to check the poolability of the data. The restrictive assumption of a single intercept with the same parameters over time and across trading partners was taken into consideration. As

observed in Table 5.4, the coefficient estimates for the standard gravity model are statistically significant. The exchange rate, population size, and the GDP for South Africa and Angola present a positive signed coefficient, which is also significant, except for the oil price (-0.46). The estimated coefficient for the real exchange rate is positive and significant, indicating that price competitiveness is important. Another possible explanation for the positive sign is that these elasticities measure the change in the total export of the agricultural sector of South Africa to a 1 per cent change in the value of the explanatory variables included in the first stage estimation.

Intuitively the expectation from Table 5.5 is that the cross-section heterogeneity may be apparent because panel data suggests that South Africa and Angola are heterogeneous. Therefore time-series and cross-section analysis not managing this heterogeneity create the risk of obtaining inaccurate results. Given the significance of the cross-section measurement of the data, the same pattern was estimated in the data where every pool equation is weighted by an estimate of the cross-section residual standard deviation (Baltagi, 2001). The results obtained are similar to the two ways fixed effects model as predicted by the theory.

Table 5.5: Cross-section regression results

	Weighted Statistics
R-square	0.9340
Adjusted R-square	0.9258
S.E. of regression	1.5520
Durbin-Watson stat	113.226
Mean dependent var	29.1391
S.D. dependent var	27.9890
Sum squared resid	2447.11

Source: Regression results

The simulation results from Table 5.7 show that the value of R^2 is 0.98 indicating that the model explains successfully 98 per cent of the variation in the dependent variable. It is evident from the high value of R^2 that the variables included in the regression model are the main determinants of the country-specific effects. Regarding the estimation of the variable "constant", all the explanatory factors in the model are equivalent to 3.8 per cent on average for the agricultural products that will be exported from South Africa

to Angola. However, the constant is statistically insignificant. The coefficient for the variable "distance" is negative and statistically significant at the 5 per cent significance level. This proves that a country that is *situated geographically further from South Africa is expected to attract lesser exports.*

Table 5.6: Regression results for the two-ways FEM

	Coefficient	t-Statistic
Constant	3.7990	179.444
Distance in kilometres between South Africa and its trading partners	-0.0005	-226.84
Dummy variable for countries speaking English	0.4352	10.9359
Dummy variable for countries in the European Union	1.7842	119.183
Dummy variable for countries in the continent of Africa	-1.4783	-38.985
Dummy variable for countries that are members to NAFTA	-0.4766	-2.1520
Dummy variables for countries that are members to MERCOSUR	-1.5433	-39.443

Source: Regression results

Table 5.7: Individual effects regressed over distance and dummies

	Weighted Statistics
R-square	0.9823
Adjusted R-square	0.9822
S.E. of regression	2.5683
Durbin-Watson stat	11228.0100
Mean dependent var	-1.6653
S.D. dependent var	22.9390
Sum squared resid	8,001.0360

Source: Cross-section regression results

Tables 5.6 and 5.7 report, respectively, estimation results for the basic version of the FEM and individual effects regressed over distance and dummies. Given the importance of the cross-section dimension of the data, each equation is downweighted by an estimate of the cross-section residual standard deviation. Table 5.6 reports the estimates of the two-ways FEM with cross-section weights. The interpretation of the coefficients on the integration dummy variables is also relevant for this analysis. Since the model is estimated in natural logarithms, all dummy variables are given a value of one in natural logarithms when the correspondent condition is satisfied and a value of zero otherwise. Thus a value of 1.78 (the European Union dummy in Table 5.6) indicates that intra-European Union trade is about 119 per cent above what

could be expected from the gravity model. Similarly, intra-English speaking countries indicate 0.4 per cent which is about 11 per cent higher than expected levels.

Furthermore, Tables 5.6 and 5.7 present the results obtained when the fixed effects are regressed on the distance variable and dummies which are fixed over time (common language). The results show that only the European Union and English speaking countries are statistically significant, whereas distance presents the incorrect sign while it is important. The integration dummy for the European Union and English speaking countries increase in magnitude whereas the ones for Africa, NAFTA and MERCOSUR decrease. A very high R^2 coefficient is obtained, which indicates that there are other determinants of the trading-pair effects, different from the ones traditionally included in the analysis, which should be investigated. Our results are similar to those obtained by Chen and Wall (1999). The coefficient estimate for the distance variable is less than 1 per cent due to the fact that Angola is geographically close to South Africa. The most important aspect in the second stage estimation is the sign of the coefficients. The further the distance between South Africa and its trading partner, the lower the volume of trade between them. Hence a negative coefficient is expected for the distance variable. The dummies indicate that South Africa exports more to trade blocs with positive coefficients and less to trade blocs with negative coefficients.

5.3.1 Estimates of potential trade

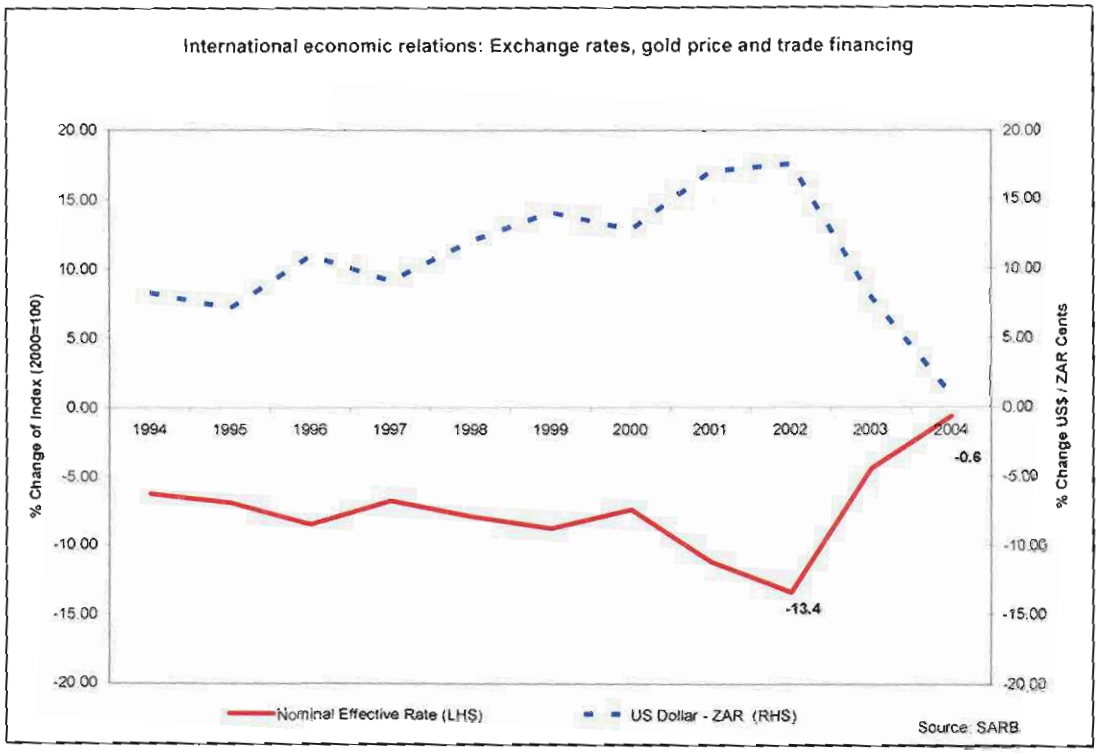
The model estimated in the first stage is solved to calculate the potential exports of the agricultural sector of South Africa. Generally, the model is found to explain South Africa's export trade. The coefficients obtained from the gravity equations are used to estimate bilateral trade flows and to evaluate potential exports. Estimated coefficients in Table 5.6 (Two-ways FEM with cross-section weights) served as the basis for the evaluation of the trade potential. Figure 5.3 presents the estimates for potential exports of agricultural goods to Angola along with the actual exports values for every year in the sample. The simulation results show that from 1994 to 1997, actual exports in the agricultural sector were bigger than potential exports. During this period democracy was introduced in South Africa. However, from 1998 to 2000, actual exports decreased considerably, while the potential exports exceeded the actual export values.

The reason could be that the exchange rate was reasonably unstable in South Africa over this period as can be seen in figure 5.3 below. In 2001, actual exports exceeded potential exports in the agricultural sector. Furthermore, the potential exports exceeded the actual exports during 2002 and 2003.

The difference between potential and actual exports to Angola means that the actual level of exports is below those that normal trade relations would support. However, explanations about increasing and decreasing potentials should be based on time specific factors, such as, for example, climate phenomena affecting the agriculture sector. From Figure 5.2 it can be seen that the nominal effective exchange rate declined by approximately -13.4 per cent in the worst case over a rolling three year period, while only reaching a positive three year average by 2005.

Appendix A contains the estimates for the country-specific effects. The country-specific effects are all the factors that are specific or unique to each country that are not included in the gravity model. The simulation results show that there are unobservable unique characteristics of each country, that enhance South Africa's exports of agricultural goods to other countries such as Congo, Cyprus, Gabon, Saudi Arabia and Zambia. Similarly, there are also unobservable country characteristics that tend to inhibit South Africa's exports of agricultural goods to Algeria, Chile, Ecuador, Paraguay and the Russian Federation (see Appendix A for results).

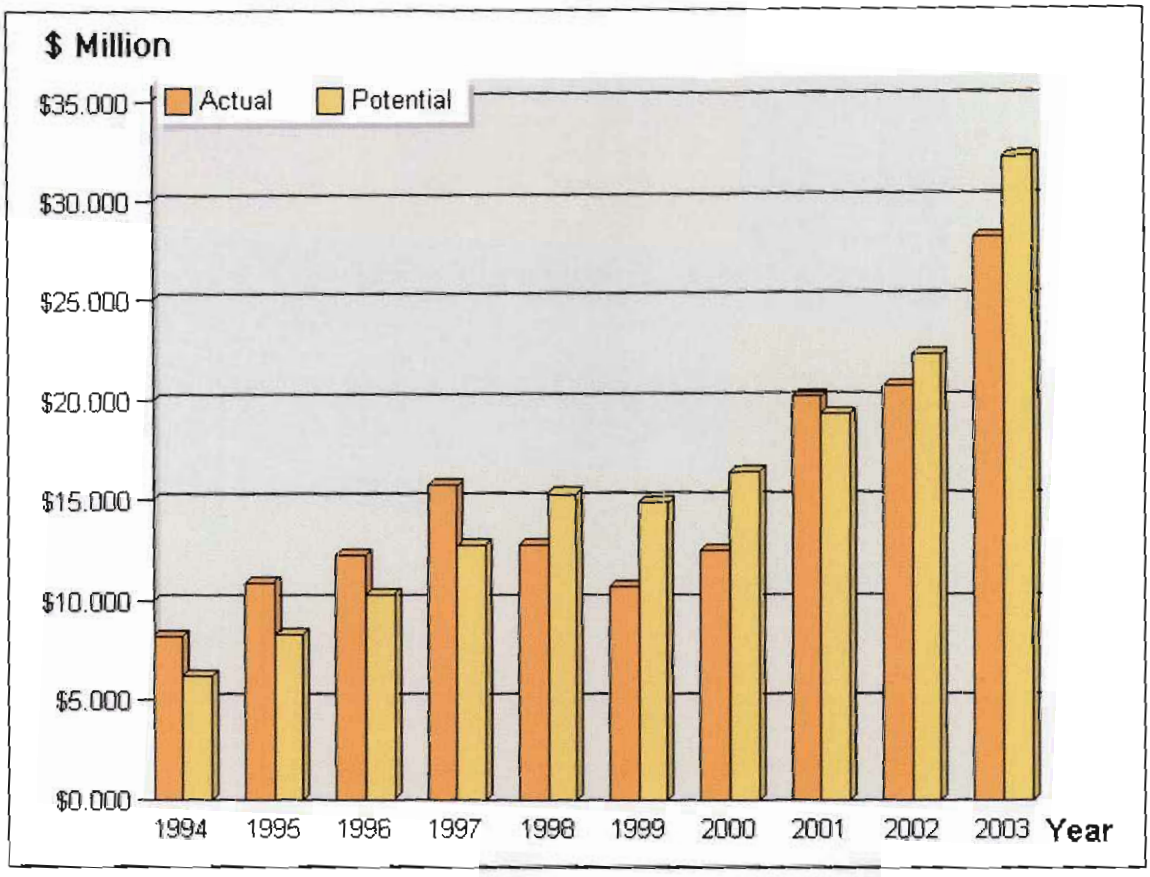
Figure 5.2: Exchange rate history



Source: The South African Reserve Bank (SARB)

Table 5.3 shows the potential and actual exports from South Africa to Angola in millions of dollars.

Figure 5.3: Potential and actual exports between South Africa and Angola ($million)



Source: the dti gravity model results

5.4 EXPERIMENTAL ASSESSMENT FROM THE MODEL RESULTS

The dti gravity model is used to run a number of simulations using different scenarios. Each scenario is executed based on the kind of variables to be shocked. A shock is an external fact which affects a variable in the model. Specific interest is given to the uncontrollable phenomenon affecting economic variables such as GDP, exchange rate and the price of oil.

The shock is introduced in the form of a percentage increase or decrease of the values of one of the explanatory variables. However, the type of shock that is considered in this model is a permanent shock — a shock to the values of a specific variable. The four variables identified in the model are the exchange rate, oil price, GDP for the exporting country and GDP for the importing country. During the

simulation exercises, while one variable is shocked, the others remain constant (exogenous). Furthermore, a 5 per cent shock was chosen for the purpose of these simulations. All variables including exchange rate, GDP and oil price were shocked by 5 percent.

A number of simulations were performed and, in total, four scenarios were considered. The first scenario relates to the shock applied to exchange rates. This variable is decreased by 5 per cent while other variables remain fixed in the model. In the second scenario, the GDP of Angola is shocked and increased by 5 per cent. In the third scenario, the GDP of South Africa is increased by 5 per cent while the last scenario focuses on the oil price. The oil price is decreased by 5 per cent while other variables remain unchanged. The simulation results are presented in this section.

5.4.1 Exchange rate shock

5.4.1.1 Simulation statement: 5 per cent appreciation (decrease) in the exchange rate

Exchange rates play a central role in international trade because they allow us to compare the prices of goods and services produced in different countries. Changes in the exchange rate are described as depreciations or appreciations. For instance, a depreciation of the South African rand against the Angolan dollar is a fall in the Angolan dollar price of rand. In other word, the depreciation of the South African rand makes its products cheaper for Angola, whereas an appreciation of the rand makes its products more expensive for Angola. All else equal, an appreciation of a country's currency raises the relative price of its exports and lowers the relative price of its imports. On the other hand, depreciation lowers the relative price of a country's exports and raises the relative price of its imports (Rose, 2000).

Amongst other variables such as GDP and oil price in the gravity model, exchange rate was chosen as an important variable to shock because it has been argued by the economist such as Wolf (2000) who declared that when the interest rates for a country augment, the demand for that money will also augment. Therefore the speculation of the currency of South Africa for instance can undermine the real economic growth of South Africa when involved in exporting the agricultural products to Angola.

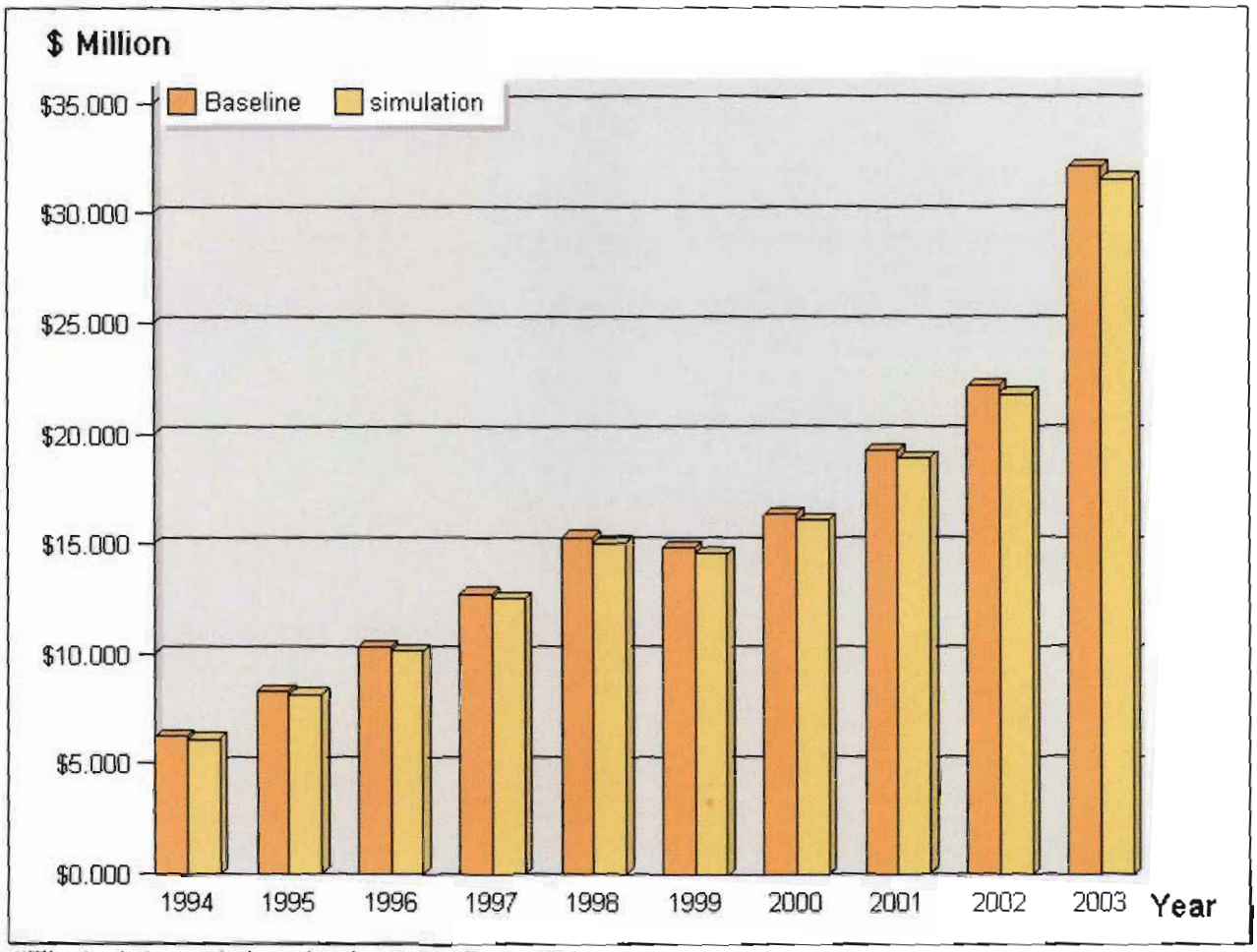
As mentioned in Section 2.2, Bergstrand (1985, 1989) inserted for the first time the real exchange rates into the gravity model. Besides, Soloaga and Winters (2001) suggested that the price effects been introduced in the cross-section analysis even though the result of the analysis showed that the value of the money could not be evaluated accurately. The exchange rate activities could be improved only in case where the variable time dimension is taken into consideration in the analysis.

For the first scenario, the shock is applied to the exchange rate variable in the gravity model. The exchange rate is decreased by 5 per cent, while the oil price and the GDP for South Africa and Angola remain constant. Figure 5.4 is generated by the gravity model after the shock has been applied. The average effect is estimated by the model according to the level of the shock applied to the exchange rate. Besides, the estimated coefficient of the real exchange rate in the model is significant demonstrating that price competitiveness is essential.

The results from the simulation presented in figure 5.4 below can be interpreted as follows. The -1 per cent is the average effect generated from the simulation by the model. The simulation result shows that the average effect is negative (-1 per cent). The outcome obtained from this simulation indicates that a reduction of 5 per cent applied to the exchange rate had a negative impact of a 1 per cent decrease on the export of agricultural goods to Angola. From the results it can be seen that the exchange rate has a significant impact on exports. Therefore an appreciation of the rand against the US dollar of 5 per cent leads to a 1 per cent decrease in exports of agricultural goods. This is in line with economic theory, which states that an appreciation of the domestic currency against major currencies gives rise to a decrease in exports of domestic goods. When the currency of the exporting country appreciates, domestic goods become expensive to other countries, hence exports decrease.

From these results, the South African exporters who are actively and deliberately involved in the export market with Angola will better avoid the depreciation of the rand by being proactive in the exports of the agricultural sector. The strength of the currency should not be the only determinant for export competitiveness. The use of the gravity model seems imperative in the identification of the trade potential which is to be maximised.

*Figure 5.4: Results from the exchange rate shock**



*(*The simulation result shows that the average effect is: -1%)*

Source: the dti gravity model results

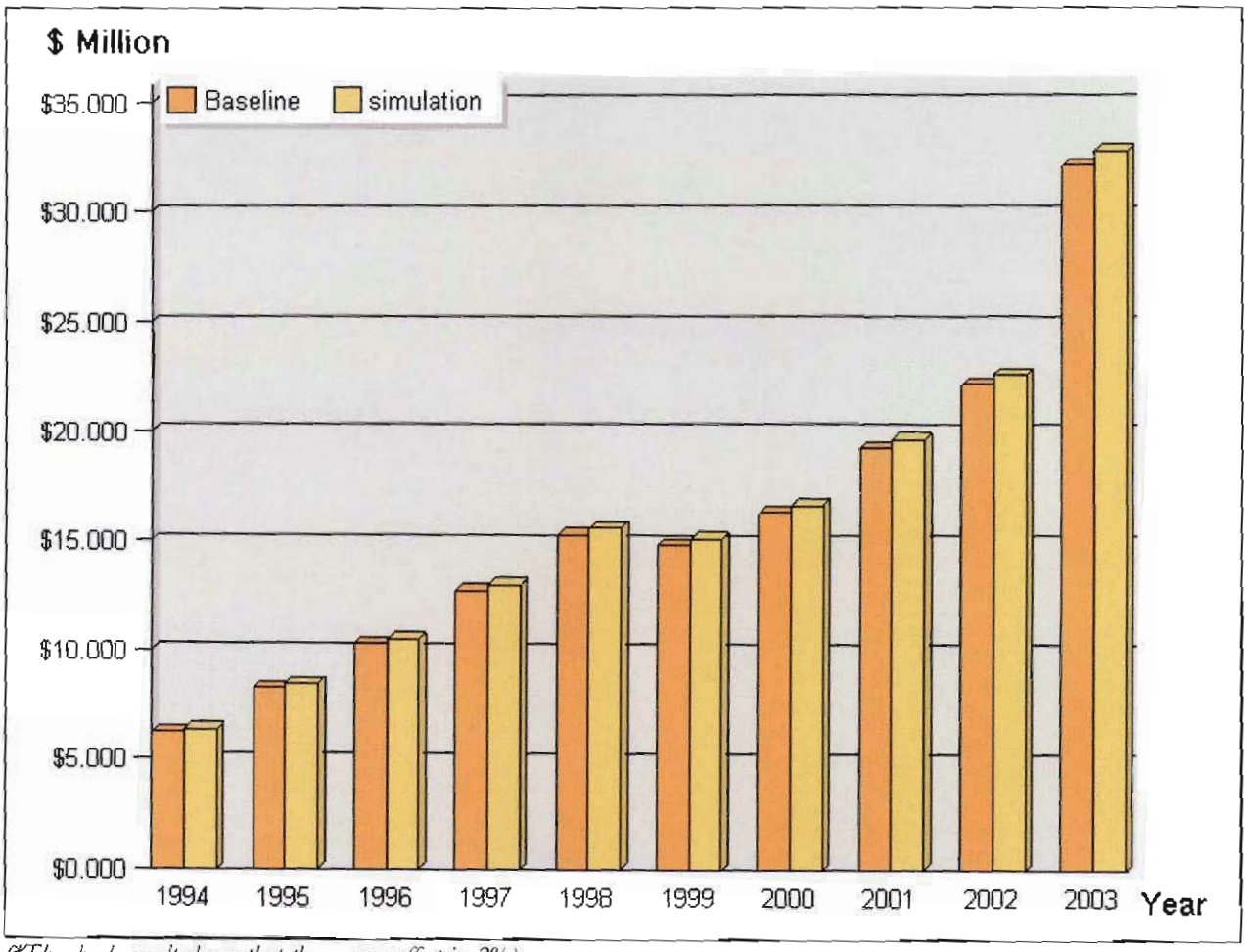
5.4.2 Shock applied to the GDP of Angola

5.4.2.1 Simulation statement: The GDP of Angola is augmented by 5 per cent

Gross Domestic Product (GDP) is a measure of the total economic activity occurring in Angola. The exercise done in this section is related to the shock applied to the GDP of Angola as importing country. The external factor has affected the GDP to be increased by 5 per cent. The assumption is that one variable is shocked at the time while other variables remain unchanged. The outcome of the simulation is reflected in figure 5.5 below.

The results from the shock show that the average effect is 2 per cent. A 2 per cent increase from the average effect can be interpreted as a positive reflection of exports for the agricultural sector to Angola. Under this scenario, there is a definite potential for trade between South Africa and Angola in the agricultural sector. However, the 5 per cent increase in the GDP of Angola did stimulate South Africa to increase its export by 2 per cent.

*Figure 5.5: Results from a 5 per cent shock to the GDP of Angola**



*(*The shock result shows that the average effect is: 2%)*

Source: the dti gravity model results

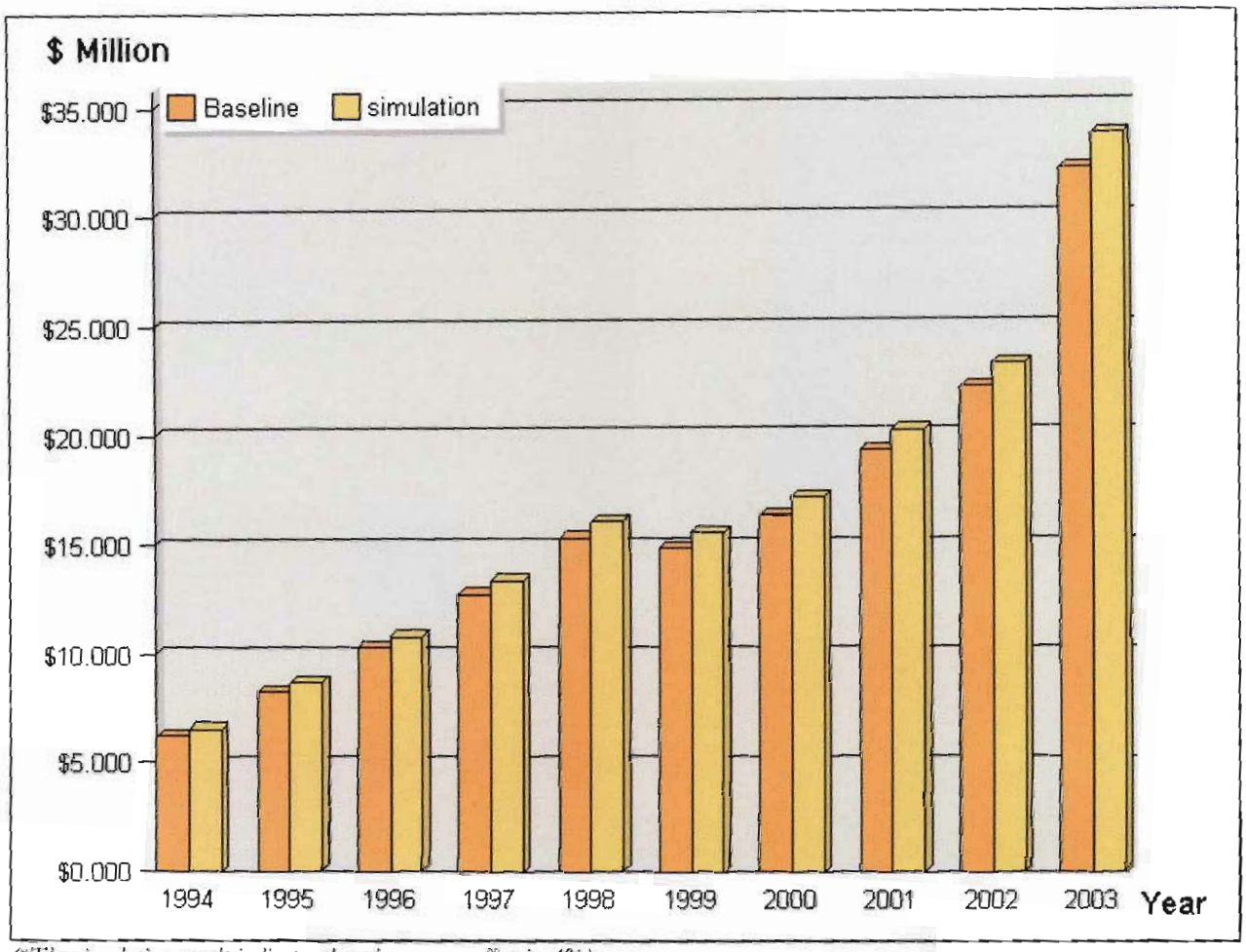
5.4.3 Scenario regarding the GDP of South Africa

5.4.3.1 Simulation statement: The GDP of South Africa is augmented by 5 per cent

The simulation performed in this section concerns the GDP of South Africa. In this scenario, South Africa is the exporting country. South Africa's GDP is increased by 5 per cent while the exchange rate, oil price and GDP of Angola are fixed. The shock is applied using the gravity model. The results of the simulation are presented in figure 5.6 below.

The simulation results indicate that the average effect of the potential for trade is 4 per cent. It is an indication that the export of agricultural goods to Angola is positive. The potential trade between the two countries can be improved. However, the 5 per cent increase in GDP did stimulate exports to increase by 4 per cent.

*Figure 5.6: Results of a 5 per cent increase in the GDP of South Africa**



*(*The simulation result indicates that the average effect is: 4%)*

Source: the dti gravity model results

5.4.4 Experimentation on the oil price

5.4.4. Simulation statement: The price of oil is decreased by 5 per cent

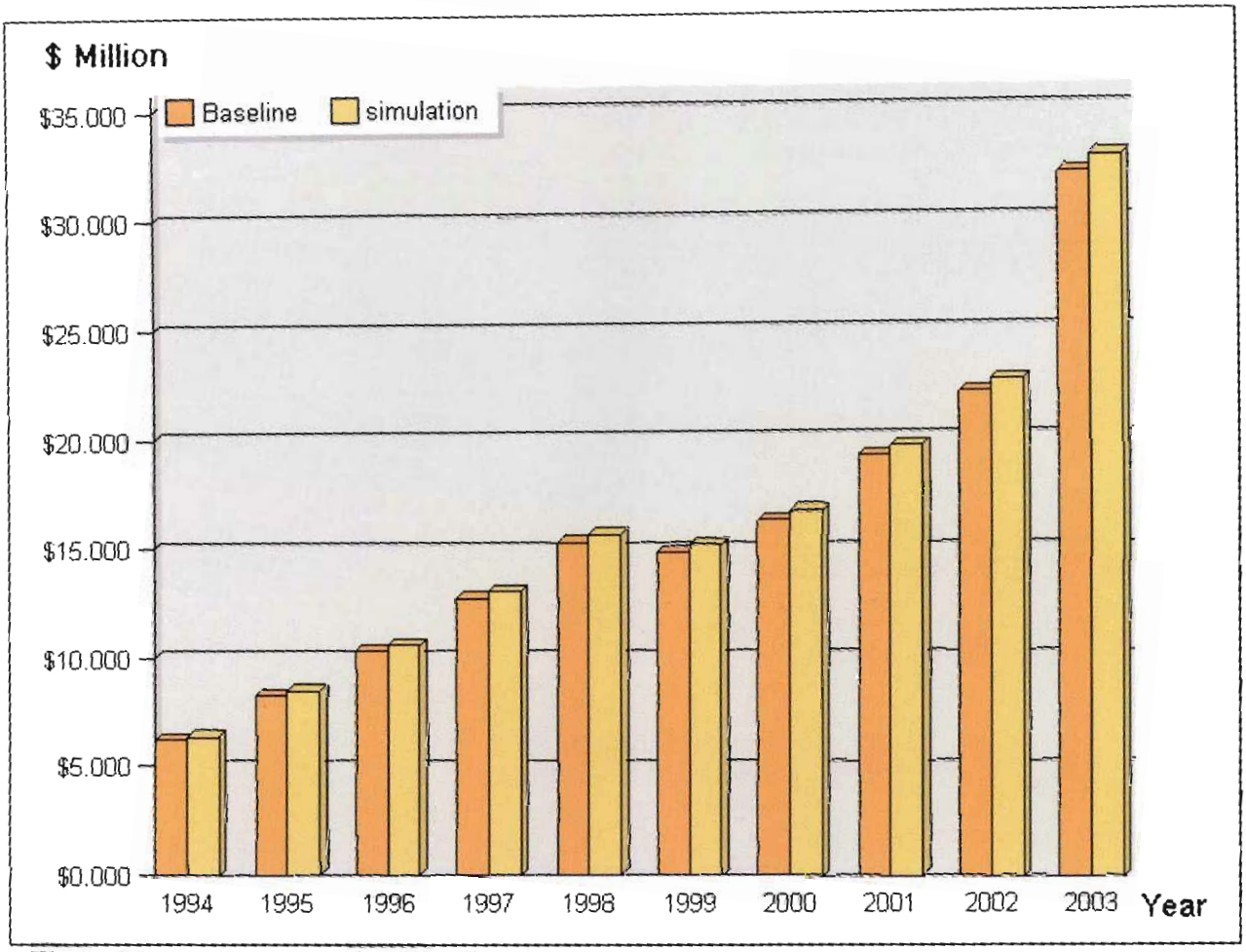
The literature review shows that some experts are predicting the oil price shock based on geology and geopolitics. Others are focusing on the economic incentives which play a major role in estimating the price of oil (Sargento, 2006). Actually the reality regarding the oil price is that the demand continues to increase while the production is dropping. Therefore, high prices of the oil are not going to stop soon. As discussed by Yeyati (2003), looking ahead, oil prices could easily drop in the near future that is why we preferred to

shock the oil prices by 5 percent reduction in this study. In fact, this scenario models a reduction of 5 per cent in the price of oil while the exchange rate and GDP for both countries are unchanged. Figure 5.7 is generated by the gravity model after the shock has been applied. The average effect is estimated by the model according to the level of the shock applied to the oil price. The results of the simulation are presented in figure 5.7 below.

The panel data used in this study consisted of annual observations across 154 countries, covering the period 1994-2003. The integration of the dummy variables and the interpretation of their coefficients are important for the analysis of the simulation results. Given that our model is estimated in natural logs, a specific value is affected to every dummy variable. For instance a value of "one" in natural log is given when the correspondent condition is fulfilled and a value of "zero" otherwise as described in Section 3.2 (Zarzoso, 2001).

The simulation results reveal that the average effect of the oil price shock is a 2 per cent change in the trade potential between the two countries. The impact of a 2 per cent increase is beneficial for the export of agricultural goods. The potential for trade is therefore realised between these two countries. The outcome obtained from this simulation indicates that a reduction of 5 per cent applied to the oil price contributed positively to the export of agricultural goods. This means that low oil prices can have a considerable effect on South Africa's exports of agricultural goods.

*Figure 5.7: Results of a 5 per cent decrease in the price of oil**



*(*The simulation result reveals that the average effect is: 2%)*

Source: the dti gravity model results

5.5 SUMMARY

In the present chapter, the gravity model was used to perform experimental evaluations of the potential for trade between South Africa and Angola. The various simulations undertaken in this chapter confirm that the gravity model generates quite good results when trade flows are known a priori, i.e., when the model is used with the purpose to explain (Sargento, 2006). The study focuses on the methodology used in Chen and Wall (1999), which aims to estimate fixed effects and variables that are constant over the sample size.

The results obtained from the gravity model used in this particular trade flow application showed that the model explained successfully 98 per cent of the variation in the dependent variable. This supports the assumption that the variables included in the regression model are the main determinants of the country-specific effects. Regarding the estimation of the variable "constant", all the explanatory factors in the model were equivalent to 3.8 per cent on average for the agricultural goods to be exported from South Africa to Angola. However, the coefficient for the variable "distance" was negative and statistically significant at the 5 per cent significance level. This proves that a country that is situated geographically further from South Africa is expected to attract lesser exports.

Estimated coefficients in Table 5.6 served as the basis for the evaluation of the potential for trade. Figure 5.3 presented the estimates for potential exports of the agricultural sector to Angola along with the actual export values for every year in the sample. The simulation results showed that from 1994 to 1997, actual exports in the agricultural sector were bigger than potential exports. During this period democracy was introduced in South Africa. However, from 1998 to 2000, actual exports decreased considerably, while the potential exports exceed the actual export values. The reason could be that the exchange rate was reasonably unstable in South Africa over this period. In 2001, actual exports exceeded potential exports in the agricultural sector. Furthermore, the potential exports exceeded the actual exports during 2002 and 2003. The difference between potential and actual exports to Angola means that the actual level of exports is below those that normal trade relations would support. However, explanations about increasing and decreasing potentials should be based on time specific factors, such as for example, climate phenomena affecting the agriculture sector.

Shocks were introduced in the form of a percentage increase or decrease of the values of one of the explanatory variables. There were four variables in total, which were identified in the model for performing the various simulations. The four variables were the exchange rate, the price of oil, the GDP of the exporting country and the GDP of the importing country. During the simulation exercises, one variable was shocked, while the others were held constant (exogenous).

The results obtained from the various scenarios allow for the conclusion that the gravity model is the best suited to explain trade flow behaviour. The 5 per cent reduction applied to the exchange rate had a

negative impact on exports of agricultural goods to Angola. The 5 per cent increase applied to the GDP of Angola did stimulate South Africa to increase its exports by 2 per cent. Nonetheless, in the case of the South African GDP shock, the impact was positive. Exports increased by 4 per cent in the agricultural sector. The outcome obtained from the last simulation indicated that a 5 per cent reduction applied to the oil price contributed positively to the export of agricultural goods.

The next chapter summarises the main conclusions that were drawn from the various simulations and provides some avenues for further research.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY

This study began with the observation that South Africa and Angola are currently involved in bilateral trade, especially in the agricultural sector. The study set out to answer the question whether there was potential for bilateral trade in the agricultural sector between South Africa and Angola. The answer to this problem is important, for if this study does confirm the importance of this sector as an important export industry, it might have significant implications for policy efforts such as the Customised Sector Program. Furthermore, this might strengthen the use of the gravity model to scientifically justify export promotion activities in the future.

Chapter 2 reviewed the gravity model's basic specification and its extensions in recent trade flows applications. This chapter revealed that there is substantial literature pertaining to the gravity model. Evans (2000) and Feenstra (2002) showed that trade flows follow the physical theories of gravity, where two opposite forces influence the capacity of trade involving two countries. Therefore, the importance of the nature of trade between South Africa and Angola was introduced. An overview of the literature on the gravity model was provided and a description of the dti gravity model given. This instrument was then used for the scientific measurement of the potential for trade between South Africa and Angola. Therefore, Chapter 2 recommended the use of the dti gravity model as a valid instrument for analysing the potential for trade in that it adds value in the field of applied gravity modelling in South Africa.

Chapter 3 described the gravity model as an instrument with the ability to perform dynamic analyses of bilateral trade. This chapter presented some plausible elements of the gravity model and gave a detailed explanation of the workings of the model. The mathematical representation of a generalised gravity model was given in section 3.2 and the empirical estimation of total exports showed that potential supply and demand is determined by the relative size of the two economies. Various motivations were given as to why the gravity model can be estimated using a panel data framework. Firstly, panel data makes it feasible to establish relationships between regressors for a period of time. Secondly, panel data has the

capability to scrutinize the probable unnoticeable trading per individual effects. In the case where there is a correlation between individual effects and regressors in the model, the OLS estimates are not recommended, especially when the individual effects are not taken into consideration. Furthermore, the use of the REM was advised when the samples are taken from a large population for analysing trade flows. Another option was given by using the FEM when the selection of countries is done in advance.

Chapters 2 and 3 set the scene for the application of the gravity model as an instrument to analyse the potential for trade between South Africa and Angola. Chapter 4 introduced the agricultural sector with an overview of the challenges that the sector faces with regard to trade and the application of policy instruments. The general understanding between the South African government and the agricultural industry on South African agricultural trade policy was defined. This leads to the empirical evaluation of the agricultural sector in Chapter 5.

Chapter 5 provided the practical application of the gravity model described in chapter 3. The results obtained from the simulations were used to analyse the potential for bilateral trade between South Africa and Angola. The actual and potential level of trade was evaluated for the agricultural sector. The dti gravity model was used to perform various simulations, where shocks were applied to variables such as GDP, the exchange rate and the price of oil. The results from the shocks applied to the exchange rate showed that the average effect of the potential trade between South Africa and Angola decreased by 1 per cent. This is in line with economic theory, which states that an appreciation of the domestic currency against major currencies gives rise to a decrease in exports of the exporting country. When the domestic currency appreciates, domestic goods become more expensive to other countries, hence exports decrease. The shock of a 5 per cent increase applied to the GDP of Angola did stimulate South Africa to increase its exports by 2 per cent. Nonetheless, in the case of the South African GDP shock, the impact was positive. Exports increased by 4 per cent in the agricultural sector. In the last exercise, the reduction of 5 per cent applied to the oil price contributed positively to exports from South Africa to Angola. This means that low oil prices can have a considerable effect on South Africa's exports of agricultural goods (mainly on transport costs). In fact, the 2 per cent improvement in the average effect showed that there was a

potential for trade between these two countries. Therefore, South Africa benefited from exports of agricultural goods to Angola.

6.2 CONCLUSIONS

Thus, this study has made two important contributions:

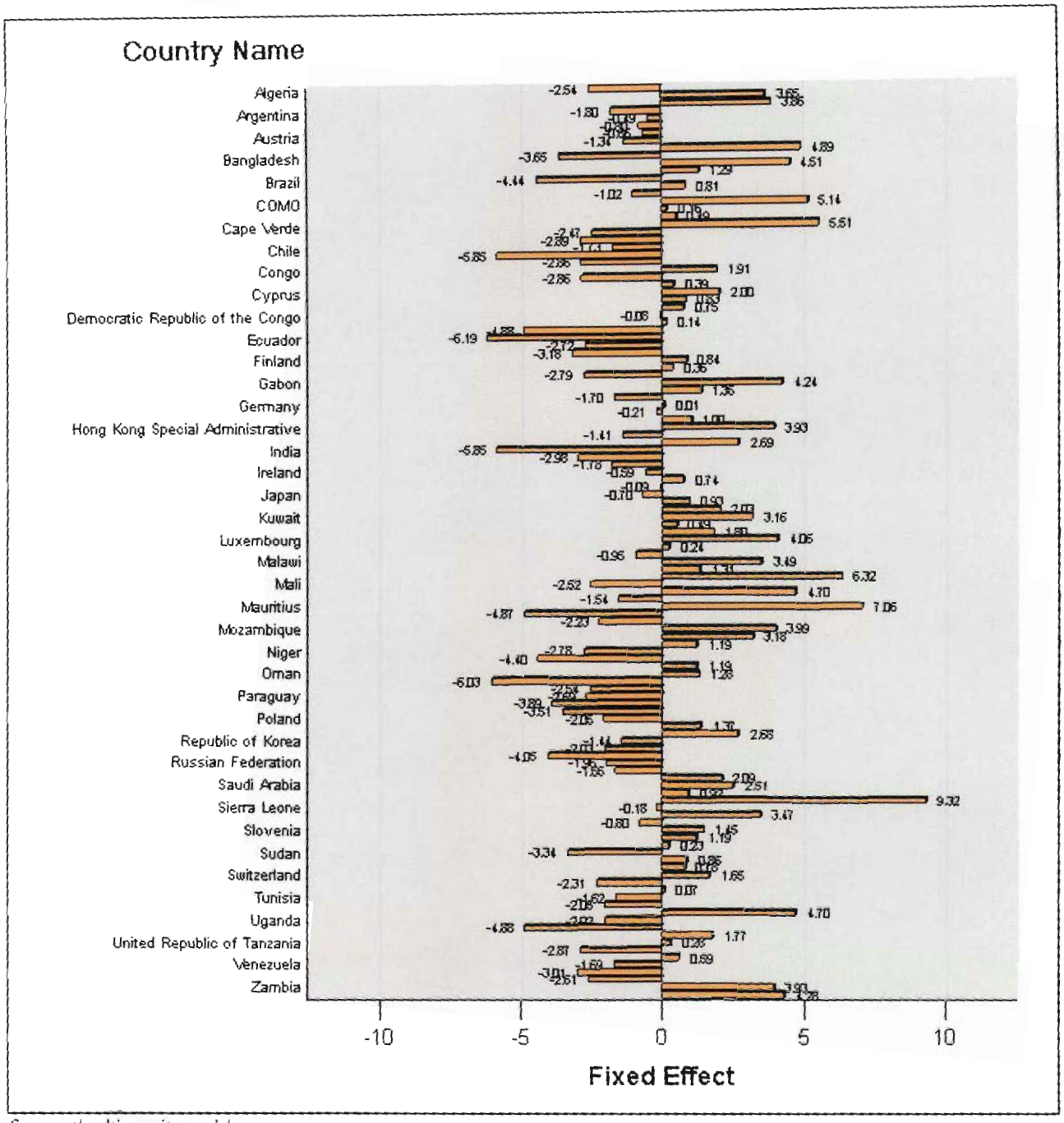
- Firstly, it has provided an empirical application of the gravity model. The results show that there is a potential for trade between South Africa and Angola in the agricultural sector. For instance, the potential exports exceeded the actual exports during 2002 and 2003. The difference between potential and actual exports to Angola means that the actual level of exports is below those that normal trade relations would support. This was achieved through the gravity model. This instrument measured scientifically the potential trade in that it adds value in the field of applied modelling in South Africa. The macroeconomic variables such as size of the economy, exchange rates and the oil price were shocked in the model.
- Secondly, it has contributed towards the policy debate in South Africa. The results inform policymakers of the potential for trade in the agricultural sector. The policy maker should promote exports and increase the level of investment in the agricultural sector.

6.3 FUTURE RESEARCH

Scope for further research on bilateral trade between South Africa and other countries is to be encouraged. Future research should attempt to update the gravity model database. This depends on the accuracy and availability of trade data. There is hope that more investigations will be stimulated to go beyond conducting simulations with the model described here. Empirical tests might also be conducted to determine whether the gravity model is the most adequate to generate undisclosed trade data The theory described in this study is very well documented and can be used for the improvement of the dti gravity model.

APPENDIX A: FIXED EFFECT BY COUNTRY

Figure A.1: Fixed effect by country



Source: the dti gravity model

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