

THE IMPACT OF INTERNATIONAL TRADE ON ECONOMIC GROWTH IN SOUTH  
AFRICA: AN ECONOMETRICS ANALYSIS



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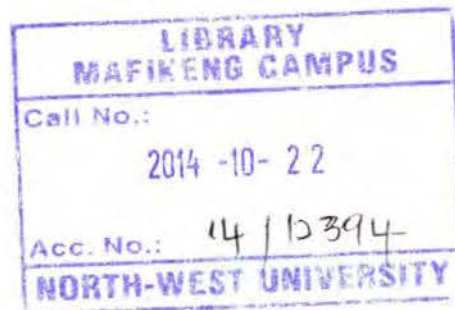
The Research Project Submitted in Partial Fulfilment of the Requirements for a Master's Degree in Economics in the Faculty of Commerce and Administration at the Mafikeng campus of the North West University

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Mafikeng

South Africa

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## Declaration

I, SEIPATI MOGOE, hereby declare that the work presented here by me has not been submitted anywhere for a requirement for a degree. Any literature cited within this dissertation has been acknowledged and listed in the bibliography.

Full names..... Date.....

Signed.....

## Acknowledgment

I would like to express my sincere gratitude to my supervisor, Dr Itumeleng Mongale. His guidance, support and assistance are greatly appreciated.

To my mother Matshidiso, who motivated me to study and also my brother Mooketsi, and sister Sophy who always encouraged me to keep strong through the difficulties encountered during this study. I will also like to thank my grandparents Jacobeth and Kgositsile who always encouraged me to believe in god through this study.

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## **ABSTRACT**

International trade is one of the leading discussions taken not only in South Africa but worldwide on daily basis. The importance of international trade is that one country can be able to assist the other country to meet its needs. The level of economic growth is important in any country not only in South Africa.

The purpose of this study is to examine the impact of foreign trade on economic growth in South Africa. The findings of this study will demonstrate the light about positive and negative effects of international trade on economic growth. The empirical analysis is conducted by using a time series data from 1990Q1 – 2013Q2 quarterly obtained from South African Reserve Bank (SARB) and Organisation of Economic Co-operation Development (OECD). The study follows a Cointegrated vector autoregression (CVAR) which contains the following: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for stationarity. The model is also taken through the Johansen cointegration test and Vector error correction model (VECM). VECM approach will be followed if cointegration amongst the variables has been established.

The findings of the study are that all variables have unit root. The cointegration model emphasizes the long run equilibrium relationship between dependent and independent variables. The empirical results for the Johansen cointegration test reject the null hypothesis of no cointegration and suggest the presence of a long term relationship among all the variables. Empirical investigation reveals that three variables such as inflation rate, export and exchange rates are positively related to GDP while other one variable such as import is negatively related to GDP. The conclusion drawn from this work is that there is a correlation amongst GDP and its independent variable. This dissertation recommends that The South African government must start strengthening the competitiveness of export by making sure that it is always balanced with the import

Key words: economic growth, foreign trade, cointegrated vector autoregression, South Africa

JEL Classification: F1, F4, C1, E2

## GLOSSARY OF TERMS

**International trade** is about two or more countries exchanging goods and services that will benefit each countries need, goods and services such as capital, clothing, food and etc. This kind of trade has policies that are followed before trading take place between countries.

**Economic growth** can be defined as improvement of a country such as its technology. Annual rate increases in total production such as real (GDP) Gross domestic products and also infrastructure and investment.

Inflation rate is a certain percentage on how prices are general increasing from one portion to the other .Inflation is increased by more money in the circulation and has a movement that shows its rise and declines.

**Openness** consists of both export and import, it's all about a country having an open economy, meaning that a country does not only have circulation of income and spending on firms, household and government and trading within a country. A country has introduced itself to an open economy that contains trading with other countries that will both deal with paying for import and exporting of goods and services.

**Diversity** is the act or practice of manufacturing different types of products and also inversing in a different types of securities, selling a variety of merchandise etc, so that a failure in or an economic slump affecting one of them will not be disastrous.

## LIST OF ACRONYMS AND ABBREVIATIONS

ADF – Augmented of Dickey – Fuller

ARIMA – Autoregressive integrated moving average

BOP – Balance of payment

CVAR – Cointegrated vector autoregression

EU – European Union

FDI – Foreign direct investment

GATT – General agreement of tariffs and trade

GDP – Gross domestic product

IMF – International monetary fund

IR – Industrial revolution

OECD - Organisation for economic Co-operation and development

PP – Phillips Perron

RTA – Regional trade augment

R&D – Role of Domestic

SACU – South African customer union

SADC – South African development community

SARB – South African reserve bank

TFP – Total factor productivity

TPF – Total productivity factor

USA – United State of America

VECM – Vector error correctional model

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# CHAPTER 1

## INTRODUCTION OF THE STUDY

### 1.1 Introduction

International trade is one of the leading discussions taken not only in South Africa but worldwide on daily basis. The importance of international trade is that one country can be able to assist the other country to meet its needs. The level of economic growth is important in any country not only in South Africa.

According to Qaiser *et al* (2009), the word trade is been defined as “the activity in which people are buying and selling or exchanging the goods and services”. International trade is the exchange of capital, goods and services across international borders. It is a system where the goods and services are advertised, sell or switched between two or more countries through import and export processes. A trade theory indicates that there is generally a positive association among openness, export to GDP ratio, investment to GDP ratio and inflation. There are several ways in which finding that openness, export to GDP ratio, investment to GDP ratio influence economic growth

Some of the following economic variables will be considered in this study: exports rate, exchange rate, imports rate, inflation rates, openness and also diversity. Trade theories and economic growth theories by different economists such as Hecksher–Ohlin trade theory and the Neo – Classical growth and Endogenous growth theory will be dealt with in this study.

### 1.2 Background

South Africa's economic growth performance has strengthened the sustainability of growth at the end of apartheid in 1994. Estimations of potential output growth based on alternative methodologies was conducted, including a standard production function approach. It suggests that during 1995–2003 the rate of potential output growth increased to 3%. The measure of potential output is based on historical rates

of factor utilization and total factor productivity (TFP), rather than on literal full employment. In addition, it should be noted that because it is based on historical data, it includes the effects of structural and institutional rigidities that may have impeded growth in the past but not necessarily in the future. The actual rate of real GDP growth also rose to nearly 3,5 from 1/4% during 1980–94, largely reflecting a turnaround in TFP growth as the combined growth contribution of labour and capital accumulation stayed roughly unchanged in those years (Arora, 2003).

On the other hand, Fituni *et al* (1994) indicate that the share of exports to GDP decreased from 31.5% in 1985 to 21.3% in 1992. The statistics given clearly shows that international isolation of South Africa had a substantial negative influence on the dynamics of external trade. In 1992 when negotiations regarding elimination of apartheid by political means commenced, the trend was reversed during this time a steady increase in the share of exports and imports to GDP of South Africa began to be observed. By 2001 the share of imports made up 27.1% of GDP, and the share of exports – 31.0% of GDP.

In 2007 the overall volume of exports was equal to 75.9 billion US dollars, and the total volume of imports was 81.7 billion dollars with GDP being equivalent to 283.4 billion dollars. Thus, the share of imports was equal to 28.8% of GDP, and the share of exports – 26.7 % of GDP. 3 Overall, from 1994 to 2005, the volume of South African exports (excluding gold exports) grew at an average annual rate of 7.6%. Such rapid growth of exports can be explained (primarily) by a decline in the rand real exchange rate (on average by 3.9% per year from 1994 to 2001) that significantly increased the competitive advantage of South African goods. These figures essentially say that South Africa managed to fully reintegrate within international economy after the first democratic elections of 1994 (Fituni *et al*, 1994).

### **1.3 Problem statement**

The purpose of this study is to investigate the impact of foreign trade on economic growth in South Africa.

As South Africa developed from the economic unproductivity and international separation of the apartheid era, the new government and its theme of economic renovation received international approval and reassurance. At the same time, however, it faced inconsistent pressures to speed economic growth in order to support South Africa's standing among international investors and contributors, and to improve living situations for the majority of citizens.

The year 2012 was one of the hardest years since 1994 as labour conflict in the mining sector crippled production. In addition, the country's major trading partner, the euro area, slipped into recession. Nevertheless, fixed investment grew faster in 2012 while economic growth picked up in 2012 but fell short of estimates as export volumes scarcely lengthened and consumer demand slackened. Economic growth is expected to benefit from expanded organization investment and an increase in electrical capacity. That been said, the strong retrieval will depend on the resolution of global challenges and on alleviating structural constraints. The rand also has been declining in value and is expected to remain under pressure. The national government debt has enlarged to nearly 39% of the gross domestic product (GDP) in 2011-12. Promise crops trended down in year 2012 but yet fiscal room sustained to be forced by the international economic slowdown, the impact of social discontent and large increases in the public sector wage bill could affect the government's plan to increase organization investment in South Africa.

#### **1.4 Aims/objectives**

The main aim of this study is to investigate international trade and its influence on economic growth. The following objectives will used to reach the main aim:

- ❖ To identify relevant variables which play a role on international trade and also economic growth after trade between countries have taken place.
- ❖ To determine whether international trade and economic growth are correlated in a long run or a short run.
- ❖ To determine if international trade affect economic growth of South Africa positively or negatively.

The above objectives will be attained by the use of CVAR framework.

## **1.5 Research questions**

- Does the exchange rate affect South African rand in the long run when trade has taken place?
- Does international trade increase inflation in South Africa?
- Does the international trade and economic growth correlate?

## **1.6 Significance of the study**

The purpose of this study is to investigate the impact of foreign trade on economic growth in South Africa. Once the international trade takes place, the internal trade can get affected either positively or negatively.

## **1.7 Limitations/ delimitation of the study**

There were some limitations experienced in relation to the availability of some data. Although most of the quarterly data was readily available, some of the data was on monthly basis. This data had to be attuned to quarterly for the purpose of the study. There was no delimitation experienced in this study.

## **1.8. Structure of the dissertation**

Chapter 1 is the introductory chapter which gives the background of the study and research problem among others. Chapter 2 focuses on the literature review, where previous studies that focused on international trade and economic growth and other related topics are discussed. The methodology that is undertaken to perform an econometric analysis of the study is presented in Chapter 3. This section consists of the presentation of the econometric models, variables and data description. Chapter 4 presents the empirical results. It is mainly the presentation of the economic and statistical outputs which are computed with E-Views. The last chapter of this study is Chapter 5. It presents the findings and the conclusion of the investigation.

## **1.9. Ethical considerations**

This study is mainly an econometric analysis of a secondary data obtained from online services; therefore, there are no ethical considerations.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1. Introduction

This chapter focuses on the theoretical and empirical literature regarding foreign trade and its impact on economic growth in South Africa. The first review in this chapter describes the different types of measurement of trade policy in South Africa. The chapter also focuses on different types of trade theories, the theories of economic growth: post Keynesian, endogenous growth, neo-classical growth and also the empirical review on foreign trade and economic growth.

#### 2.2. Theoretical literature

According to Awe (2013), Jhingan defines economic growth "as the process whereby the real per capita income for a country increases over a long period of time". He states that economic growth is measured by increase in the amount of goods and services in each successive time period. Thus, growth occurs when an economy's productive capacity increases which in turn is used to produce more goods and services. It is in view of this that foreign direct investment (FDI) has been seen as being potent for growth.

Trade is one of the factors that bring countries and firms together. In order for a country to be able to trade with another country, a policy and measurement of trade must be set and followed reason being that, to protect its product, to make sure that international competition does not have an impact on domestic products.

One of the major dynamic benefits of trade is that export markets widen the total market for a country's producers. If production is subject to increasing returns, export growth becomes a continual source of productivity growth. There is also a close connection between increasing returns and the accumulation of capital. For a small country with no trade, there is very little scope for large scale investment in advanced capital equipment; specialisation is limited by the extent of the market. But if a poor small country can trade, there is some prospect of industrialisation and of

dispensing with traditional methods of production. It is worth remembering that at least 60 countries in the world classified as developing, and 31 in Africa, have populations of less than 15 million. Without export markets, the production of many goods would not be economically viable (Thirlwa, 2000).

According to Yanikkaya (2003), it is worthwhile to note that the theoretical growth literature has given more attention to the relationship between trade policies and growth rather than the relationship between trade volumes and growth. Therefore, the conclusion about the relationship between trade barriers and growth cannot be directly applied to the effects of changes in trade volumes on growth. Even though these two concepts, trade volumes and trade restrictions, are very closely related, their relationship with growth may differ considerably. This is because there are several other very important factors that affect a country's external sector, such as geographical factors, country size, and income. In other words, one should be as clear as possible about which openness measure is used and what are the exact mechanisms through which it affects the growth?

In the theory of international trade, the static gains from trade and losses from trade restrictions have been examined thoroughly. Yet, trade theory provides little guideline as to the effects of international trade on growth and technical progress. On the contrary, the new trade theory makes it clear that the gains from trade can arise from several fundamental sources: differences in comparative advantage and economy-wide increasing returns. The phenomenal differences among the growth rates of the East Asian, the Latin American, and Sub-Saharan African countries over the last several decades have stimulated a renewed interest in the effects of trade policies on growth. During most of the 20th century, import substitution industrialization (ISI) strategies dominated most developing countries' development strategies. While developing countries in Latin America that followed ISI strategies experienced relatively lower growth rates, East Asian countries, that employed export-promotion policies, consistently outperformed other countries (Yanikkaya, 2003).

According to Taner (n.d), Traditional trade theory in a Heckscher-Ohlin setting predicts that countries will tend to specialize in the export of goods whose production

is intensive in factors with which they are abundantly endowed. According to the new trade theories which explain trade in terms of technology, technology diffusion/adjustment lags and continuous innovation processes, less developed countries will specialize in the export of old, mature goods where production processes become routine and less skilled labour has to play a greater role. As the export structure of countries changes from resource intensive and labour intensive industries to human capital intensive, technology intensive industries would interpret this as an improvement in the structure and quality composition of exports. If countries compete successfully in high-tech industries and focus on markets in which quality and know-how are more important than low-price strategies we speak about technological competitiveness, one aspect of qualitative competitiveness.

Since endogenous-growth models are often thought to have provided the missing theoretical link between trade openness and long-run growth, it is useful to spend a moment on why such models in fact provide an ambiguous answer. The general answer to the question: "Does trade promote Innovation in a small open economy?" is: "It depends." In particular, the answer depends on whether the forces of comparative advantage push the economy's resources in the direction of activities that generate long run growth (via externalities in research and development, expanding product variety, upgrading product quality, and so on) or divert them from such activities. Other authors have worked out examples where a country that is behind in technological development can be driven by trade to specialize in traditional goods and experience a reduction in its long-run rate of growth. Such models are in fact formalizations of some very old arguments about infant industries and about the need for temporary protection to catch up with more advanced countries (Rodrigues *et al*, 2001).

### **2.2.1. Different types of foreign trade and growth**

The types of foreign trade and growth consist of two: classical period and post classical period of growth and foreign trade. Classical period discusses its two models and how they make gains to international trade and post classical period discuss the new theory of neo – classical and also post classical before Solow.

### **2. 2.1.1 Classical period: international trade and growth**

The classics do not distinguish the questions of economic growth from the questions of international trade; the examination of this problem leads us to the classics' main models of International trade. However, given the aim of this work, we attempt to advance on those models which basically discuss the 'static gains of the International trade'. As far as the interaction between international trade and economic growth is concerned, we found two main ideas to point out in Smith theory of international trade and economic growth. On the one hand, International trade made it possible to overcome the reduced dimension of the internal market and, on the other hand, by increasing the extension of the market, the labour division improved and the productivity increased (Afonso, 2001).

### **2.2.1.2 Post classical period: international trade and growth**

Classical thought gave way to 'marginalism' from the 1870s onwards. This fact led to a 'new theory' (neoclassical) which, for some time, kept the main lines of the evolution of the economy in the long-term away from the studies. The structures of this section takes into account the separation that occurred between IT and economic growth theories, and takes also into consideration some reactions to the classical and neoclassical theories (Afonso, 2011).

#### **2.2.1.2.1 Neo classical theory**

The followers of Ricardo ignored the question of the foundations of comparative advantages and did not identify factors, resulting from International trade that could rise, in a lasting form, the rate of EG (economic growth) and its tendency in the long-term. In general, the changes introduced in the Ricardian theory demonstrated the increase of welfare caused by international trade, but ignored eventual gains in the rate of EG. It was in the context of neoclassical general equilibrium that the model of Heckscher (1919) and Ohlin (1933) appeared, whose contributions completed in the late 40's. In a rigid analysis of the model, the followers observed that it permits to

advocate the opening of the countries to International trade, showing that it is efficient, mutually beneficial and positive for the entire world. However, it limits the analysis to the static gains of welfare ( Afonso, 2011).

#### **2.2.1.2.2 Post classical before Solow**

Afonso (2011), points out that: "The causes which determine the economic progress of nations belong to the study of international trade". In effect, the expansion of the market that it represented led to the increase of global production and originated the increase of internal and external economies, which resulted in increasing income for the economy. But, although he understood the importance of those externalities, he also recognized the difficulties of his analytic treatment. And also he was concerned with economic growth when he considered, like Smith, that the dimension of the market limited the labour division and therefore, the productivity. He also examined the inter-relation between industries in the process of economic growth, the creation of new industries due to the specialization resulting from the extension of the market, the importance of specialization and standardization in a vast market and the influence of this market on technological progress.

#### **2.2.2 Trade as engine of growth**

The origins of trade can be traced to the absolute and comparative advantage as well as Hecksher Ohlin theories. The theory of absolute advantage was formulated by Adam Smith in his famous book titled: "Inquiry into the nature and the wealth of Nation" 1776. The theory emanated due to the demise of mercantilism. Smith argued that with free trade each nation could specialize in the production of those commodities in which it could produce more efficiently than other nations and import those commodities it could not produce efficiently. According to Adam Smith, the international specialization of factors in production would result in increase in the world output. Thus this specialization makes goods available to all nations (Kehinde, 2012).

### **2.2.2.1 Comparative advantage theory**

This theory was propounded by David Ricardo. The theory assumed the existence of two countries, two commodities and one factors of production. According to David Ricardo a, country export the commodity whose comparative advantage lower and import commodity whose comparative cost is higher. The theory also assumed that the level of technology is fixed for both nations and that trades are balanced and rolls out the flow of money between nations. However, the theory is based on the labour theory of values which states that the price of the values of a commodity is equal to the labour time going into the production process. Labour is used in a fixed proportion in the production of all commodities. But the assumptions underlying is quite unrealistic because labour can be subdivided into skilled, semiskilled and unskilled labour and there are other factors of production. Despite the limitations, comparative cost advantage cannot be discarded because its application is relevant in explaining the concept of opportunity cost in the modern theory of trade (Kahinde, 2012).

### **2.2.2.2 Hecksher-Ohlin trade theory**

The theory focuses on the differences in relative factor endowments and factor prices between nation on the assumption of equal technology and tastes. The Model was based on two main propositions; namely; a country will specialize in the production and export of commodity whose production requires intensive use of abundant resources. Secondly, a country differs in factor endowment. Some countries are capital intensive while some are labour intensive. He identified the difference in pre-trade product prices between nations as the immediate basis of trade, the prices depends on production possibility curve (supply side) as well as the taste and preference (demand side). But the production possibility curve depends on factor endowment and technology. A nation should produce and export a product for which abundant resources is used, be it capital or labour. The developing countries are labour abundant and therefore they should concentrate in the production of primary product such as agricultural product and they should import capital intensive product i.e. manufactured goods from the developed countries. The model also assumes two countries, two commodities and two factors and that two factors inputs

labour and capital are homogenous. The production function is assumed to exhibit constant return to scale (Kahinde, 2012).

### **2.2.3 Theories of economic growth**

#### **2.2.3.1 The post Keynesian**

The post Keynesian growth accounting is the determinants of growth and business cycle, the first model goes with many similarities to Keynesian model and develops a consumption function and assumes capitalists save all their income and labour consumes all their income therefore capital formation depends on income distribution that can be expanded to a growth model. Domar's growth model productive capacity and potential output is treated as a constant multiple of stock of capital a "razor's-edge" growth path at which any deviation from exogenously fixed rate of capital output ratio, growth path would diverge from natural growth path and become unstable. The GDP rate was equal to the ratio of investment to GDP lagged by one year divided by the ratio of "required" investment to desired growth, the Incremental Capital Output Ratio. Harrod's fundamental equation the warranted rate of growth is a function of saving and optimal capital output ratio which is different from actual capital output ratio. Capital output ratio was treated exogenously (Ramjerdi, 2012).

#### **2.2.3.2 The endogenous growth theory**

According to Kargbo (2012), endogenous growth theory was constructed from the shortcomings of the neoclassical model of economic growth. This new growth theory acknowledges the importance of endogeneity of capital in the growth process. Assumption of increasing returns as opposed to constant returns of capital typical in the neoclassical growth theory was another differencing attribute. This theory also emphasized the importance of human capital in the growth process, and hence the assessment of foreign aid on economic growth fits into this new growth theory since aid in the form of technical assistance can be an important attribute in influencing capacity building and hence human capital in most aid-recipient countries. Lucas, for instance, assumes that investment in education leads to production of human capital which is the crucial determinant of the growth process. Issues of research and

development and learning by doing or by investment became important in the new growth theory.

The implication of this theory for developing countries is that such countries stand to benefit more from trade with developed countries by drawing on the new knowledge in research and development and new technologies and hence the need to encourage trade openness. The new growth theory in particular recognizes the importance of public policy to economic growth and this justified the inclusion of policy variables in empirical aid-growth regressions. Further, the assumption of increasing returns to capital of the new growth model implies that foreign aid will improve growth well into the long run (Kargbo, 2012).

### **2.2.3.3 Neo-classical growth**

This was first propounded by Robert Solow over 40 years ago. The model believes that a sustained increase in capital investments increased the growth rate only temporarily, because the ratio of capital to labour goes up. The marginal product of additional units is assumed to decline and thus an economy eventually moves back to a long term growth-path with the real GDP growing at the same rate as the growth of the workforce plus factor to reflect improving productivity. Neo-classical economists who subscribe to the Solow model believe that to raise an economy long term trend rate of growth requires an increase in labour supply and also a higher level of productivity of labour and capital. Differences in the rate of technological change between countries are said to explain much of the variation in growth rates. The neo-classical models treat productivity improvements as an exogenous variable which means that productivity improvements are assumed to be independent of the amount of capital investment (Kehinde *et al*, 2012).

### **2.2.3.4 The neoclassical paradigm**

Until the late 1980s, the 'Neoclassical Paradigm' dominated both 'International Economic Theory' as well as 'Growth Theory'. In the canonical neoclassical growth model, without technical progress then macroeconomic capital accumulation is

prone to diminishing returns to scale. This means that each additional unit of the homogenous input factor capital contributes less to output than the precedent unit. In this setting, the economy reaches steady-state equilibrium, characterised as equilibrium path where per capita consumption is constant when the marginal product of capital equals the rate of time preference. The economy exhibits growth of output per capita, i.e. efficiency growth, and an increase in capital-intensity only in the transition time to the steady-state. The single possibility to introduce a permanent increase in a country's growth rate is assuming exogenous technological progress that increases the efficiency of labour. In open economy neoclassical scenery, the flows of the two homogenous input factors capital and labour are seen as being governed by international factor cost differences with factors flowing from the location of relative abundance to the place of relative scarcity. Of course this is only possible if there are no restrictions on the free flow. While theorists acknowledge the relative restrictiveness of labour mobility, the world has seen several liberalisation rounds in international capital flows (Hofman, 2013)

Theoretical literature has explored the relationship between international trade and growth. Since the 1960s, the role of international trade as an "engine of growth" has been emphasized by academics. International trade is expected to bring about both static and dynamic gains. Static gains from trade are closely linked to conventional trade theory (e.g., Ricardo's comparative advantages theory). According to the hypothesis of free movement of production factors across sectors, the international trade theory of Heckscher-Ohlin-Samuelson (hereafter referred to as HOS) suggests that trade openness might generate substantial gains in two major ways: by specialization in production according to country's or region's comparative advantage and by reallocation of resources between traded and non-traded sectors (Deumal *et al*, 2011)

International trade might constitute an effective channel for international transmission of know-how and dissemination of technological progress. In developing economies, openness to international trade could be a means of overcoming the narrowness of the domestic market and provide an outlet for surplus products in relation to domestic requirements. Furthermore, extension of market size due to export orientation is likely to bring about economies of scale in production processes. A

trading nation could improve the skills and dexterity of its labour force by learning through exporting. Exposure to new products (import of high-tech inputs), advanced organizational methods and production processes could stimulate technological upgrades and greater efficiency. In addition, integration in global innovation networks and international marketing contacts might provide ideas to local producers to innovate and develop new products (Deumal *et al*, 2011)

According to Stern (2007), the integration of world markets that characterizes the process of globalization has facilitated, somewhat paradoxically, a fragmentation of global production. Improvements in information technology transport and logistics have made it possible to “deconstruct” product value chains and allocate global production tasks for goods and services much more finely and in line with comparative costs of production in different locations. Global production chains have become fragmented and truly global. Low and middle-income countries that have succeeded in integrating themselves into the global economy through trade and investment have generally grown faster than richer countries. Those that have not succeeded have grown more slowly. These broad conclusions are not sufficient, of course, to map into a unique set of policy and institutional prescriptions that apply to all countries and all situations. Political reality and differences in economic and institutional circumstances mean that each country must find a path that works best for itself.

For South Africa, endowments of natural resources or basic industries are no longer necessary or sufficient for participation in this new global environment. International trade is a substitute for self-sufficiency at all stages in product value chains and the mere presence of these raw materials domestically, if not managed properly, can be a hindrance rather than a help to downstream industries. Instead, improved logistics and trade facilitation are likely to be far more critical to the country's future industrial competitiveness, development and growth (Stern *et al*, 2007).

Okojie (2012) developed an export-led growth model built on the notion of cumulative causation and takes into consideration the fact that exports are the main components of demand. Keynesian models in Kaldorian lines, such as The balance of payments constrained growth model, find the channel between trade and growth

by means of demand pull characteristics of exports. Static trade models suggest movements toward openness can temporarily due to short - run gains from the reallocation of resources, which would imply a positive relationship between changes in openness and GDP growth. The new growth literature identifies some avenues of such technological change and technological gaps through which openness might affect long – run growth. The relationship between export performance and economic growth has been a subject of considerable interest to development economists, especially those who believe that economic growth should be sustained and maintained.

According to Badlingmaier (2007), the early classical theorists Ricardo and Heckscher already pointed out to possible gains from trade. These gains stem from specialization in production due to international trade. If countries specialize according to their comparative advantage enhanced resource allocation can be achieved. This improves (allocation) efficiency because resources which have formerly been employed in the production of other goods are now shifted to the production of the good(s) a country produces best. Consequently, the welfare (income) of all trading nations is improved. This constitutes, however, only a level-effect in consumption possibilities. Further effects, like for instance an increase in output growth rates, cannot be explained by these theories. More recent theories of the connection between trade and growth suggest different (growth) effects of trade, from none to positive as well as negative effects.

In a world where large industries with economies of scale dominate, the classical explanation of trade and its positive impact on welfare does not hold. The cost advantage e.g. a first mover gains because of increasing economies of scale can prevent possible other producers from entering the market even though they would have an (comparative) advantage. In this scenario, a small country that opens up to trade and has not yet acquired the necessary scale effects is not capable to compete with the first mover. Another line of argumentation points to possible disadvantages of an increased specialization particularly for developing countries. If these countries e.g. specialize in sectors with less productivity growth or lower income elasticity of demand (e.g. agricultural sector), their income growth will always lag behind that of

developed countries and the income disparity between rich and poor countries will grow. (Badlingmaier, 2007).

Okojie (2012) asserted that for a long time, there was hardly any country which exhibited sustained growth rate higher than its growth of exports. They also claim that growth rates of individual developing countries since 1950 correlate better with their export performance than with any other single economic indicator. In his work, he explained the possibility that export growth may set up a vicious cycle of growth such that once a country is launched on the path, it maintains its competitive position in world trade and performs continually better relative to other countries. He also contended that export growth relieves a country of balance of payments constraints so that the faster exports grow, the faster output growth can be without running into balance of payments difficulties. His findings suggest that an export based strategy of development offers the best prospects for economic growth

Mercantilism to classicism and modern trade theories as found in the history of economic thought have argued in favour of global trade. To them, trade is a sine-qua-non to the improvement of welfare through the efficient allocation of resource factors across various sectors and countries. The theoretical underpin is the Heckscher Ohlin theory of international trade. This theory, as argued by many international economists, is an improvement of David Ricardo's theory of comparative advantage because trade occurs as a result of differences in comparative cost which is also due to inter-country differences in relative factor endowment. Heckscher Ohlin theory is relevant because it began with the comparative advantage and links the pattern of global trade to the economic structure of trading nations. This provides the model to explaining a change in global trade on the growth of economies (Opukri *et al*, 2013).

Kahinde (2012) assert that trade can promote growth from the supply side, but if the balances of payment cost reduce the availability of imported inputs which enter the product of exports, thus forcing exporters to use expensive imports of double quality. He concludes that high level of trade restriction have been an important obstacle to export performance and growth. He contends that the reduction of this restriction can be expected to result in significantly improved trade performance in the region.

Countries that are more open to trade are likely to experience higher growth rate and higher per capital income than closed economy. general equilibrium model was used to establish that the greater number of intermediate inputs combination results in productivity gain and higher outputs, despite using same capital and labour input which exhibit increasing return to scale.

Economy watch (2010) indicates that one group of economists is of the view that international trade has brought about unfavourable changes in the economic and financial scenarios of the developing countries. According to them, the gains from trade have gone mostly to the developed nations of the world. Liberalization of trade policies, reduction of tariffs and globalization have adversely affected the industrial setups of the less developed and developing economies. As an aftermath of liberalization, majority of the infant industries in these nations have closed their operations. Many other industries that used to operate under government protection found it very difficult to compete with their global counterparts.

According to Loots (2002), the analysis of trade openness and liberalization in emerging market economies in South Africa reveals that trade volume seems to have a relative small impact on GDP per capita and is mainly driven by the performance of East Asian emerging market economies. In contrast, trade liberalization led to an approximate 50% on GDP per capita over the 11-year period and is mainly driven by Latin American and the mixed group of emerging economies. The financial dimension focused on capital account openness and financial liberalization. The evidence on capital account openness suggests that it is associated with a 34% increase in real GDP per capita growth over the period. Financial liberalization seems to have a dramatic impact of approximately 136% over the 11-year period. The results on both the financial liberalization variables indicate that it is strongly driven by the emerging East Asian region and can be ascribed to the dramatic turnabout in the financial sector policies during the late 1980s and early 1990s.

## 2.3 Empirical literature

The empirical literature on the relationship between international trade and economic growth has grown to huge proportions over the past four decades. Before attempting to extract a consensus estimate, a brief review of the evolution of this broad and varied literature is in order. Most of the earliest empirical studies of international trade and growth supplemented more detailed studies of the protectionist import substitution policies by the governments of most developing economies after World War II. In One such study, simple correlation analysis was used and a strong positive correlation between trade and growth for 41 developing economies was found, which led him to conclude that the protectionist import substitution policies had been ill-advised. By applying regression analysis for a sample of 10 countries in order to test the relationship between trade and growth, he found to be positive and statistically significant (Lewer *et al*, 2003).

According to Rodrigues (2001), the prevailing view in policy circles in North America and Europe is that recent economic history provides a conclusive answer in the affirmative. Multilateral institutions such as the World Bank, the IMF, and the OECD regularly promulgate advice predicated on the belief that openness generates predictable and positive consequences for growth. A recent report by the OECD (1998) states: "More open and outward oriented economies consistently outperform countries with restrictive trade and [foreign] investment regimes. According to the international monetary fund's (IMF) (1997), Policies toward foreign trade are among the more important factors promoting economic growth and convergence in developing countries. This view is widespread in the economics profession as well. For example, Rodrigues judges that it is straightforward to demonstrate empirically the superior growth performance of countries with "outer-oriented" trade strategies. Most specifications of empirical growth regressions find that some indicator of external openness-whether trade ratios or indices or average tariff level-is strongly associated with income growth.

According to Sun (2010), empirically there appears to be good evidence that international trade affects economic growth positively by facilitating capital accumulation, industrial structure upgrading, technological progress and institutional

advancement. Specifically, increase in imports of capital and intermediate products, which are not available in the domestic market, may result in the rise in productivity of manufacturing. More active participation in the international market by promoting exports leads to more intense competition and improvement in terms of productivity. Learning-by-doing may be more rapid in export industry thanks to the knowledge and technology spill over effects. In addition, the benefits of international trade are mainly generated from the external environment, appropriate trade strategy and structure of trade patterns. There are comprehensive empirical studies on the impact of trade on economic growth. Before the 1960s, research on trade effects was limited to a few specific countries. With the development of econometrics, however, many complicated methods based on a mathematical model were introduced to analyse the interactive impact between trade and economic growth. So far, the discussions in this area have been generally divided into two categories. One focuses on the causality relationship between international trade and economic growth to examine whether economic growth is propelled by international trade or vice versa. The other mainly discusses the contribution of foreign trade to economic growth.

Many econometric studies have confirmed that positive relationship exist between global trade and economic growth. And it argues that it is possible for protectionism to be favourable to a country that has a comparative advantage in terms of productivity growth especially in a labour abundant economy (Opukri et al, 2013).

Qaiser ( 2012) Finds an optimistic association sandwich between export and growth of economics, on the little support for positive impacts of liberalization on trade. He examines the affiliation among openness, exports to GDP ratio and economic enlargement for five ASEAN nations, and detected co integration between openness, exports to GDP ratio and economic expansion for all nations. stated the result of long-term investigation in the computerized exports management. He discussed the Pakistan's export trend and problem of export facing Pakistan and how to remove the difficulties of exports in Pakistan how it manage the export through the computer.

Recent empirical work across developing countries as a whole supports this pessimistic conclusion as far as regional trade agreements are concerned, but finds that broad trade liberalisation does lead to faster growth. no evidence that regional

integration among developing countries exerted a positive effect on income and growth, except in the case of the Southern African Customs Union (SACU) where favourable growth effects were found for Botswana, Lesotho and Swaziland. 109 cases of participation in 18 regional trade agreements over the period 1950 to 1992 were taken and concludes that their impact on the growth rate of members has been negative. 51 cases of broad liberalisation were also taken and it was found that countries have grown faster after liberalisation. Two measures of liberalisation (or trade openness) are used. One is the standard measure used in much of the 'new' growth theory literature of the ratio of total trade (exports + imports) to GDP. The second is the so-called Sachs-Warner (1995) ratio of openness. This measures define the economy as 'open' if all five of the following conditions are met: (i) an average tariff rate of less than 40%; (ii) average non-tariff barriers equivalent to a tariff rate of less than 40%; (iii) a black market exchange rate premium of less than 20 percent, (iv) no communistic government, and (v) no state monopoly of major exports. These criteria can be used for pin-pointing the precise year (s) of trade openness for a country. The procedure for testing the effect on growth of trade liberalisation, or belonging to a regional trade agreement (RTA) (Thrilwa, 2000).

According to Daumal (2011) many empirical papers have explored the links between international trade and growth. The seminal empirical studies provide support for the growth enhancing effect of international trade. Sachs and Warner measure examine the impact of trade liberalization on the growth of 122 countries. The Results outline that open countries exhibit higher growth rates than protectionist countries. In the same way, showing that trade openness generated higher income levels in a cross section of 63 countries in the year 1985. Some recent studies point to a significant contribution of trade openness to economic growth. They reveal that greater trade openness (which is quantified by trade volume) brings about higher growth rates. The main distinctive characteristic of these recent papers lies in the use of the Generalized Method of Moments (GMM) estimator on panel datasets. In this way, endogeneity and invariant omitted variables bias could be tackled. Generally speaking, empirical studies which rely on within-country variation mostly report robust growth benefits from trade liberalization.

Qaiser 2012 assessed the implication of globalization for poverty and agricultural in Pakistan. There was a suggestion that there is adverse impact of globalization on agriculture and poverty, the strong disassociation between economic growths, terms of trade and exports. He argues that openness on inflation create positive effect in international market through monetary and fiscal policies and suggest that foreign debt has positive impact on the Pakistan's textile sector and agricultural sector both in the short and the long run.

According Burgut (2013), the Organisation of Economic Co-operation Development (OECD) (2003) conducted a study on the impact that trade had on the average income per population. According to the result, the elasticity of international trade was 0.2, which was statistically significant in his analysis of trade of trade agreements on economic growth in United States of America (USA) concludes that nations pursue trade liberalization to achieve a number of national objectives. In addition to the "static" gains from trade, he suggests that trade potentially plays a dynamic role in the economy. The positive impact of international trade on economic growth theory as evidenced by earlier studies. He finds an affirmative and significant long-run effect of exports and investment on output in Australia. The evidence supporting the positive and significant long-run effects overwhelms the evidence providing mixed effects of trade (and investment) on output is widely accepted that the level of international trade in an economy may be one of the main sources of its growth.

The study concluded that exports positively affected economic growth in the polished economy. In addition, the dynamic interactions between exports and imports influenced the GDP it also concluded that China's outstanding performance in economic growth could be traced back to its increasing involvement in global trade and dynamic trade policy. This rapid economic growth has made the country target the world as its market. The increasing participation in the global market helps China reap the static and dynamic benefits from trade, facilitating the rapid national economic growth (Burgut, 2013).

Ramjerdi, 2012 used a time-series to data for 88 countries for years 1960-1982 and concluded there was a positive correlation between exports and economic growth for

more than 80% of the countries. He examined the important role of domestic R&D as well as imported sum of R&D of a country's trade partner on the path of total productivity factor (TPF). They used accumulated R&D stock as a proxy for each countries stock of knowledge by using data from 22 industrialized economies for the period 1971-1990; the results showed both domestic and foreign R&D have a positive relation effect on a country's TPF. Further, the more open the economy the greater the effect of the stock of external R&D on the domestic TPF and that the less developed countries benefited the most from the stocks of external R&D.

According to Osterfeld (2007), it is necessary to test the theoretical models by means of empirical investigations. In his survey of the literature two types of empirical research he distinguished: "large scale multi-country studies that have investigated in detail the experiences of a group of countries with trade policy reform" and "econometric studies that have investigated, on broad cross-country data, the relationship between the pace of exports expansion and aggregate economic growth. He also used the data of individual country studies to test whether trade has a positive impact on output growth or not. Each of them found a positive impact of trade on growth. Nevertheless it cannot be seen as persuasive evidence because of missing theoretical foundations and an arbitrary classification of the trade orientation of the considered countries.

On the basis of a cross-sectional study covering fifty countries examines the importance of export for economic growth and maintains that there is a causal relationship between exports and economic growth, and that this relationship is one of interdependence rather than unilateral causation. He pointed out that exports are a key factor in promoting economic growth and that a rise in export stimulates rise in aggregate economic output. The focus was on correlation between the rate of growth of export and GNP. He finds that the correlation between rates of growth of export and gross national products (GNP) is particularly strong among the countries with successful growth experience (Amah *et al*, 2012).

According to Omoju (2012), International trade brings welfare and efficiency gains to all countries irrespective of their initial conditions, level of development, technological abilities and natural resources endowments. Empirically, the effect of foreign trade

on economic growth has been an important and controversial subject for several decades. A number of studies, using different approaches, have found growth to be enhanced by trade openness, or liberalization. On the other hand, some studies have argued that trade or trade expansion may not be beneficial for the economic growth of all countries at all times.

Significant impact of trade openness on level of per capita income was found. They posit that trade possibilities enhance growth through greater capital stock, stock of education and higher total factor productivity. They, however, warned explicitly against drawing inferences for trade policies based on their results as it brings different factors into play. The influence of foreign trade and investment on growth via inequality and distribution of income in developing countries was addressed. The argument of that survey of theory and empirical evidence are inconclusive. It was stated that there are no compelling theoretical reasons to believe, in general, that trade promotes growth and empirical works supporting a connection at country level has been heavily criticized on methodological grounds. Further argument was reached that it would be difficult to believe that trade liberalization has not contributed significantly to the growth of the world economy in the second half of the 20th century. He concluded that trade was a product of economic growth; and that the world economy would have grown as rapidly as it did even if trade barriers are as high as they were in the 1950s implying that other factors aside trade also promotes growth (Omoju, 2012).

In difference to the multi-country studies, the econometric approaches were based on broad country data. The intention of maximizing the sample of countries was to provide a more reliable picture of the relationship between the trade policy of a country and its growth. Rank correlation coefficients on a 41-country sample to test whether trade promotes growth were used. Both of them find a significantly positive correlation between growth and different trade measures. Unfortunately, the results can be criticized in three ways: First of all, the studies do not check for other (possible) driving factors than trade. Furthermore, they do not take account of the causality problem between trade and growth. Additionally, the econometric approaches lack a firm theoretical background. Therefore, there were problems he tried to avoid by developing a conceptual framework which uses neoclassical

production functions. A moderately positive correlation between trade and growth was found but there are no authors who persuasively solve the causality problem between trade and growth. Because of that an advanced econometric methods was used to get rid of the causality problem by using geographic characteristics of a country as an instrument (Osterfeld, 2007).

While endogenous growth theories have led to a richer appreciation of the nature and role of technological change, the limited empirical evidence to date does not clearly favour these theories over neoclassical growth theory. There is widespread agreement that international comparative data fit a pattern of conditional convergence (among countries with similar rates of investment and levels of schooling, poor countries grow faster than rich ones, ultimately converging to the same standard of living). Conditional convergence can be reconciled with both an extended version of the neoclassical model and some versions of endogenous growth models. A wide variety of techniques has been used in an attempt to demonstrate that increases in exports, increases in trade, or liberalized trade policies lead to faster rates of economic growth. In-depth comparative country studies, popularized in the 1970s, suggested that developing countries with policies which were relatively open toward international trade enjoyed better economic performance than countries with relatively closed policies. Attempts to establish statistical causation between exports and growth have had mixed success, as have attempts to include measures of trade or trade liberalization in cross-country studies of economic growth (Ferrantino, 1997).

While a substantial part of earlier studies showed evidence of correlation between exports and growth which was used to support the export – led growth hypothesis, this tends to hold only for cross section studies. Recent evidence on time series analysis cast doubts on the positive effects of exports on growth in the long run. An additional empirical demonstration of a strong association between export performance and economic growth by undertaking a comprehensive study of the role of exports on the economic growth of 10 countries from 1954 – 1974 was expressed. A single non – linear regression equation was specifically estimated for each of the chosen countries and she found exports and gross national product to be highly correlated. It was noted that the proponents of the export – led strategy and free

trade point out that most developing countries that follow inward – oriented policies under the import substitution strategy in Latin America had poor achievements. A study was showed that some of the Latin American countries on the average exhibited a complete lack of growth with real income declining between 1960 and 1990. This view also noted that the ultimate source of global poverty reduction is sustained economic growth. It was stressed that least developed countries particularly in Africa, have been increasingly marginalized in international trade mainly due to their high dependence on the production and export of primary commodities. The study found no clear systematic association between exchange rate devaluation on the one hand, and growth and diversification of exports on the other hand since the early 1980s. His paper attributes success or failure of GDP and industrial growth, inter alia, to the volume of investment and the availability of imports (Okojie, 2012).

There was a report that externally-oriented industries were found to have higher rates of growth compared to other industries in the South African economy in the post 1990s period. The drive of this process of opening up the economy was enhanced by the endorsement in 1994 of the General Agreement on Tariffs and Trade (GATT) and the execution of Preferential Trading Agreement (PTA)s with the European Union (EU) and the South African Development Community (SADC) in 1999 and 2000 respectively. The salient facet of these agreements is the reduction of import protection. The EU-SA agreement has an asymmetric nature whereby duties on 95 per cent of the EU's imports from South Africa will totally be phased out by the end of the agreement's 12-year duration; while on the other hand, only 86 per cent of South Africa's imports from the EU will become duty-free during the same period. The SADC agreement, though created in 1996, was only endorsed by 11 of its current members in 2000. According to this agreement, 98 per cent of intra SADC trade will have to become free of duty by the year 2012. Owing to the fact that South Africa is the largest economy in the region, the agreement requires it to undergo faster liberalisation reforms than other countries in the community (Kanda *et al*, 2011).

## 2.4 Chapter Summary

In this chapter we examined the theoretical and empirical theories of foreign trade and economic growth. The literature has given more attention to relationship between foreign trade which consist of import, export and exchange and also they are effect on South African economy. Kahinde (2012) reviews trade as engine of growth, firstly, the comparative advantage theory that was produced by David Ricardo, whom his theories conclude that trade must be between two nations, using two commodities and one factor of production. Secondly, the Hecksher – ohlin theory whom his focus is based on the differences in relative factor endowment and price assumption, according to Hecksher- ohlin assumption, there must be equal taste and technology between countries. Thirdly, the absolute advantage theory that was introduced by Adam Smith, he argues that there must be free trade, by that each country will be able to specialize in the production of their commodities, so that it can specialise on the commodity than importing the commodity from other countries. All these types of trade teaches us that trade can be done in different ways, whether by one country or more trading with each other using one or two commodities. Or it can be done by one country producing its one product and specializing with it rather than importing the product from other countries.

Ram (1987) expanded Feder's model using time series data of 88 countries to investigate the relationship between foreign trade and economic growth, his empirical findings was:

- There is a positive correlation between export and economic growth for more than 80% of the counties

In this chapter theory and empirical literature review were selected, as the topic is based on certain variables that have been put in a model in chapter 3. The following is continues of chapter 2, representing methods that will be used to put our topic into test.

## CHAPTER 3

### THEORITICAL FRAMEWORK, METHODOLOGY AND DATA

#### 3.1. Introduction

The chapter focuses on the specification of a model, definition and justification of the variables that affect the relationship between economic growth and international trade. The chapter also present the data to make estimations. The study uses a time series data and also the cointegration approach.

#### 3.2. Model specifications

This study tries to build an econometric model which will be able to provide a better understanding of the relationship between economic growth and international trade in the South African economy. The Erhieyovwe and Onokero (2013)'s model will be used as the basis for the formulation of the model of this study. Their model is made up of three variables; namely GDP as a dependent variable and Export and Exchange rate as an independent variables. This study uses the same variables but more variables such as Import and Inflation rate will be included as other determinants of foreign trade in the South African economy. The study estimates the growth model which can be expressed in its functional forms as follows:

$$GDP = f(EXCH, EXPT, IMPT, INF) \quad 3.1$$

where

GDP = Gross domestic product is dependent variable

EXCH = Exchange rate

EXPT = Export

IMPT = Import

INF = Inflation Rate

The above equation can be expressed in a linear function as follows:

$$GDP = \alpha_0 + EXCRAT + \alpha_2 EXPT + \alpha_3 IMPT + \alpha_4 INF + \mu_t \quad 3.2$$

where  $\mu$  = stochastic or random error term (which means properties of zero mean and non-serial correlation).

$\alpha_0$  = constant interception

### 3.3. Definition and Justification

This study followed the quantitative method of research using the secondary data from institutions like South African Reserve Bank (SARB) and Organisation of Economic Co-operation development (OECD). Time series data were used with the Quarterly rate that begins from 1990Q1 – 2013Q2. The study also follows a Cointegrated vector autoregression (CVAR) which contains the following: (ADF) Augmented of Dickey – Fuller testing and (PP) Phillips Perron testing for stationarity, Johansen cointegration test and (VECM) Vector error correction model test. Heteroscedasticity using the white type test, normal distribution, Rumsey reset serial correlation.

#### 3.3.1. Foreign trade

International trade analysis focuses primarily on the real transactions in the international economy, that is, on those transactions that involve a physical movement of goods or a tangible commitment of economic resources (Krugman *et al*, 2012). therefore the description of data for this study is going to be, taxes on international trade and transaction percentage of total value.

#### 3.3.2. Economic growth

According to (Mankiw *et al*, 2011), economic growth is the increase in the amount of goods and services in an economy over a period of time, it is also caused by the number of labour force in the market arising and having hard work. Economic growth is the term that is used by economists to describe the rate of increase in an economy's potential real output in the economy. It can result from either the increase in physical factor inputs in the economy or an improved quality and

utilisation of the existing level of inputs (Nellis *et al*, 2004). Therefore this study is going to use GDP at market price data.

### **3.3.3. Export**

Since South African exports are actually imports by the other countries from South Africa, the explanation of exports is relatively simple accordingly. South African exports are determined by the factors similar to those concerning imports. The export decision is primarily taken in other countries, i.e. South African producers supply of export of goods occurs on the demand from foreigners. It does not depend on domestic income or production (GDP) to any significant extent (Fourie *et al*, 2009). Therefore this study used foreign trade; exports of goods and services including gold price indices data.

### **3.3.4. Import**

Import is concerned with the purchasing of foreign products (both consumer goods and capital goods) the major share of South African imports comprises machinery and capital items and also oil ( Fourie *et al*,2009).therefore the study will us foreign trade on goods and services and price indices data.

### **3.3.5. Exchange rate**

Foreign trade involves payment in foreign currencies such as the euro, pound, dollars and yen. South African importers have to pay in these currencies for the goods they buy and are therefore obligated to exchange South African rand for these currencies. There is thus a demand on the part of South African importers for Euros, Pounds, Dollars, and Yen among others. On the other hand, importers in other countries such as Germany and the UK, have to pay in a rand for South African exports and must therefore exchange Euros, pounds etc. for rand. In this way South African exporters lead to supply of foreign currencies (Mohr *et al*, 2008). This study

is going to use South African cent per Australian dollar middle rate R1=100 cents data.

### **3.3.6. Inflation rate**

Inflation is defined by Thirlwall (1974) as a 'rise in the general price level whatever its cause'. Inflation, according to Mishkin (2001), is 'a continual increase in the price level'. Dornbusch *et al.* (1999) define inflation similarly as 'the rate of change in prices'. Mohr (2005) importantly points out that inflation is the 'sustained increase in the general level of prices' as opposed to a once-off increase. Generally there is no disagreement as to the meaning of inflation and it is clearly understood that it is the continuous 'upward adjustment of prices' (Curwen, 1976). However, difficulties arise when determining the effect of inflation on unemployment and thus on a country's economic growth and development (Morar, 2011)

### **3.4. Analytic technique**

The study uses quantitative research method. The number of methods that were being feasible is limited because this study used a limited quarterly data set from 1990Q1-2013Q2 and also limited or few variables. Since most economic variables are nonstationary (they contain unit roots), the study used cointegration methodology to analyse the data. The Technique involves the determination of long-run cointegration relationship by testing for stationarity of the variables. Stationarity is tested using the ADF and PP test statistic. The rejection of the null of nonstationarity (unit root) means that the variables in the equation are cointegrated. If there is any nonstationarity, it was be corrected and the existence of the short run relationship among variables will be tested by means of a vector error correction model (VECM). Furthermore diagnostic and stability tests such as heteroscedasticity using white type method, Ramsey reset, serial correlation lastly, normal distribution will also be conducted.

### 3.4.1. Non stationarity

According to (Robinson *et al*, 2004), a non stationarity series are very common in macroeconomics. They occur for various underlying reasons and they may have important implications for the appropriate treatment of series. For example, consider a country whose monetary policy is a price level target were the target increase at a constant rate (i.e. in the absence of shock, inflation will be constant) although shocks will take the price level away from the target, such deviation will be temporary. For simplicity, assume that the mean deviation is zero; the price level will be stationary in this case but will be able to extract a stationary series by detrending it.

A time series variable that does not meet the requirements and therefore exhibits a trend over time is called a nonstationary variable. A nonstationary variable causes misleading results. The trend that the nonstationary variable follows is not represented in the model. Since the trend is not controlled for, the estimation process gives the nonstationary variable credit for the trend. It will seem as if the regression has much better goodness of fit than it really does, and the nonstationary variable will seem to have greater impact in the regression than it really does. When a regression has a strong goodness of fit and significant t – statistic because of a trend or other factors not accounted for in the model, it is often referred to as spurious regression or a spurious correlation (Halcoussis, 2005).

### 3.4.2. Stationary/ unit root testing

According to Gujarati (2003: 806), if a model is estimated using non-stationary data series, the estimation will generate spurious results. Thus, the first step in the process of determining the existence of a long-run relationship is to determine the stationarity of the series, also known as the order of integration. In order for co integration to exist, the variables must be stationary at level or first difference. There are numerous means of testing for stationarity, for example the unit root test, the autocorrelation function and the visual plots of data. This research utilized two unit root tests: the Augmented Dickey Fuller and the Phillips-Perron (PP) test (Dlamini, 2008).

The distribution theory supporting the DF and ADF test is based on the assumption that the error terms are statistically independent and have a constant variance. Therefore, when using the ADF methodology, one has to make sure that the error terms are uncorrelated and that they don't have a constant variance. Phillips and Perron (1988) developed a generalization of the ADF test procedure that allows for fairly mild while the ADF test corrects for higher order serial correlation by adding lagged difference terms on the right hand side, the PP test makes a correlation to the t – statistic of the coefficient  $\gamma$  from the AR(1) regression to account for the serial correlation in  $\epsilon_t$ . So the PP test statistics are only modification of the ADF statistics that take into account the less restrictive nature of the error process (Asterious *et al*, 2011).

According to Cheung (1995) the argument Dickey – Fuller or (ADF) is a commonly used unit root test, fitting an autoregressive AR (k) model, this test examines the null hypothesis of an (autoregressive integrated moving average) ARIMA (p, 1, 0) process against the stationary ARIMA (p + 1, 0, 0) alternative. Dickey and fuller derived the limiting distribution of the ADF test when  $p \leq k - 1$ , approximate critical values for the test with  $k = 1$  were tabulated by fuller (1976) for specific simple size. For the case of  $k > 1$  the ADF test has the same limiting distribution as when  $k = 1$ , provided that the condition  $p \leq k - 1$  holds.

Let  $x$  be a time series. Deriving from an AR (k) representation, the ADF test involves the following regression.

$$\Delta X_t = \mu + \gamma t + \alpha x_{t-1} + \sum_{j=1}^{k-1} \beta_j \Delta x_{t-j} + \mu_t \tag{3.4}$$

where  $\Delta$  is the difference operator and  $\mu_t$  is a white – noise innovation. The tests examine the negative of the parameter  $\alpha$  based on its regression t ratio. Dickey fuller (1979) derived the asymptotic distribution of the statistic. Hall (1994) showed that the asymptotic distribution is unaffected by the data based model selection using standard information criteria.

Variables should ideally be integrated of the same order, preferably I(1). If all the variables are I (0), there will be no problem of a spurious regression and a standard regression may be estimated (Brooks, 2008: 326).

### 3.4.3. Johansen Cointegration

Asterious *et al* (2007) maintain that cointegration is when in a special case X and Y is really related. This means that we would expect them to move together and therefore the two stochastic trends would be very similar to each other. When we combine them together, it should be possible to find a combination of them which eliminates a nonstationarity. This means that the variables are cointegrated. This should happen when there is a relationship linking the two variables together and so cointegration becomes a very powerful way of detecting the presence of economic structure. Therefore cointegration becomes an overriding requirement for any economic model using non stationarity time series data. If the variables do not cointegrate, which means we have a problem of spurious regression, an econometric work becomes almost meaningless. On the other hand if the stochastic trends do cancel, then we have cointegration.

### 3.4.4. Vector error correction model (VECM)

According to Asteriou (2011), the VAR model has some very good characteristics, like its simplicity. The econometrician does not have to worry about which variable are endogenous or exogenous. Secondly, the estimation is also simple in the sense that each equation can be estimated separately with the usual OLS method. Thirdly, the forecasts obtained from VAR models are in most cases better than those obtained from the far more complex simultaneous equation models (Mahmoud, 1984 and McNees, 1986). VAR models have faced several criticisms over various points; firstly they are theoretical in that they are not based on any economic theory. If the cointegration is established among the variables, this study will follow the Vector Error Correction Model (VECM) approach which is another version of VAR, not the normal VAR will be followed.

VEGM is a multivariate generalization of ECM model. It can also be seen as a VAR model designed for the use with nonstationary time series that are known to be cointegrated. The specification of VEC models contains the cointegration relations,

so it assumes that the economy converges to the long-run relationships. On the other hand, it allows also for the short-run adjustment dynamics. The very simple example of VEC model is the one illustrated on 3.5 and 3.6 equations respectively, with one cointegration equation ( $y = \beta x$ ) and one lag of difference terms:

$$\Delta x_t = \alpha_1(Y_t - 1 - \beta x_t - 1) + Y_{11}\Delta x_{t-1} + Y_{12}\Delta Y_{t-1} + \varepsilon_{1t} \quad 3.5$$

$$\Delta Y_t = \alpha_2(Y_t - 1 - \beta x_t - 1) + Y_{21}\Delta x_{t-1} + Y_{22}\Delta Y_{t-1} + \varepsilon_{2t} \quad 3.6$$

As mentioned earlier, if a long-term equilibrium relationship exists between the characteristics of a series such as a mean and a variance we apply VECM in order to evaluate the short run over time. If both are constant over time, then the series properties of the cointegrated series are correlated. In case of variables being nonstationary (i.e. is not a random cointegration VECM is no longer required and we directly walk/has no unit root), otherwise, the series is described to precede Granger causality tests to establish causal as being a non-stationary process (i.e. a random walk/has links between variables. In VECM the cointegration rank shows the number of cointegrating vectors. For instance a rank of two indicates that two linearly independent combinations of the non-stationary variables will be stationary. A negative and significant coefficient of the ECM indicates that any short-term fluctuations between the independent variables and the dependent variables will give rise to a stable long run relationship between variables (Asari et al. 2011).

### 3.5. Diagnostic and stability tests.

According to Hothon (n.d), the diagnostic tests are not only useful in econometrics but also in many other fields where linear regression is used, which we will demonstrate with an application from biostatistics. It is important to assess the goodness-of-fit of data models, in particular not only using omnibus tests but tests designed for a certain direction of the alternative. The diagnostic checks do not have to be seen as pure significance procedures but also as an explorative tool to extract information about the structure of the data, especially in connection with residual

plots or other diagnostic plots. The recursive CUSUM test, these procedures can “be regarded as yardsticks for the interpretation of data rather than leading to hard and fast decisions.” Moreover, we will always be able to reject the null hypothesis provided we have enough data at hand. The question is not whether the model is wrong (it always is), but if the irregularities are serious.

### **3.5.1. Normal distribution test**

Normal distribution is a nonstop probability distribution, a meaning that tells the probability of a number in some circumstance that fall between any two real numbers. Normal distributions are very important in statistics and are regularly used in the natural and social sciences for real-valued random variables whose distributions are not known. The normal distribution is also just about zero once the value  $x$  lies more than a few standard deviations away from the mean. Therefore, it may not be suitable when one expects an important portion of outliers—values that lie many standard deviations away from the mean. Least-squares and other conjecture methods that are most favourable for normally distributed variables often become highly undependable when applied to such data.

### **3.5.2. Serial correlation tests**

According to Feng Gau (2002), serial correlation occurs when error term from time periods, usually from adjacent periods is correlated. If we ignore the serial correlation in error, the impacts on the OLS estimates are as follows: OLS estimates (and forecasts based on them) are unbiased and consistent even if the error terms are serially correlated. The problem is with the efficiency of the estimates. In the proof of the Gauss-Markov Theorem that established efficiency, one of the steps involved is the minimization of the variance of the linear combination

### 3.5.3. Rumsey reset test

Rumsey's reset (Regression Specification Error Test) test (Rumsey 1969) is similar in purpose to White's test for functional form. The RESET test is based on the notion that if the functional form of the model is incorrect, then the correct specification might be approximated by the inclusion of powers of the variables in the original model. The original set of independent variable is augmented by powers of these variables. If the coefficients associated with the added variables are statistically significant, misspecification from sources such as incorrect functional form or the exclusion of relevant variables is suggested (Long *et al*, 1993).

### 3.5.4. White test Heteroscedasticity

Heteroscedasticity occurs when the variance of the errors varies across observations. If the errors are heteroscedasticity, the OLS estimator remains unbiased, but becomes inefficient. More importantly, estimates of the standard errors are inconsistent. The estimated standard errors can be either too large or too small, in either case resulting in incorrect inferences. Given that heteroscedasticity is a common problem in cross-sectional data analysis, methods that correct for heteroscedasticity are important for prudent data analysis (Ervin *et al*, 1998). White (1980) developed a more general test for heteroscedasticity that eliminates the advantage that appeared in the previous tests. Whites test is also an LM test but it has advantages in that (a) it does not assume any prior determination of heteroscedasticity; (b) unlike the Breusch – Pagan tests, it does not depend on normality assumptions and (c) it proposes a particular choice for the Zs in the auxiliary regression (Asterious *et al*, 2011).

## 3.6. Chapter summary

The chapter focused on the relationship between foreign trade and economic growth. The economy of South Africa is closed when there is no foreign trade involved. Import and export make the country to be open, where exchange rate takes place

when trade is happening. A quarterly time series data from 1990Q1-Q2 was collected to determine the relationship between foreign trade and economic growth. ADF and PP were used for stationary, cointegration and Vector error correction model was used to test if variables do correlate in the long run or short run. Heteroscedasticity was used to test for the fitness of the regression model, Ramsey reset and normality distribution, serial correlation and heteroscedasticity test using white type of a test method.

This chapter presented variables that were used in the literature review, and continued of Chapter 2. It helped us understand which methods were used in order to reach our objectives. The following chapter which is Chapter 4 deals with results and interpretation of tests, which were mentioned in the methodology for empirical understanding.

## CHAPTER 4

### RESULTS AND INTERPRETATION

#### 4.1 Introduction

This chapter responds to the objectives that were set in Chapter 1. The chapter is divided into six sections and it presents the empirical results and their interpretation. The analyses include the stationarity tests, cointegration analysis and the Vector error correction model. The last section discusses the diagnostic tests which consist of serial correlation test; Ramsey reset test and the White heteroscedasticity analysis.

#### 4.2 Analysis of results

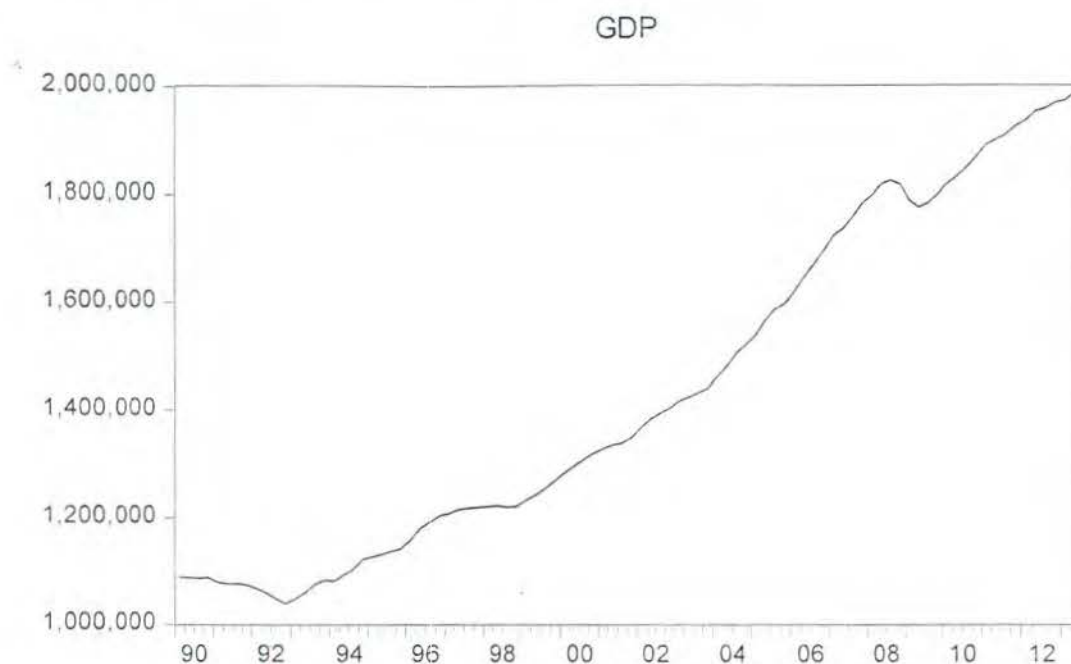
##### 4.2 .1. Visual inspections

According to Pujuma et al, (2013), visual inspection is based on the classical method for identifying properties of time series data. Also, It was recommend that plotting the series to have a first impression about the Data Generating Process. We are interested in finding data behaviours that could violate the stationary assumptions. The interest is therefore on the series that always come back to the mean and have an equal variance. The covariance between any two values in the series depends solely in the interval of time that separates them.

Pujuma et al, (2013) also maintain that trend stationary is visible, that is, the mean is changing over time while the series fluctuates within an equal variance. Hence, in order to have reliable results in some statistical estimators such as OLS that depend on the stationarity assumption, the series need to be transformed into stationary by "de-trending." In the case of stochastic trend processes (e.g. random walk, random walk with drift, and random walk with drift and trend), it is hard to tell by a simple visual inspection because it only offers an initial guess about the Data Generating Progress.

All variables were tested for visual inspection and more or less similar trend were observed for both levels and first difference. For the sake of space and to avoid duplication, only two variables are used to illustrate the process of visual inspection as follows:

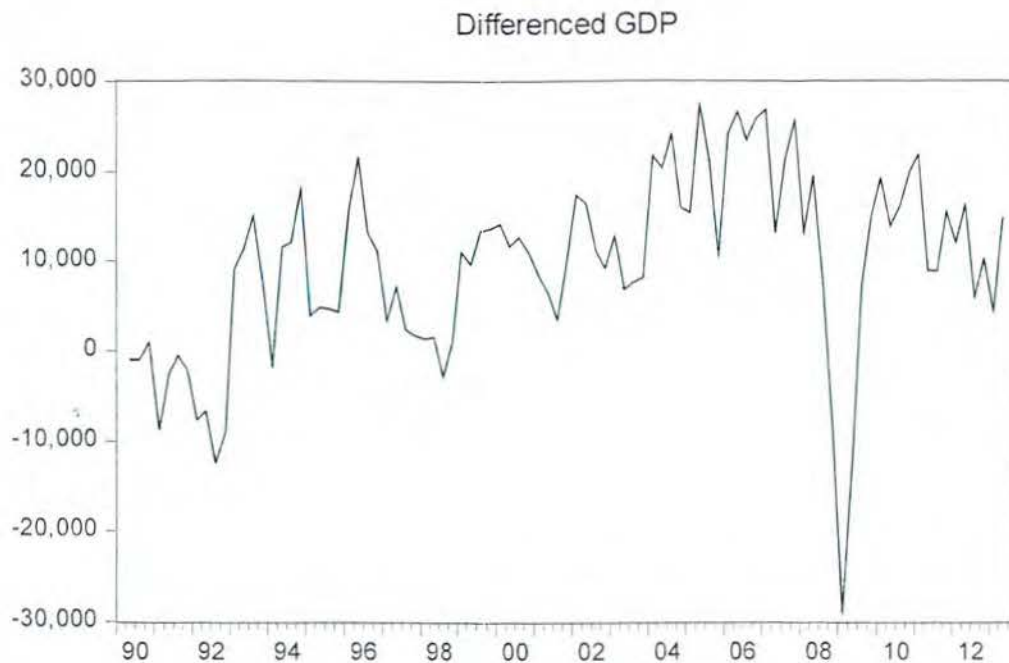
Figure 4.1 Graphical representation of GDP at level



**Source: Own calculations on E-views**

According to the graphical presentation in figure 4.1, GDP seems to be non-stationary at level because of the upwards trending movement over time. It gives the impression that economic growth is controlled by time and is growing from one point to the other without declining over the years.

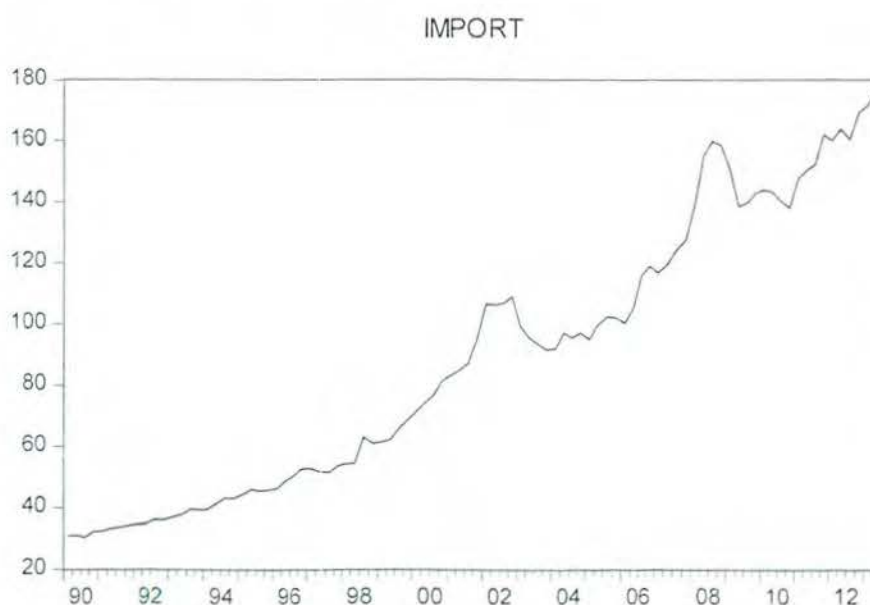
Figure 4.2 graphical representation of GDP at first difference



**Source: Own calculations on E-Views**

From figure 4.2 we get the impression that economic growth is stationary at first difference. This is based on the fact that there is an evidence of white noise process that has no trending behaviour and it frequently crosses the mean value of zero. The impression is that stationarity has been achieved at first difference because visually variance seems to be time-invariant.

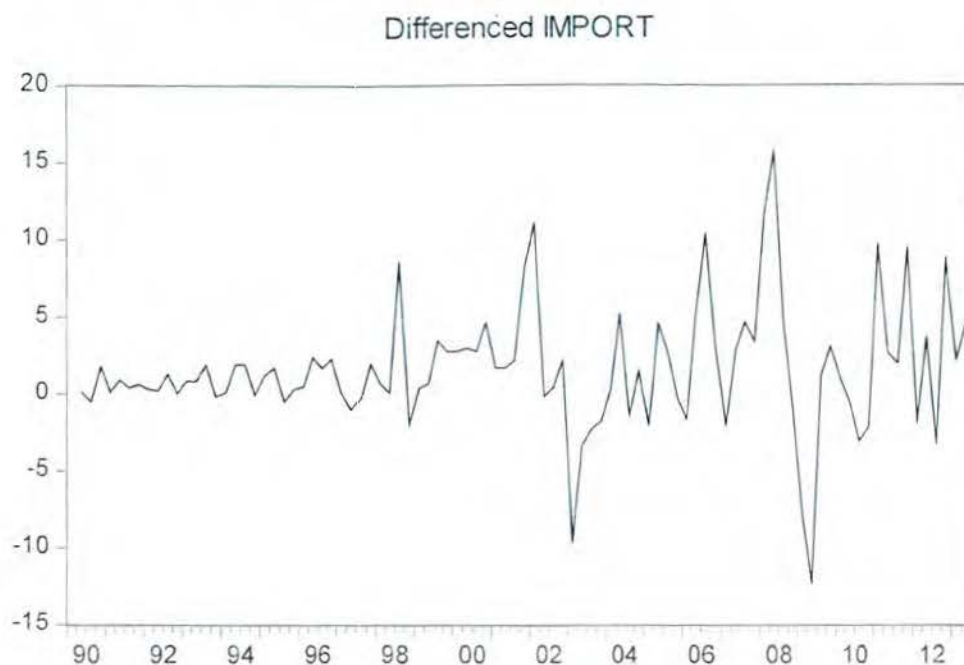
Figure 4.3 Graphical representation of Import at level.



**Source: Own calculations using E-Views**

According to the illustration in figure 4.3, there is an upward trending which indicates that the time series might be non-stationary at level. After differencing in Figure 4.4 stationarity seems to be achieved at first difference.

Figure 4.4 graphical presentation of import at first difference.



Source: Own calculations using E-Views

### 4.3 Unit root test / stationarity

The following section presents testing of unit root which is the first step in the estimation of the model. It involves variables which are described in the model specification. This was achieved by using a time series quarterly data from 1990Q1-2013Q2. All the model levels, that is, Trends, Trends and Intercept and None were tested to confirm stationarity. Specific lag length is used so that serial correlation is removed from the error term. Testing for the order of integration ADF and PP unit root tests were performed.

The unit root test presented on Table 4.1 below presents the results on stationarity on five variables GDP as a dependent variable, (IMP) import, (EXP) export, (EXCH) exchange rate, (INF) inflation rate

Table 4.1 Argument of dick- fuller (ADF) TEST

	Model level	ADF tests at level	Lag Length	First Diff	ADF test	Lag length	Order of integration
GDP	INTERCEPT	(0.956968) -2.893230**	1	ΔGDP	(-3.894932) -2.893230**	0	I(1)
	TRENDS AND INTERCEPT	(-2.734259) -3.459397**	1		(-4.225398) -3.459397**	0	I(1)
	NONE	(3.024693) -1.944364**	1		(-2.560501) -1.944364**	0	I(1)
IMP	INTERCEPT	(0.331596) -2.893230**	1	ΔIMP	(-6.952832) -2.893230**	0	I(1)
	TRENDS AND INTERCEPT	(-2.970382) -3.459397**	1		(-7.015095) -3.459397**	0	I(1)
	NONE	(2.417887) -1.944364**	1		(-6.268675) -1.944364**	0	I(1)
EXP	INTERCEPT	(2.241419) -2.892879**	0	ΔEXP	(-7.682373) -2.893230**	0	I(1)
	TRENDS AND INTERCEPT	(-1.155557) -3.458856**	0		(-8.157154) -3.459397**	0	I(1)
	NONE	(5.411418) -1.944324**	0		(-6.481981) -1.944364**	0	I(1)
EXCH	INTERCEPT	(0.990114) -2.892879**	0	ΔEXCH	(-8.022139) -2.893230**	0	I(1)
	TRENDS AND INTERCEPT	(-2.252225) -3.459397**	1		(-8.147262) -3.459397**	0	I(1)
	NONE	(3.080831) -1.944324**	0		(-7.499959) -1.944364**	0	I(1)
INF	INTERCEPT	4.800264) -2.893230**	1	ΔINF			I(1)
	TRENDS AND INTERCEPT	(-0.031447) -3.459397**	0		(-12,07154) -3.459397**	0	I(1)
	NONE	(14.38572) -1.944324**	0				I(1)

\*\*\*0.01,\*\*0.05,\*0.10 significant level

NOTE: I(1) Indicates unit root at first difference being stationary

I(0) indicates unit root in level being stationary

Δ indicates changes in first difference

\*\* indicates critical value at 5% significance level

The ADF test results presented in Table 4.1 indicate that our variables are nonstationary at levels. They are I(0), meaning that they are nonstationary at levels and they only become I (1) at first differences

The first variable that was tested was GDP which is the dependent variable. The results revealed that at the first form level the variable was non stationary because it was less negative on the ADF test statistics than the t critical values at 5%. This indicates that the ADF reject the null hypothesis of a unit root at level I(O), and the variable became stationary at first difference. All the variables were nonstationary at level, but became stationary at first difference excluding (INF) inflation rate which became stationary only on trend and intercept at first difference I(1).

The results of the tests and the relevant critical values at (1%, 5%, 10%) as well as the number of lags to get rid of serial correlation, are provided in Table 4.2 below.

Table 4.2 shows the results of PP test which was performed to verify the unit root tests results performed by the ADF tests.

Table 4.2 Phillips Perron (PP) tests

	Model level	PP Tests	Bandwidth	1st Diff	PP Test	Bandwidth	Order of integration
GDP	INTERCEPT	(1.781982) -2.892879**	5	$\Delta$ GDP	(-3.820909) -2.893230**	4	I(1)
	TRENDS AND INTERCEPT	(-2.728751) -3.458856**	5		(-4.202127) -3.459397**	4	I(1)
	NONE	(5.850760) -1.944324**	5		(-2.316058) -1.944364**	6	I(1)
IMP	INTERCEPT	(0.825760) -2.892879**	0	$\Delta$ IMP	(-6.919771) -2.893230**	3	I(1)
	TRENDS AND INTERCEPT	(-2.473299) -3.458865**	1		(-6.89080) -3.459397	4	I(1)
	NONE	(3.694099) -1.944324**	0		(-6.268675) 1.944364**	0	I(1)
EXP	INTERCEPT	(2.241419) -2.892879**	0	$\Delta$ EXP	(-7.679915) -2.893230**	1	I(1)
	TRENDS AND INTERCEPT	(-1.155572) -3.458856**	0		(-8.147800) -3.459397**	2	I(1)

	NONE	(5.411418) -1.944324**	0		(-6.929863) -1.944364**	4	I(1)
EXCH	INTERCEPT	(0.990114) -2.892879**	0	$\Delta$ EXCH	(-8.022139) -2.893230**	0	I(1)
	TRENDS AND INTERCEPT	(-1.839999) -3.458856**	2		(-8.165197) -3.459397**	1	I(1)
	NONE	(3.080831) -1.994324**	0		(-7.447088) -1.944364**	2	I(1)
INF	INTERCEPT	(5.426119) -2.892879**	17	$\Delta$ INF	(-9.929453) -2.893230**	4	I(1)
	TREND AND INTERCEPT	(-0.196312) -3.458856**	13		(-12.14429) -3.459397**	8	I(1)
	NONE	(16.25887) -1.944324**	4		(-4.064097) -1.944364**	3	I(1)

\*\*\*0.01, \*\*0.05, \*0.10 significant level

NOTE: I(1) Indicates unit root at first difference being stationary

I(0) indicates unit root in level being stationary

$\Delta$  indicates changes in first difference

\*\* indicates critical value at 5% significance level

The results of PP unit root test confirm that GDP is not stationary at level, that is, it is I(0). All the variables including inflation were non-stationary at level, but became stationary at first difference I(1).

Since all the variables are found to be stationary, the Johansen cointegration can be performed.

#### 4.4 Johansen cointegration test

The purpose of this test is to determine the existence of a long run equilibrium relationship amongst all the variables. The summary of the cointegration test results are presented in Table 4.3 and the complete portion is found in Appendix A.

TABLE 4.3 A .Johansen cointegration test

Sample (adjusted): 1990Q4 2013Q2  
 Included observations: 91 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: GDP EXPORT EXCH IMPORT INF  
 Lags interval (in first differences): 1 to 2

## Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.375144	93.85690	69.81889	0.0002
At most 1 *	0.285801	51.06561	47.85613	0.0242
At most 2	0.117625	20.43564	29.79707	0.3938
At most 3	0.066325	9.048059	15.49471	0.3610
At most 4	0.030333	2.803018	3.841466	0.0941

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

TABLE 4.3 B

## Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.375144	42.79129	33.87687	0.0034
At most 1 *	0.285801	30.62997	27.58434	0.0197
At most 2	0.117625	11.38758	21.13162	0.6086
At most 3	0.066325	6.245041	14.26460	0.5820
At most 4	0.030333	2.803018	3.841466	0.0941

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

Both the trace and the maximum eigenvalue tests results in Tables 4.3A and 4.3B respectively reject the null hypothesis of no cointegration. They indicate the presence of two cointegrating equations at 5% level of significance. The implication is that there is a long run relationship between the dependent variable GDP and its repressors. According to Gujarati *et al* (2009), as the critical values increase, the *p*-values decrease. Given that the *p*-values in Table 4.3A are closer to zero, the null hypotheses is rejected with increasing confidence. Since all the variables were found

to be stationary and cointegrated, the study can now perform the VECM not VAR model.

#### 4.5 Vector error correction model

Table 4.4 presents the Vector error correction model



Vector Error Correction Estimates

Sample (adjusted): 1991Q2 2013Q2  
 Included observations: 89 after adjustments  
 Standard errors in ( ) & t-statistics in [ ]

Error Correction:	D(GDP)	D(IMPORT)	D(INF)	D(EXPORT)	D(EXCH)
CointEq1	-0.004996 (0.00698) [-0.71599]	-2.34E-06 (4.3E-06) [-0.53892]	5.74E-06 (9.2E-07) [ 6.21313]	3.03E-06 (4.0E-06) [ 0.75468]	1.23E-09 (9.5E-09) [ 0.12856]
R-squared	0.679532	0.280117	0.535669	0.330815	0.254636
Adj. R-squared	0.579087	0.054483	0.390133	0.121070	0.021014
Sum sq. resids	2.80E+09	1084.612	49.15995	930.9188	0.005253
S.E. equation	6470.174	4.023461	0.856581	3.727507	0.008854
F-statistic	6.765198	1.241464	3.680653	1.577225	1.089950
Log likelihood	-894.6213	-237.5507	-99.87224	-230.7509	307.0408
Akaike AIC	20.59823	5.832600	2.738702	5.679795	-6.405411
Schwarz SC	21.21340	6.447769	3.353871	6.294963	-5.790243
Mean dependent	10225.20	1.617978	1.553034	2.048315	0.002858
S.D. dependent	9972.858	4.137757	1.096859	3.975954	0.008949
Determinant resid covariance (dof adj.)		115715.3			
Determinant resid covariance		27977.87			
Log likelihood		-1087.071			
Akaike information criterion		27.01282			
Schwarz criterion		30.22848			

The results in table 4.4 show that the dependent variable (GDP) has a correlation with the four independent variables, meaning that the independent variables have a relationship. The R-squared which is the coefficient of determinations shows the percentage of variations in the explanatory variables. It measures the explanatory

powers of the model. It is usually between zero and one. A close inspection according of the above table indicates that the specific model has a fairly high coefficient of determination. The R- squared of 0.67 (67%) indicates that 0.67 the model is perfectly fit meaning that the regression is not spurious. The estimated coefficient value of (GDP) is -0.005 has a priori (negative). This serves as evidence for the existence of cointegration relationship amongst the variables of the economic growth function. The adjustment of the model to the previous year's disequilibrium is 0.58% which suggests a high speed convergence to equilibrium if there appears a disequilibrium shock. The implication of this is that the model has goodness of fit.

The results estimated on VECM at lag 1, shows that there is a positive relationship between GDP, inflation rate, export and exchange rate. However, import is negatively related to GDP. The complete results are presented in appendix B.

#### **4.6 Diagnostic tests and stability tests**

The diagnostic tests are responsible for checking the model specification and the goodness off fitness. The tests results are based on statistical values. The following are considered on interpreting the results. A small value to probability means we reject the null hypothesis and accept it when the p-values are larger than the 0.05 for a 95% confidence interval. The following tests will be interpreted under diagnostic tests: serial correlation, normal distribution, Ramsey reset and the white tests

##### **4.6.1 Serial correlation**

The bellow table 4.6 of Breuch – Godfrey serial correlation is just a small part of the results; the whole table is at Appendix C2. The Breush- Godfrey serial correction LM tests in table 4.6 below indicates that we reject the null hypothesis on both the f statistics and obs\*R-squared since both probabilities are small, and we therefore accept the alternative that there is no correlation between the variables.

Table 4.6 The Breush- Godfrey serial correction LM tests

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	125.0613	Prob. F(4,85)	0.0000
Obs*R-squared	80.34761	Prob. Chi-Square(4)	0.0000

Source: own calculations using E-views

4.6.2 Normal distribution

Figure 4.5 Normal distribution

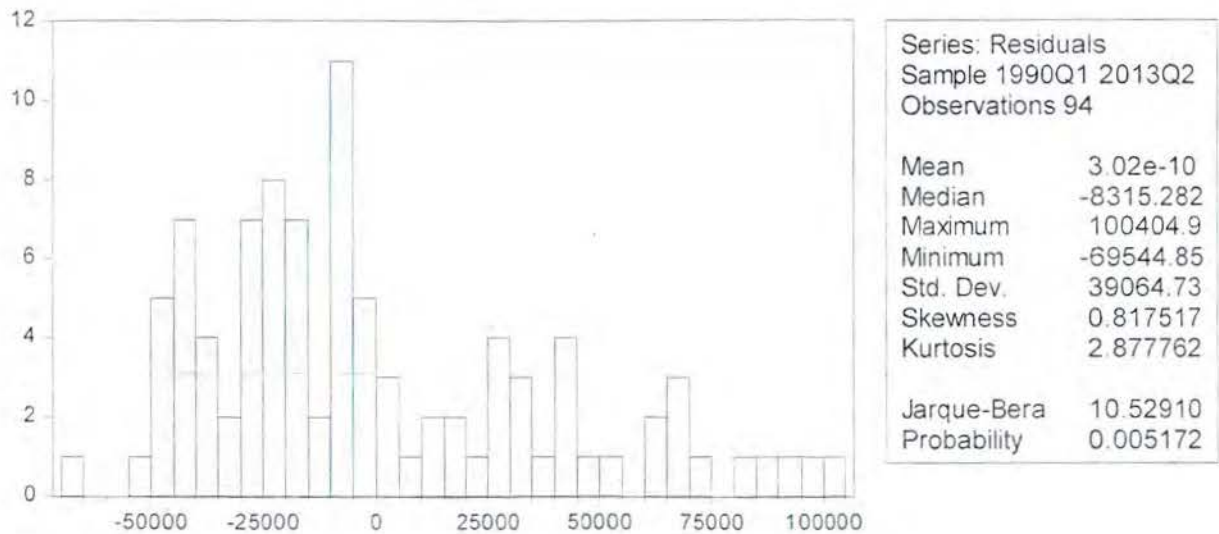


Figure 4.5 shows that the null hypothesis tests  $H_1$  at the probability of 0.01 accept the probability and also for the results show that the graph is bell shaped. The Jarque – Bera test is used to test for null hypothesis.

4.6.3 Rumsey reset

According to table 4.7 the null hypothesis of Ramsey reset shows the model is correctly specified. With the probability of 0.00 we accept the null hypothesis

## Rumsey Reset Test

Equation: UNTITLED

Specification: GDP EXPORT EXCH IMPORT INF C

Omitted Variables: Powers of fitted values from 2 to 5

	Value	Df	Probability
	28.1113		
F-statistic	9	(4, 85)	0.0000
	79.2242		
Likelihood ratio	9	4	0.0000

### 4.6.4 White heteroscedasticity

Table 4.8 White heteroscedasticity

Table 4.8 shows that the f statistics is 6.95 and the probability 0.00, therefore we reject the null hypothesis of heteroscedasticity.

#### Heteroskedasticity Test: White

F-statistic	6.956159	Prob. F(14,79)	0.0000
		Prob. Chi-	
Obs*R-squared	51.89921	Square(14)	0.0000
Scaled explained		Prob. Chi-	
SS	43.68130	Square(14)	0.0001

### 4.7 Chapter summary

This chapter presented results based on the objectives that were set to be achieved in chapter 1. ADF and PP tests resulted that, all the five variables became stationary at the first difference both in ADF and PP; we continued to test for long term correlation between GDP and its independent variable. The results came back showing that there is a long run between all the variables. According to vector error correction model, there is a long run speed of adjustment and having a negative sign (0.00) on the dependent variable (GDP). Diagnostic test took place which included serial correlation: we accepted the null hypothesis. Ramsey reset: we also accepted the null hypothesis, lastly the heteroscedasticity: we rejected the null hypothesis. The

following chapter continues from chapter 4. Recommendations and policy will be made based on the results.

## CHAPTER 5

### SUMMARY, CONCLUSION AND POLICY RECOMMENDATION

#### 5.1 Introduction

This chapter focuses on the summary and findings of the study. The first section gives the summary of the study, the second section is based on the conclusion of the study and the last focuses on policy recommendation.

#### 5.2 Summary of the study

The study analysed the impact of foreign trade on economic growth in South Africa. This was done in order to determine if foreign trade does have an impact on economic growth of South Africa. The main step was to address the objectives of the study. The first objective: to identify relevant variables which plays role on international trade and also on economic growth after trade has taken place. The second objective: To determine whether international trade and are correlated in a long run or a short run. Lastly the third objective: to determine if international trade affect economic growth of South Africa positively or negatively.

Several economists and theories were reviewed on both international trade and economic growth. Theories that include neoclassical theory, Adam Smith, Hecksher-Ohlin, Keynesian and Solow's theory were discussed. Chapter 3 reviewed methodology which consist of model specification, the data techniques, that were used in order to reach our objectives in chapter one. Time series quarterly data from 1990Q1 – 2013Q2 were sourced from SARB and Organisational of economic co-operational development. The study tried to build an econometric model which will be able to provide a better understanding of the relationship between economic growth and international trade in South Africa. The Erhieyovwe and Onokero (2013)'s model was used as the basis for the formulation of the model of the study. The following analytic techniques were performed namely: ADF and PP, the findings are reported in table 4.1 and table 4.2. Not all the variables were stationary at levels, but they were stationary at first difference One variable that is inflation rate (INF) was

found to be stationary at trend and intercept with the ADF test. To interpret the results on stationarity, the value of t- statistics must be less than the critical value at level, indicating stationary at level I(0), first difference Stationarity I(1) and second difference stationarity(2).

### 5.3 Conclusion

The Johansen Cointegration tests, results indicated that all the variables produced a long run relationship. These show that export, import, economic growth, exchange rate and inflation rate have a long run economic relationship. The difference between two cointegration tests, the maximum eigenvalue test accepted the null hypothesis of no cointegration whilst the trace test statistics rejected the null hypothesis. This study therefore is based the conclusion on the trace test because of its power as indicated by Lutkepohl *et al* (2002) who maintain that the trace tests tend to have more distorted sizes whereas their powers is in some situations superior to that of the maximum eigenvalue tests.

The vector error correction model, results in table 4.3. how that the speed of adjustment towards the long run equilibrium is significant, meaning that the dependent variables have a long run relationship with the dependent variables.

International trade and economic growth model went through diagnostic tests and stability tests, including the Jargue- Bera, the Breush –Godfrey, the White test and Ramsey reset. According to the Breuch-godfrey serial correlation, we accepted the null hypothesis with the f- statics of 0.00. With the normal, distribution the null hypothesis was accepted at 0.01, the histogram showing a bell shape. Ramsey reset test was taken and according to the results in table 4.5, the null hypothesis was accepted at 0.00 and this shows that the model is correctly specified. The heteroscedasticity resulted that there is heteroscedasticity in the model, with the probability of 0.00 and if statistics of 6.95.

In conclusion the study examined the impact of foreign trade on economic growth in south Africa, bearing in mind the variables that were used, such as inflation rate, exports and exchange rate are positively related to GDP, while import have a

negative influence on GDP. The results shows that the level of export is important on international trade, since well it creates growth and expansion of infrastructure in South African economy, exchange rate can also be considered as important since well it has a relationship with GDP and also boost trade internationally, it has a urge impact when trading takes place. The level of inflation can be sustained, but also plays a urge role on trade as a factor. The results that is presented in this study are similar to the study of Kahinde *et al* (2012) foreign trade and economic growth in Nigeria, and also Erhreyovwe *et al* (2012) : international trade as an engine og growth in developing countries in Nigeria.

#### **5.4 Policy recommendation**

The main objective of the study was to find the impact of foreign trade on South African economic growth. The South African economy has been apparently slowing down negatively in the year 2013 second quarter.

The South African government must start strengthening the competitiveness export by making sure that it is always balanced with the import. The government must come up with the strategy on how import can be a tool that can create investment, and infrastructure on South African economy. The government must focus on the level of South African currency, by working on strengthening it so that the economy can gain from it. Lastly, the government must also focus not only on trading international but also internally, so that job opportunities can be created within the country.

This study may be further investigated by using variables such as foreign direct investment and also methods such as Granger Causality tests, for more results

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## APPENDIX A: JOHANESS COINTEGRATION

Date: 10/23/13 Time: 08:52  
 Sample (adjusted): 1990Q4 2013Q2  
 Included observations: 91 after adjustments  
 Trend assumption: Linear deterministic trend  
 Series: GDP EXPORT EXCH IMPORT  
 INF  
 Lags interval (in first differences): 1 to 2

### Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.375144	93.85690	69.81889	0.0002
At most 1 *	0.285801	51.06561	47.85613	0.0242
At most 2	0.117625	20.43564	29.79707	0.3938
At most 3	0.066325	9.048059	15.49471	0.3610
At most 4	0.030333	2.803018	3.841466	0.0941

Trace test indicates 2 cointegratingeqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

### Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.375144	42.79129	33.87687	0.0034
At most 1 *	0.285801	30.62997	27.58434	0.0197
At most 2	0.117625	11.38758	21.13162	0.6086
At most 3	0.066325	6.245041	14.26460	0.5820
At most 4	0.030333	2.803018	3.841466	0.0941

Max-eigenvalue test indicates 2 cointegratingeqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

### Unrestricted Cointegrating Coefficients (normalized by b'S11\*b=I):

	GDP	EXPORT	EXCH	IMPORT	INF
	-5.66E-06	-0.119447	-0.002962	-0.017418	0.213680
	3.84E-06	0.084251	0.020967	-0.104098	-0.153231
	2.63E-05	-0.066665	0.022579	-0.144217	-0.047651
	3.12E-06	-0.104679	0.015505	0.085072	-0.042801
	-9.30E-06	-0.013196	0.020699	-0.099127	0.111488

### Unrestricted Adjustment Coefficients (alpha):

	D(GDP)	D(EXPORT)	D(EXCH)	D(IMPORT)	D(INF)
	2379.223	-2182.324	199.9247	277.3861	
	0.168379	-0.660420	0.866515	-0.335470	

D(EXCH)	-1.627013	-5.462489	2.478358	-5.440920
D(IMPORT)	0.113089	-0.152828	1.126360	-0.251268
D(INF)	-0.425898	-0.374337	0.057223	0.026777

1 Cointegrating Equation(s): Log likelihood -1868.474

Normalized cointegrating coefficients (standard error in parentheses)

GDP	EXPORT	EXCH	IMPORT	INF
1.000000	21088.73 (4853.64)	522.8815 (913.105)	3075.244 (5055.31)	-37726.03 (6500.80)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.013476 (0.00362)
D(EXPORT)	-9.54E-07 (2.2E-06)
D(EXCH)	9.22E-06 (1.6E-05)
D(IMPORT)	-6.41E-07 (2.2E-06)
D(INF)	2.41E-06 (5.9E-07)

2 Cointegrating Equation(s): Log likelihood -1853.159

Normalized cointegrating coefficients (standard error in parentheses)

GDP	EXPORT	EXCH	IMPORT	INF
1.000000	0.000000	-123672.1 (47663.8)	762453.5 (258971.)	16455.06 (216493.)
0.000000	1.000000	5.889162 (2.23896)	-36.00872 (12.1649)	-2.569196 (10.1695)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.021861 (0.00404)	-468.0540 (86.3637)
D(EXPORT)	-3.49E-06 (2.6E-06)	-0.075754 (0.05604)
D(EXCH)	-1.18E-05 (1.9E-05)	-0.265882 (0.39857)
D(IMPORT)	-1.23E-06 (2.7E-06)	-0.026384 (0.05726)
D(INF)	9.74E-07 (6.5E-07)	0.019334 (0.01379)

3 Cointegrating Equation(s): Log likelihood -1847.466

Normalized cointegrating coefficients (standard error in parentheses)

GDP	EXPORT	EXCH	IMPORT	INF
1.000000	0.000000	0.000000	502.3940 (2191.23)	-5520.594 (2328.98)
0.000000	1.000000	0.000000	0.274761 (0.16768)	-1.522734 (0.17822)

0.000000	0.000000	1.000000	-6.161060 (1.59878)	-0.177693 (1.69928)
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Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.016605 (0.01604)	-481.3819 (94.8529)	-48.28843 (18.2759)
D(EXPORT)	1.93E-05 (1.0E-05)	-0.133520 (0.05957)	0.005219 (0.01148)
D(EXCH)	5.34E-05 (7.4E-05)	-0.431101 (0.43576)	-0.053754 (0.08396)
D(IMPORT)	2.84E-05 (1.0E-05)	-0.101473 (0.05955)	0.021893 (0.01147)
D(INF)	2.48E-06 (2.6E-06)	0.015519 (0.01512)	-0.005295 (0.00291)

4 Cointegrating Equation(s): Log likelihood -1844.343

Normalized cointegrating coefficients (standard error in parentheses)

GDP	EXPORT	EXCH	IMPORT	INF
1.000000	0.000000	0.000000	0.000000	-5080.070 (537.578)
0.000000	1.000000	0.000000	0.000000	-1.281810 (0.03944)
0.000000	0.000000	1.000000	0.000000	-5.580014 (0.52046)
0.000000	0.000000	0.000000	1.000000	-0.876849 (0.08373)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-0.015739 (0.01612)	-510.4183 (113.053)	-43.98757 (20.4119)	180.4988 (116.696)
D(EXPORT)	1.82E-05 (1.0E-05)	-0.098403 (0.07073)	1.78E-05 (0.01277)	-0.087690 (0.07301)
D(EXCH)	3.64E-05 (7.2E-05)	0.138447 (0.50669)	-0.138115 (0.09148)	-0.223319 (0.52301)
D(IMPORT)	2.76E-05 (1.0E-05)	-0.075170 (0.07087)	0.017997 (0.01280)	-0.169876 (0.07315)
D(INF)	2.56E-06 (2.6E-06)	0.012716 (0.01803)	-0.004880 (0.00326)	0.040412 (0.01861)

## APPENDIX B: VECTOR ERROR CORRECTION MODEL

Error Correction:	D(GDP)	D(IMPORT)	D(INF)	D(EXPORT)	D(EXCH)
CointEq1	-0.004996 (0.00698) [-0.71599]	-2.34E-06 (4.3E-06) [-0.53892]	5.74E-06 (9.2E-07) [6.21313]	3.03E-06 (4.0E-06) [0.75468]	1.23E-09 (9.5E-09) [0.12856]
D(GDP(-1))	0.661616 (0.12303) [5.37789]	0.000100 (7.7E-05) [1.30709]	1.19E-05 (1.6E-05) [0.73071]	4.39E-05 (7.1E-05) [0.61958]	1.62E-07 (1.7E-07) [0.96485]
D(GDP(-2))	0.012847 (0.14198) [0.09048]	-3.71E-05 (8.8E-05) [-0.42048]	-1.44E-05 (1.9E-05) [-0.76605]	1.90E-05 (8.2E-05) [0.23218]	-1.39E-07 (1.9E-07) [-0.71522]
D(GDP(-3))	0.047401 (0.13449) [0.35244]	-6.91E-05 (8.4E-05) [-0.82672]	-5.77E-06 (1.8E-05) [-0.32406]	-6.62E-05 (7.7E-05) [-0.85441]	-2.74E-07 (1.8E-07) [-1.48817]
D(GDP(-4))	0.137311 (0.11581) [1.18570]	0.000129 (7.2E-05) [1.79157]	-1.46E-05 (1.5E-05) [-0.95105]	0.000122 (6.7E-05) [1.82463]	3.07E-07 (1.6E-07) [1.94012]
D(IMPORT(-1))	-555.9275 (314.200) [-1.76934]	-0.007959 (0.19538) [-0.04074]	-0.020222 (0.04160) [-0.48614]	0.182925 (0.18101) [1.01057]	-0.000508 (0.00043) [-1.18104]
D(IMPORT(-2))	-229.0305 (327.172) [-0.70003]	0.114632 (0.20345) [0.56344]	-0.063214 (0.04331) [-1.45943]	0.214278 (0.18849) [1.13684]	2.38E-05 (0.00045) [0.05311]
D(IMPORT(-3))	-503.2884 (323.191) [-1.55725]	-0.120756 (0.20098) [-0.60085]	-0.047119 (0.04279) [-1.10125]	0.136886 (0.18619) [0.73516]	0.000355 (0.00044) [0.80301]
D(IMPORT(-4))	94.71213 (329.114) [0.28778]	-0.216876 (0.20466) [-1.05970]	-0.048827 (0.04357) [-1.12062]	-0.484152 (0.18960) [-2.55349]	-0.001056 (0.00045) [-2.34403]
D(INF(-1))	529.8380 (886.743) [0.59751]	-0.047583 (0.55142) [-0.08629]	-0.494782 (0.11740) [-4.21467]	0.348110 (0.51086) [0.68142]	-0.000999 (0.00121) [-0.82305]
D(INF(-2))	1146.068 (994.435) [1.15248]	-0.117409 (0.61839) [-0.18986]	-0.422681 (0.13165) [-3.21058]	0.288420 (0.57290) [0.50344]	-0.002839 (0.00136) [-2.08615]
D(INF(-3))	688.3046 (1077.73) [0.63866]	0.584995 (0.67019) [0.87288]	-0.441312 (0.14268) [-3.09301]	0.157791 (0.62089) [0.25414]	-0.000493 (0.00147) [-0.33409]
D(INF(-4))	543.7265 (974.255) [0.55809]	0.245417 (0.60584) [0.40509]	-0.165252 (0.12898) [-1.28121]	-0.254165 (0.56127) [-0.45284]	0.000300 (0.00133) [0.22520]
D(EXPORT(-1))	267.5527 (341.572) [0.78330]	0.232658 (0.21241) [1.09535]	-0.011364 (0.04522) [-0.25130]	-0.217143 (0.19678) [-1.10347]	0.000664 (0.00047) [1.42115]
D(EXPORT(-2))	-98.16573	-0.096093	0.083749	-0.225688	4.51E-05

	(364.049)	(0.22638)	(0.04820)	(0.20973)	(0.00050)
	[-0.26965]	[-0.42447]	[ 1.73767]	[-1.07608]	[ 0.09060]
D(EXPORT(-3))	-189.3519	-0.009059	0.073622	-0.135581	-0.000256
	(348.189)	(0.21652)	(0.04610)	(0.20059)	(0.00048)
	[-0.54382]	[-0.04184]	[ 1.59714]	[-0.67590]	[-0.53781]
D(EXPORT(-4))	-132.9091	0.050373	-0.034648	0.170511	0.001057
	(334.128)	(0.20778)	(0.04423)	(0.19249)	(0.00046)
	[-0.39778]	[ 0.24244]	[-0.78328]	[ 0.88580]	[ 2.31112]
D(EXCH(-1))	125333.1	108.4362	11.11903	109.6510	0.147732
	(99843.4)	(62.0874)	(13.2182)	(57.5204)	(0.13663)
	[ 1.25530]	[ 1.74651]	[ 0.84119]	[ 1.90630]	[ 1.08124]
D(EXCH(-2))	206040.0	-12.04454	-13.72896	-37.60524	-0.035243
	(98071.2)	(60.9853)	(12.9836)	(56.4994)	(0.13421)
	[ 2.10092]	[-0.19750]	[-1.05741]	[-0.66559]	[-0.26260]
D(EXCH(-3))	-75047.97	21.81428	-0.394238	-3.965257	0.032183
	(99153.6)	(61.6584)	(13.1269)	(57.1230)	(0.13569)
	[-0.75689]	[ 0.35379]	[-0.03003]	[-0.06942]	[ 0.23718]
D(EXCH(-4))	-73205.54	32.69986	41.40529	6.371628	-0.100557
	(99759.8)	(62.0354)	(13.2071)	(57.4722)	(0.13652)
	[-0.73382]	[ 0.52712]	[ 3.13507]	[ 0.11086]	[-0.73658]
C	-1224.978	-1.042261	4.088064	0.523794	0.007326
	(4617.07)	(2.87111)	(0.61125)	(2.65992)	(0.00632)
	[-0.26531]	[-0.36302]	[ 6.68804]	[ 0.19692]	[ 1.15952]
R-squared	0.679532	0.280117	0.535669	0.330815	0.254636
Adj. R-squared	0.579087	0.054483	0.390133	0.121070	0.021014
Sum sq. Resids	2.80E+09	1084.612	49.15995	930.9188	0.005253
S.E. equation	6470.174	4.023461	0.856581	3.727507	0.008854
F-statistic	6.765198	1.241464	3.680653	1.577225	1.089950
Log likelihood	-894.6213	-237.5507	-99.87224	-230.7509	307.0408
Akaike AIC	20.59823	5.832600	2.738702	5.679795	-6.405411
Schwarz SC	21.21340	6.447769	3.353871	6.294963	-5.790243
Mean dependent	10225.20	1.617978	1.553034	2.048315	0.002858
S.D. dependent	9972.858	4.137757	1.096859	3.975954	0.008949

## APPENDIX C: DIAGNOSTIC TEST

### 1 Breusch – Godfrey serial correlation LM test:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	125.0613	Prob. F(4,85)	0.0000
Obs*R-squared	80.34761	Prob. Chi-Square(4)	0.0000

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 10/28/13 Time: 14:09

Sample: 1990Q1 2013Q2

Included observations: 94

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXPORT	-200.9226	237.1228	-0.847336	0.3992
EXCH	52.67462	48.04722	1.096310	0.2760
IMPORT	-587.4661	277.0177	-2.120681	0.0369
INF	638.9147	302.5657	2.111656	0.0377
C	-7564.941	7187.888	-1.052457	0.2956
RESID(-1)	0.931751	0.105894	8.798894	0.0000
RESID(-2)	0.143472	0.145597	0.985409	0.3272
RESID(-3)	-0.118983	0.146312	-0.813212	0.4184
RESID(-4)	-0.057266	0.107591	-0.532252	0.5959

R-squared	0.854762	Mean dependent var	3.02E-10
Adjusted R-squared	0.841092	S.D. dependent var	39064.73
S.E. of regression	15572.46	Akaike info criterion	22.23524
Sum squared resid	2.06E+10	Schwarz criterion	22.47875
Log likelihood	-1036.056	Hannan-Quinn criter.	22.33360
F-statistic	62.53067	Durbin-Watson stat	1.626227
Prob(F-statistic)	0.000000		

## 2 White noise Heteroscedasticity

Heteroskedasticity Test: White

F-statistic	6.956159	Prob. F(14,79)	0.0000
Obs*R-squared	51.89921	Prob. Chi-Square(14)	0.0000
Scaled explained SS	43.68130	Prob. Chi-Square(14)	0.0001

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 10/28/13 Time: 14:07

Sample: 1990Q1 2013Q2

Included observations: 94

Variable	Coefficient	t	Std. Error	t-Statistic	Prob.
C	3.47E+09		3.54E+09	0.980258	0.3300
EXPORT	1.11E+09		3.03E+08	3.659640	0.0005
EXPORT^2	4175287.		5131401.	0.813674	0.4183
EXPORT*EXCH	452056.8		1197828.	0.377397	0.7069
	-				
EXPORT*IMPORT	25124747		10403363	-2.415060	0.0180
EXPORT*INF	5899161.		6390109.	0.923171	0.3587
EXCH	7188119.		46022642	0.156187	0.8763
EXCH^2	-182825.7		127067.1	-1.438812	0.1542
EXCH*IMPORT	963298.1		923889.1	1.042656	0.3003
EXCH*INF	499426.1		993502.9	0.502692	0.6166
	-				
IMPORT	1.23E+09		3.55E+08	-3.477279	0.0008
IMPORT^2	5443588.		5395639.	1.008887	0.3161
IMPORT*INF	22774643		7675815.	2.967065	0.0040
INF	44441147		1.93E+08	0.230439	0.8183
	-				
INF^2	17901185		5568872.	-3.214508	0.0019

### 3 Rumsey reset test

	Value	df	Probability
F-statistic	28.11139	(4, 85)	0.0000
Likelihood ratio	79.22429	4	0.0000

Unrestricted Test Equation:  
 Dependent Variable: GDP  
 Method: Least Squares  
 Date: 10/28/13 Time: 14:11  
 Sample: 1990Q1 2013Q2  
 Included observations: 94

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXPORT	115940.8	48253.88	2.402725	0.0185
EXCH	-76336.43	31308.36	-2.438212	0.0168
IMPORT	477306.0	194779.1	2.450500	0.0163
INF	778960.8	315480.2	2.469127	0.0155
C	88530297	34627746	2.556629	0.0123
FITTED^2	-0.000215	8.34E-05	-2.581955	0.0115
FITTED^3	1.53E-10	5.71E-11	2.670468	0.0091
FITTED^4	-5.25E-17	1.94E-17	-2.711651	0.0081
FITTED^5	7.03E-24	2.59E-24	2.710132	0.0081
R-squared	0.993077	Mean dependent var	1430046.	
Adjusted R-squared	0.992426	S.D. dependent var	308061.2	
S.E. of regression	26810.36	Akaike info criterion	23.32181	
Sum squared resid	6.11E+10	Schwarz criterion	23.56532	
Log likelihood	-1087.125	Hannan-Quinn criter.	23.42017	
F-statistic	1524.210	Durbin-Watson stat	0.256054	
Prob(F-statistic)	0.000000			

## APPENDIX D: DATA

YEARS	GDP	IMPORT	EXPORT	INF	EXCH
1990/01	1087779	30.8	31.2	25.36	197.68
1990/02	1086881	30.9	32.4	26.6	204.55
1990/03	1085968	30.4	31.5	27.06	210.19
1990/04	1086976	32.2	31.8	27.61	198.84
1991/01	1078330	32.3	31.2	29.09	201.83
1991/02	1075896	33.2	32.6	30.36	216.51
1991/03	1075479	33.6	33.7	31.48	224.64
1991/04	1073629	34.2	34.8	32.49	220.08
1992/01	1066105	34.5	34.3	33.99	213.37
1992/02	1059566	34.7	34.6	34.54	216.51
1992/03	1047299	36	34.4	35.95	203.23
1992/04	1038400	36	34.5	36.97	207.7
1993/01	1047599	36.8	36.2	37.92	215.18
1993/02	1059090	37.6	37.3	39.51	222.61
1993/03	1074336	39.5	38.7	40.5	226.41
1993/04	1082295	39.3	38.3	41.9	225.32
1994/01	1080753	39.4	37.4	42.98	243.34
1994/02	1092477	41.3	42.5	43.68	261.79
1994/03	1104765	43.2	43	43.62	266.54
1994/04	1123205	43.1	41	44.94	267.52
1995/01	1127262	44.3	40.6	46.64	266.92
1995/02	1132267	46	44.8	47.92	264.94
1995/03	1137155	45.5	43.1	48.84	270.24
1995/04	1141643	45.8	44.3	49.79	273.39
1996/01	1157662	46.3	46.1	50.9	285.11
1996/02	1179346	48.7	49.3	52.03	341.16
1996/03	1192729	50.4	50.2	52.37	352.48
1996/04	1204041	52.7	51.3	53.5	368.76
1997/01	1207500	52.8	51.4	54.75	351.16
1997/02	1214886	51.8	51.3	56.03	343.85
1997/03	1217424	51.6	51.7	56.75	341.66
1997/04	1219262	53.6	52.2	58.23	332.92
1998/01	1220803	54.3	53.5	58.97	329.82
1998/02	1222530	54.4	54.3	60.82	324.74
1998/03	1219850	63	59.9	61.02	373.02
1998/04	1221029	61	58.7	62.37	360.66
1999/01	1232258	61.4	60	63.31	386.74
1999/02	1242065	62.1	60	64.31	400.56
1999/03	1255629	65.6	59.6	65.89	396.53
1999/04	1269437	68.4	61.8	66.82	394.38

2000/01	1283716	71.2	64.5	68.09	397.84
2000/02	1295527	74.2	68.3	69.84	403.88
2000/03	1308358	77	70.3	72.07	402.02
2000/04	1319489	81.7	74.7	73.25	404.64
2001/01	1328058	83.4	77.7	74.82	415.89
2001/02	1334697	85.1	78.5	75.33	411.81
2001/03	1338242	87.3	80	76.16	430.38
2001/04	1348532	95.5	88.2	78.71	521.19
2002/01	1366030	106.6	100.3	81.43	597.16
2002/02	1382572	106.4	99.5	83.6	576.52
2002/03	1393913	106.8	101.7	85.26	571.45
2002/04	1403225	109	99.7	87.47	538.29
2003/01	1416210	99.4	96.6	87.72	495.06
2003/02	1423126	96	91.7	88.23	496.83
2003/03	1430849	93.7	90.6	89.43	488.31
2003/04	1439103	91.9	89.5	91.18	481.99
2004/01	1460889	92.2	94.7	93.47	518.68
2004/02	1481304	97.4	95.6	93.57	471.06
2004/03	1505525	95.9	94.4	94.99	448.04
2004/04	1521602	97.4	93	97.21	458.11
2005/01	1537071	95.3	93.6	97.63	466.43
2005/02	1564655	99.9	100.8	98.41	429.6
2005/03	1585991	102.5	100.9	100.07	494.53
2005/04	1596611	102.2	104.8	103.11	485.99
2006/01	1620881	100.5	104.9	103.36	454.97
2006/02	1647548	105.8	111.1	103.41	481.35
2006/03	1671028	116.2	119.9	109.021	541.36
2006/04	1697027	119.1	121.5	110.11	563.45
2007/01	1723976	117	125.2	112.8	568.48
2007/02	1737298	119.8	128.4	112.89	590.63
2007/03	1758806	124.5	129.6	115.3	601.79
2007/04	1784580	127.9	131.9	119.39	602.43
2008/01	1797770	139.6	152.4	121.59	683.87
2008/02	1817405	155.4	161.9	122.64	734.46
2008/03	1825454	160.1	165.4	125.47	690.07
2008/04	1817747	159	166.2	127.66	665.57
2009/01	1788582	151.1	170.7	131.18	661.1
2009/02	1776240	138.8	160.1	133.17	643.57
2009/03	1783765	140	157.5	135.31	649.92
2009/04	1799001	143.1	163.1	138.97	682.19
2010/01	1818403	144.1	165.1	139.5	679.29
2010/02	1832442	143.5	173.4	144.31	665.66
2010/03	1848682	140.4	174.1	144.71	661.56
2010/04	1868681	138.2	177.5	148.81	682.42
2011/01	1890555	147.9	184.9	149.94	703.57

2011/02	1899576	150.6	186.4	151.04	720.97
2011/03	1908576	152.6	192.4	154.02	731.38
2011/04	1924237	162.1	201	157.27	818.73
2012/01	1936359	160.2	196.8	158.4	818.7
2012/02	1952846	163.9	199.5	159.37	820.02
2012/03	1958827	160.6	197.6	162.04	858.45
2012/04	1969180	169.4	203.8	165.9	903.28
2013/01	1973552	171.6	211.7	167.09	929.03
2013/02	1988373	176.3	213.5	167.31	938.8