ECONOMIC ANALYSIS OF DETERMINANTS OF VARIABILITY OF TEA EXPORT (1982-2012) IN RWANDA

BY

PLACIDE UWIMANA

MSc

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS AND RESOURCE MANAGEMENT OF DEPARTMENT OF AGRICULTURAL ECONOMICS AND RESOURCE MANAGEMENT OF MOI UNIVERSITY

2015

DECLARATIONS

Declaration by the Candidate

This thesis is my original work and has not been presented for a degree in any other university. No part of this thesis may be reproduced without the prior permission of the author and/or Moi University.

Signature..... Date.....

Placide UWIMANA, SBE/PGA/016/12

Declaration by University Supervisors

This thesis has been submitted with our approval as University supervisors

Signature..... Date.....

Prof. Timothy Sulo

Department of Agricultural Economics and Resource Management, Moi University,

P.O. Box 3900-30100, Eldoret, Kenya.

Signature..... Date.....

Prof. Mary Kipsat

School of Business and Economics, Moi University,

P.O. Box 3900-30100, Eldoret, Kenya.

DEDICATION

The thesis is dedicated to my wife Valentine Uwanyiligira and my two daughters Placidie Ange Uwanyiligira and Patience Nduwimana.

ACKNOWLEDGMENTS

My gratitude goes to Almighty God for granting me the patience, serenity, wisdom, and knowledge I needed to make this thesis a success. My sincere gratitude goes to Higher

Institute of Agriculture and Animal Husbandry (ISAE), which granted me the opportunity to do postgraduate studies. Both the course work and thesis development were performed through the unconditional love and moral support of my wife and close relatives.

My thanks are extended to the Department of Agricultural Economics and Resource Management for accepting me into the program. Without the support of professor, Dr. Philip Nyangweso as Head of the Department, this work would not have been completed; in addition, my gratitude goes to my Moi University supervisors; Prof. Timothy Sulo and Prof. Mary Kipsat whose efforts contributed in making this thesis a reality and for contributing to my understanding and appreciation of the topic at hand. I also want to recognize the collaboration and support I received from my lecturer Dr. Willy Marcel Ndayitwayeko and Dr. Vicent Ngeno who helped me to understand econometric models specification and the basics of time series as well. Their taking time in assisting, supporting and advising me on so many occasions is of great importance.

This work was possible through the efforts of many postgraduate students in the Department of Agricultural Economics and School of Business and Economics as a whole, including Kennedy Ochieng', Vincent Abuje, Victor Namboka and Gadi Munyentwari who helped in my understanding of different topics related to Agricultural Economics. Thank you to everyone who has contributed to my success.

ABSTRACT

Tea has been cultivated and consumed in China for more than two thousand years and tea growing in Rwanda started in 1952. By 2002 tea became Rwanda’s largest export, with export earnings from tea reaching US$ 18 million equating to 15,000 tons of dried tea. The problem addressed in this study is that tea farmlands increase has been constrained by population growth in Rwanda, impacting on the quantity supplied and tea exportation is volatile and very much influenced by real effective exchange rate, Income of major trading partners, total investment as a proportion of GDP, tea world market price, the coffee world

price among others. This is happening despite the effort made by the government of Rwanda aiming to increase both tea farmland and the quantities exported in order to gain from tea trading. In addition to the above highlighted issues, there are little recent empirical researches investigating factors affecting tea export for a long-run period. The purpose of the study was to analyse the export of tea in Rwanda for the period of 1982-2012. The study aimed to establish whether the volatility in quantity of tea exported is related to world price fluctuations and/or other factors affecting the quantity of tea exported. The study applied a causal (explanatory) research design, with an objective to explain the cause-effect relationship between variables. Since the study used a time series data analysis, secondary data were collected from different sources. Data analysis was done using ordinary least squares to estimate the model and establish trends of variables included in the study. Recursive Residual test and Chow test were applied in analysing the presence of structural change. To investigate the factors affecting tea export of Rwanda, various tests were done: The unit root tests were conducted using the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP) and correlogram tests. Co-integration test was conducted using the Johansen's procedure, as series were found to be integrated of the same order in Phillips-Peron test and co-integrated; Vector Error Correction Model (VECM) was estimated to adjust the series into their both short-run and long-run equilibrium conditions. Heteroscedasticity test was done in order to assess whether stochastic error terms were constant or not, autocorrelation test was done to check if stochastic error terms were correlated for different period of time. The study used export theory. A regression model was used as a production function of the quantity of tea exported as endogenous variable and tea world price, coffee world price, Gross Domestic Product of major importing countries, Real Effective Exchange Rate, investment as proportion of GDP as exogenous variables. The study depicted that in the periods of 1988-1989, 1992-1995 and 2001-2004 structural changes occurred in tea export due to Structural Adjustment Programmes (SAPs) and decline in price of coffee, liberation war and Tutsi genocide and decline in tea world price respectively. The research concludes that non causality in the long term among all variables may be possible because prior to later 80s it was pre-SAPs economy period thus export was totally controlled one. Short run causality is possible because after 80s, in short period a decline in world tea price may lead to increase in export in the sense that the demand increases. The study recommends the government to help in improving investments in factories and all stakeholders to prioritise ease forward selling or contracting and widening niche markets for tea products.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABREVIATIONS

ADF	Augmented Dickey-Fuller
CCCA	Competitive Commercial Agriculture in Sub–Saharan Africa
COMESA	Common Market for Eastern and Southern Africa
CRDW	Co-integration Regression Durbin-Watson
EAC	East African Community
ECM	Error Correction Models
ECT	Error Correction Term
EDPRS	Economic Development and Poverty Reduction Strategy
ELG	Export-Led Growth
EU	European Union
FAOSTAT	Food Agricultural Organization statistics
FRWs	Rwandan Francs
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GoR	Government of Rwanda
IAFCCI	Indo-African Chamber of Commerce and Industries
LDCs	Least Developed Countries
LM	Likelihood Maximum Test
MENA	Middle Eastern and North Africa
NAEB	National Agriculture Export Board
NES	Rwanda National Export Strategy
OCIR- Thé	Office for Rwanda Industrial Crops –Tea
OLS	Ordinary Least Square

PPP	Purchasing Power Parity
PP	Phillips-Perron
REER	Real Effective Exchange Rate
RDB	Rwanda Development Board
SAPs	Structural Adjustment Programs
SPSS	Statistical Package for Social Sciences
ISAE	Institut Superieur d’Agriculture et d’Elevage
TOT	Terms of Trade
UK	United Kingdom
U.S	United States
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
WITS	World Integrated Trade Solution

DEFINITION OF TERMS

Economic analysis: The process of deriving economic principles from relevant economic facts (Walstad *et al.*, 2005)

Effective Exchange Rate: A country's exchange rate, taking a weighted average of its bilateral nominal exchange rates against other currencies. The weights are normally based on the value of trade with other countries. The effective exchange rate is a nominal and not a real exchange rate, but it helps to explain the contribution of exchange rates to changes in a country's competitiveness better than simply looking at its rate against one currency (Times Higher Education Supplement, 2002)

Exchange rate: The exchange rate states the price, in terms of one currency, at which another currency can be bought (Baumol *et al.*, 2001)

Exports: Goods and services produced in a country and sold to buyers in other nations (Walstad *et al.*, 2005). Visible exports are goods sent abroad, invisible exports are services sold to non-residents (Times Higher Education Supplement, 2002)

Gross Domestic Product (GDP): Total monetary value of all final goods and services produced within the geographical boundaries of a country. The term "gross" implies that no deduction for the value of the expenditure goods for replacement purposes (depreciation) is made. Since the income arising from the investments and possessions owned abroad is not included, only the value of the flow of goods and services produced in the county is estimated. Hence the word "domestic" is used to distinguish it from Gross National

Product. The output considered in this case is that produced by all individuals in a country, irrespective of their citizenship (Mudida, 2009)

Income: A flow of dollars (or purchasing power) per unit of time derived from the use of human or property resources resource (Walstad *et al.,* 2005). Income is also defined as equivalent to expenditure or value of output (Income = Expenditure = Value of output (GDP)). The equation indicates that expenditures on final goods (in the goods market) are received as income (in the factor market) and that the value of the output (produced by firms) is reflected by the amount that is spent on goods and services (Parkin, 1993).

Investment spending: Investment spending, symbolised by the letter I, is the sum of the expenditures of business firms on new plant or equipment and households on new homes. Financial expenditures are not included, nor are resales of existing physical assets (Baumol *et al.*, 2001).

Price: The amount of money needed to buy a particular good, service, or resource (Walstad *et al.*, 2005).

Real Effective Exchange Rate: The real exchange rates corresponding to the trading partners of a country are used by some weighting criteria. The share of the foreign countries in a country's total foreign trade volume or the share of the currencies used in the foreign trade transactions can be given as examples of these weighting criteria (Kıpıcı, 1997).

Real Exchange Rate index: An indicator of competitiveness of a country's exportable as it shows the price of the country's goods and services relative to the price of goods and services of other countries (Alam, 2010).

CHAPTER ONE

INTRODUCTION

1.1 Overview

The chapter is divided into eight broad sections. The chapter begins with an overview in section 1.1. The same chapter presents a background of the study that deals with tea spread in world in section 1.2. Section 1.3 highlights the history of tea sector of Rwanda, and then in section 1.4 the statement of the problem is developed. Section 1.5 deals with objectives and research hypotheses relating to specific objectives are presented in section 1.6. Section 1.7 justifies the study and section 1.8 ends the chapter providing limitations of the study.

1.2 Background to the Study

Tea has been cultivated and consumed in China for more than two thousand years (Dodd, 1994). Today it is the most widely consumed caffeine containing beverage in the world. Its worldwide consumption is second only to water. The importance of tea is much more than just the consumption of it by millions of people. Tea also had a marked effect in human development in both the East and West.

Tea arrived in London for the first time in 1652. During this time in Europe the hygiene was bad. Because of the threat of waterborne disease, water was boiled before drinking; the addition of tea gave it both flavour, and stimulating properties due to the presence of caffeine. Although coffee and chocolate also became available in Europe during the same time, it was unaffordable for the general population until after the Second World War. The

only other alternative was alcohol strong enough to kill pathogens. Since people do not work, learn or function properly while constantly drunk, this was impractical.

In 1801 in England each person consumed more than a kilogram of tea per year and by the 1920's Britain was by far the world largest importer of black tea (60% of the total), and India and Ceylon were the world's largest exporters (supplying approximately 75% of the total). India also had a large and growing domestic market.

Following independence in the late 1940's both India and Sri Lanka took steps to gain control over the perceived economic benefits of the largely British-owned tea sector.

Export prices for tea were high during the 1950's (along with many other agricultural commodities) and both countries imposed export taxes and increased taxes on tea company profits. In Sri Lanka the main objective was to have a source of revenue to fund an attempt to create a welfare state. India also had the objective of keeping the domestic price of tea low to protect poor consumers (Tyler, 2013).

Tea also influenced the other parts of the world. Most of the tea now originates from India, Sri Lanka, Indonesia and Africa, where the Europeans introduced tea. Today India is the biggest producer of tea in the world, and two-thirds of that produced is for home consumption. Before 1840 tea drinking was unknown in India (Thompkins and Gwen, 2009). In the United States of America, tea also played a crucial role in the build up to the war of independence in America. In 1773 a group of colonies objected to British taxes on tea (Fullick, 1999).

While practical evidence in support of export-led growth (ELG) may not be universal, rapid export growth has been an important feature of East Asia's remarkable record of high and sustained growth. In particular, the wave of growth in the four tigers (Hong Kong, South Korea, Singapore and Taiwan) and the Newly Industrialized Countries (such as Malaysia, Indonesia and Thailand) has been used to support the argument that carefully managed openness to trade through an ELG is a mechanism for achieving rapid growth (Giles and Williams, 2000) in Yelwa *et al.*, (2013).

The experiences of these countries have provided impetus to the neoclassical economists' view that ELG strategy can lead to growth. The subject of ELG can also be approached from the wider debate on openness (or trade) and growth. What appears to be gaining currency in recent years from cross-Country growth differences is that most of the countries pursuing growth successfully are also the ones that have taken most advantage of international trade. These countries have experienced high rates of economic growth in the context of rapidly expanding exports and imports (Yelwa *et al.,* 2013).

In Africa, many tea companies took the strategic decision to develop new sources of tea production in perceived "safer" countries. Kenya, Uganda, Tanzania and Malawi already had some tea estates, growing conditions were fundamentally good and they were expected to remain as British colonies and protectorates for many decades. Substantial investment began in the 1950's. Kenya in particular had excellent growing conditions and good transport infrastructure for export via Mombasa (Tyler, 2013).

Regional trade integration measures under the East African Cooperation and the wider Common Market for Eastern and Southern Africa (COMESA) also accounted for the

dominant share of the increase in Kenya's exports, particularly in manufactured exports. The economic recovery and trade liberalization initiatives in the region, particularly in Uganda, have provided an impetus for overall increase in import demand. Recorded exports to COMESA increased from an average of 15% for the period 1990-1992 to 34% in 1996-98 (Glenday and Ndii, 2000 in Were *et al*., 2002).

The Rwandan economy is largely based on the rain-fed agricultural production of small, semi-subsistence, and increasingly fragmented farms. It has few natural resources to exploit and a small, non-competitive industrial sector. While the production of coffee and tea is well-suited to the small farms, steep slopes, and cool climates of Rwanda has ensured access to foreign exchange over the years, since the mid-1980s, farm sizes and food production have been decreasing, due in part to the resettlement of displaced people and despite Rwanda's fertile ecosystem, food production often does not keep pace with population growth, and food imports are required (WRI, 2006).

The agricultural sector occupies 79.5 percent of the labor force, generates more than 45.0 percent of the Country's export revenues and contributes to about 36.0 percent to the overall GDP. Land resource has been considered the most important factor of production, back bone of the economy and the basis of survival for the entire population generating about 90% of food required in the Country (The World Bank, 2011).

1.3 History of Tea Sector of Rwanda

Tea growing in Rwanda started in 1952. Two principal varieties of tea are used: the China plant (*C. sinensis sinensis*), used for most Chinese, Formosan and Japanese teas (but not

Puerh); and the clonal Assam plant (*C. sinensis assamica*).Tea agriculture requires a large area, in 1999 the total area for tea cultivation in Rwanda was 12,541 ha and 14,394 ha in 2008 with 1,407ha not exploited (Mupenzi *et al.*, 2011). Since its introduction, tea production has increased steadily, from 60 tons of black tea in 1958, to 1,900 tons in 1990, to 14,500 tons in 2000, reaching a peak of 17,800 tons in 2001. Although Rwanda had made modest attempts to grow tea since the Second World War, it was only in the 1960's that the industrial cultivation of tea was really established (Alinda *et al.*, 2012).

By 2002 tea became Rwanda's largest export, with export earnings from tea reaching US$ 18 million equating to 15,000 tons of dried tea. Existing foreign investment is concentrated in commercial establishments, mining, tea, coffee, and tourism (Global tenders, 2014).

Since its introduction in the 1960s, tea has been one of Rwanda‘s strongest export sectors amounting to almost 35% of national exports and revenues, growing from US$22M in 2003 to US$55.7M in 2010 with close to 13,000 hectares under plantation (GoR, 2011). The sector employs 60,000 people directly and is a source of revenue for over one million people. Rwanda seeks to achieve US$159M in estimated revenues from tea by 2015, which will require increased yields of green leaf by hectare and increasing current capacity of the tea factories. In order to achieve its objectives, several issues faced by the tea sector will need to be addressed (GoR, 2011). Currently, the tea sector employs over 60,000 people directly and about 200,000 others are involved in the tea value chain (Nuwagira, 2013) and there are about 11 tea factories (NAEB, 2012).

There is also the dual issue of low capacity of tea processing factories and poor pruning and plucking practices. These are both issues of efficiency and can be addressed by

reducing waste within the system and will lead to gains without directly affecting crop yields. There are some factories that either have to work at over-capacity or simply refuse crops because of a lack of capacity. This reduces both quality and quantity of tea production (Alinda *et al.*, 2012).

This study sought to investigate how tea export has been behaving over the period of 1982-2012. The study was centered on a dynamic time series procedure to test the validity of hypotheses of the export and variables which affected it for Rwanda.

1.4 Statement of the Problem

Although the government of Rwanda has set strategy regarding tea that is two-fold: increase production and improve quality, with increase in production by expanding and consolidating land dedicated to tea farming and reinvestment made in factories to increase productive capacity, the strategy is constrained to some challenges mainly the dual issue of low capacity of tea processing factories and poor pruning and plucking practices. Targeting for each tea farmer to farm 0.5 ha is also constrained by population growth in Rwanda that is estimated to be 3.6% per year. There are also some factories that either have to work at over-capacity or simply refuse to receive crops because of a lack of capacity. This reduces both quality and quantity of tea production and brings in challenges in tea export to the current world black tea market that is saturated, pushing down prices. The impact is that Rwanda's tea export earnings and volumes may change over time, for instance the Country's export volumes in May 2013 were 1,735 tonnes worth $4.4m, down from 2,151 tonnes worth $5.3m in April the same year, which was a drop of over $900,000 (about Rwf 594m). This was despite the average price for tea being higher at $4.5 per kilo in May

compared to $3 in April. However, there was an increase in tea output, with 2,268 tonnes produced in May 2013 from 2,222 tonnes in April. In January, the Country produced 2,723 tonnes (Nuwangira, 2013). The drop was attributed to the decline in tea export revenue to low prices on the global market and the varying grades of the teas that were auctioned over the month.

Although tea export plays a great role in Rwandan economic growth therefore contributing to achievement of 2020 vision, there are little recent empirical evidences investigating factors causing both export and price of tea volatility for a long-run period. Taking into consideration the above highlighted issues, it was of great importance to investigate the factors that affected tea export in Rwanda for the period of 1982-2012. Hence, finding the factors that affected tea export may bring light on the real causes of regular volatility of both quantity of tea exported and price in order to spur tea export in Rwanda. The research questions for this study are as follows:

(i) What are the periods when there were structural changes in quantities of tea exported?

(ii) Do both short and long term relationship between tea export and its determinants exist?

(iii) Is there a causal linkage between quantity of tea export and its determinants?

As only 3 per cent of the tea is sold locally, responding the above research questions is of a great importance given the role tea export revenues play in economic development of Rwanda.

1.5 Objectives

The overall objective of this study was to investigate the factors affecting tea export of Rwanda for a period of 1982-2012. The specific objectives included the following:

(i) To test for structural change relationship between quantities of tea exported and real effective exchange rate, income of major trading partners, total investment as a proportion of GDP, world market tea price and world market coffee price.

(ii) To test for both short and long term relationship between tea export and real effective exchange rate, income of major trading partners, total investment as a proportion of GDP, world market tea price and world market coffee price

(iii) To test for a causal linkage between quantity of tea exported and real effective exchange rate, income of major trading partners, total investment as a proportion of GDP, world market tea price and world market coffee price.

1.6 Research hypotheses

Ho_1: There is no structural change between quantities of tea exported and Real exchange rate, income of major trading partners, total investment as a proportion of GDP, world market tea price and world market coffee price

Ho_2: There is no relationship between tea export and Real exchange rate, income of major trading partners, total investment as a proportion of GDP, world market tea price and world market coffee price

Ho_3: Real exchange rate, income of major trading partners, total investment as a proportion of GDP, world market tea price and world market coffee price do not cause statistically significant effect on quantities of tea exported and vice versa

1.7 Justification for the Study

The 1980s was a decade of slow or negative growth in per capita GDP, worsening balance of payments, debt and financial crises, and declining competitiveness for most African countries (Njikam, 2003). Recently, however, new directions are being taken to reduce poverty and improve economic conditions in African countries (Anderson, 2004). Njikam (2003) in Sevcan (2012) tested the export-led growth hypothesis for the manufacturing and agricultural sectors of 21 Sub Saharan countries. During the export promotion period, 9 of the 21 countries' agricultural exports and 3 of the 21 countries' manufactured exports uni-directly caused economic growth. One strategy taken by many African countries is trade expansion through the encouragement of trade liberalization with other countries (Anderson, 2004).

According to Government of Rwanda (GoR) (2011) in Rwanda‘s Vision 2020 plan, the Country set ambitious goals for growth that required an almost seven-fold increase in the economy. Because of the progress made in the last decade, the economy now needs to expand by 250% between 2010 and 2020 in order to increase its per capita GDP from US$550 to at least US$900 GoR (2011). But this growth in the decade ahead will be more challenging, and thus far, Rwanda‘s scorecard in terms of meeting its export growth of 15% per annum is mixed.

While Rwanda‘s exports including tourism have increased significantly in recent years from $367 million in 2009 to $454 million in 2010. Imports have grown more rapidly – from US$282 million in 2003 to US$1.3 billion in 2010 GoR (2011). Rwanda is a net importer from the EAC region, representing a third of Rwanda‘s overall imports. Rwanda still fails to capture most of the value of its products, depending instead on volatile commodity products within its tea, coffee, and minerals industries for the majority of its product-based export revenues (GoR, 2011).

To guarantee continued and steady growth, and in alignment with Vision 2020 and EDPRS, the 2010 Kivu Retreat called for RDB to develop the NES as a comprehensive and coordinated approach to driving export growth. The strategy would drive export capacity, sophistication and revenues, while taking into account the many inter-related cross-cutting components that build trade competitiveness. Despite set strategies, export issues and challenges are there, for instance, Rwanda’s 2009 export revenue decreased by US$85 million in comparison with 2008 figures, due to the impact of global downturn of key sectors (GoR, 2011).

However, exports rebounded in 2010, increasing by 23.8 percent to US$454 million*:* Both coffee and tea production declined by 18% and 6%, respectively and coffee prices fell 4%; however coffee and tea exports in 2010 reached US$56.1 million and US$55.7 million respectively (GoR, 2011). Rwandan exports are still underdeveloped vis-à-vis the rest of Africa. Although the export sector is growing, Rwanda lags other African nations in terms of exports as a percentage of GDP (GoR, 2011). The above described situation shows how much Rwanda’s exports are influenced by factors like world prices, exchange rate,

especially for tea which is an important cash crop and the main source of foreign currencies for the Country (GoR, 2010) and as few studies have looked at the linkage between tea export and those factors in Rwanda for the period of 1982-2012 in order to forecast and take strategies, this study make a contribution in filling that gap. Findings of the study also help to improve tea trade in Rwanda therefore the sustainable achievement of economic growth.

1.8 Limitations of the Study

Given the nature of information needed, the study had to cover the whole territory of Rwanda to acquire accurate secondary data from appropriate institutions and factories. Nevertheless, Secondary data were only corrected from NAEB headquarter offices, FAOSTAT and World Bank web sites because in most cases, data before 1994 Tutsi genocide were not available in different institutions. Investment in tea Sector as a proportion of GDP had to be used in the study, however data were not available and general investment as proportion of GDP data were used. As most of economic models on export include capital and labor among independent variables, the researcher wanted to consider the population that has been involved in tea sector for the period under study, unfortunately, data were not available. Some missing data like REER for 2012 were obtained by extrapolation method using SPSS and the obtained data might not correspond to actual figure. The above highlighted issues are related to poor records management in some institutions. Given that analysis of tea export researches using time series in Rwanda are very few, the study did not find enough review of literature in order to contrast with

findings of the study. STATA as a tool of computation was not used in data analysis for the reason that the researcher could not easily operate it.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview

The chapter is divided into nine broad sections. The chapter begins with an overview in section 2.1. Trade and its importance are presented in section 2.2. Section 2.3 deals with rationale of export and international trade as a whole. Section 2.4 highlights the effect of tea quality on price. Section 2.5 explains the gains from trade and inter-industry trade. Section 2.6 deals with structural break. The section 2.7 talks about the review of studies on international trade theories. Section 2.8 provides some time series export related studies (empirical studies) in order to ease a discussion in this study. Given the importance of

study's conceptual framework in assisting the researcher to make meaning of subsequent findings Guba and Lincoln (1989) in Kombo (2006), it is developed in section 2.9.

2.2 International Trade and its Importance

According to Markusen *et al*. (1995) international trade is the exchange across national borders of goods, services, and factors, and the impacts of this trade on domestic and global economies. The economic unit under study is the nation.

International trade has grown tremendously nowadays: Globalization, liberalization, trade integration (agreed upon Uruguay Round Agreement in GATT) are terms used frequently in the news and scholar circle. International trade is concerned with exchange across national borders of goods, service and factors and impacts of this trade on domestic and global economics. International trade, thus, results from the interactions among individuals on one nation and with persons in other nations. Hence, theory of the firm and consumer behavior is of a paramount importance in international economics.

There exist a set of five conditions that together guarantee the no-trade situation. These are: Identical production functions among countries, the same relative endowments in all countries, constant returns to scale, identical and homogeneous tastes in all countries, the absence of distortions (such as taxes, subsidies, imperfect completion) Markusen *et al.*, (1995).

International trade brings about dynamic impacts critical to a Country's economic development, including the ability to acquire foreign capital and new technologies. Free trade with other countries can increase the efficiency of a Country's resource use, and

hence increase the exports of goods in which it has a comparative advantage. However, when importing countries impose barriers to trade, the benefits from trade can be lost. Other important benefits associated with trade include positive export strategies, such as increases in output, employment and consumption, all of which increase the demand for a nation's output (Sentsho, 2002). Trade can also help LDCs by providing them the foreign exchange necessary for economic development. Countries that trade are more able to respond to external shocks (weather) than those that do not trade. In general, external trade generates foreign exchange that contributes to financing industrialization.

2.3 Rationale of Export and International Trade as a whole

Most nations participate in international trade and face an export demand. At high prices, the amount demanded of the domestic product drops sharply at the level of price that attract imports (negative exports). At low levels of price, the domestic product may become competitive in foreign markets. Given some level of international prices, domestic prices might vary within a range which would neither attract imports nor facilitate exports. But at some lower price, exports would become profitable, making the demand for exports quite elastic. At the other extreme, domestic prices rising above some level would attract substantial imports (Ferris, 2005).

The export-base theory of growth is grounded in the idea that a local economy must increase its monetary inflow if it is to grow and the only effective way to increase monetary inflow is to increase exports (John Blair, 1995 in Kimbugwe *et al*., 2010).

According to Tiebout (1962) in Kimbugwe *et al*., (2010), export markets are considered the prime movers of the local economy. If employment serving this market rises or falls, employment serving the local market is presumed to move in the same direction.

International trade is important because it is an engine of Economic Growth (reduction of poverty still debatable), effective and efficient resource use, technology transfer (spillover of international Trade).If well integrated, the trade costs are reduced and the expansion of exports means more specialization and diversification of production sectors. It also has an impact on political stability and peace (Markusen *et al.*, 1995)

2.4 Effect of Tea Quality on Price

Good quality will increase the demand for a product, poor quality will depress it but demand will be depressed also by a high price. If a product sells badly because of poor quality, the price will have to be lowered in order to increase sales (Kipng'etich, 2007) and one of the trade problems confronting LDCs is the stabilisation of commodity prices (Södersten *et al*., 1994). It is worthy to notice that the price may be influenced by other factors than quality like a combination of inelastic demand and shifts in supply (Taylor, 2008)

2.5 Effect of Real Effective Exchange Rate on Export

Real Effective Exchange Rate is a key "price" that affect the competitiveness of a country's exporters producers of substitutes because a fall (depreciation) in real exchange rate or its rise (appreciation) increases or decreases exports of a country respectively (Griffiths e*t al.*, 2012).

2.6 Impact of Investment on Supply

Investment affects the supply side of the economy by raising its productive potential and thereby pushing outwards the productive frontier. There have been a number of studies as a generator of growth, though the results have not been conclusive. For example, in 1961, Kuznets used time series data for a number of countries and found a little relationship between the share of investment in GDP and the growth in output over time. From 1985 up to 2005 the United Kingdom (UK) spent a relatively low share of total national output on investment but over the period in question, has achieved a respectable growth performance. By way of contrast, Japan spent a relatively high share of total national output on investment but has generated a disappointing level of growth (Griffiths e*t al.*, 2012).

2.7 The Gains from Trade and Inter-Industry Trade

Probably the most important single insight in all of international economics is that there are gains from trade, that is, when countries sell goods and services to each other, this exchange is almost always to their mutual benefit (Were *et al*., 2002): International trade occurs because a Country is able to purchase goods abroad more cheaply than it can produce them at home, the result of trade is to increase a Country's level of living (Cramer, 1994). The range of circumstances under which international trade is beneficial is much wider than most people imagine. It is a common misconception that trade is harmful if there are large disparities between countries in productivity or wages (Krugman, 2003). According to Basu *et al*., 2000; Fosu, 1990; Santos-Paulino, 2000; and Giles and Williams, 2000 in Were *et al*., 2002, the role of exports in economic development has been widely acknowledged. Ideally, export activities stimulate growth in a number of ways including

production and demand linkages, economies of scale due to larger international markets, increased efficiency, adoption of superior technologies embodied in foreign-produced capital goods, learning effects and improvement of human resources, increased productivity through specialization and creation of employment.

According to Sentsho (2002) Export-led growth (ELG) is an economic development strategy in which export, and foreign trade in general play a central role in a Country's economic growth and development. There has been a general global shift towards the ELG strategy in recent years. This change has been found to be due to the actual and potential economic benefits of this strategy accords to both developing and developed countries alike. First, export growth is said to result in increased output, employment and consumption, all of which lead to an increase in the demand for a country's output (Jung and Marshall, 1985 in Sentsho, 2002). Furthermore, a buoyant export sector enlarges the domestic market so that firms achieve economies of scale and thus lower unit costs. This may be expected because an export sector allows a Country to trade along its lines of comparative advantage, specializing not only in commodities that use its abundant factors intensively, but also where its per unit costs are lower (Tyler, 1981). This generally leads to efficient resource allocation. This efficiency is further enhanced by exposure to international competition which forces firms to adopt modern technology and produce quality products that meet the demands of sophisticated consumers in international markets (Mayer, 1995).

For an open economy, international competition directs the resources of a nation toward the areas of their advantage. When domestic producers have a comparative advantage in the

production of a good, they will be able to compete effectively in the world market and profit from the export of goods to foreigners. In return, the export will generate the purchasing power necessary to buy goods that foreigners can supply more economically. Relative to the no-trade alternative, international trade and specialization result in lower prices (and higher domestic consumption) for imported products and higher prices (and lower domestic consumption) for exported products. More importantly trade permits the producers of each nation to concentrate on the things they do best (produce at a lower cost), while trading for those they do least well. The result is an expansion in both output and consumption compared to what could be achieved in the absence of trade (Gwartney *et al.*, 1995).

A Country will export the good whose free trade price is higher than its autarky price, and import the other (Feenstra, 2002) and the first gain is that there are gains to be obtained from both the opportunity for consumers to buy goods at price ratio different from that they face under autarky and the opportunity for producers to transfer resources from the (now) import-competing industry to the export industry. The second is that the gains from trade are likely to increase as we move through time. The longer the time period that has elapsed since the move to free trade the more mobility we will observe in factors of production, the further away from the origin the production –possibility curve will move, and the higher the community indifference curve that can be attained (Söbersten *et al*., 1994). However, according to Seyoum (2009), the following factors affect export: currency exchange control/risks, taxation, tariffs, and inflation, which happen to originate outside the business enterprise. Such variations require managers who are aware of global threats and

opportunities. Firms must consider the following factors: the success of the product in domestic markets, participation in overseas trade shows, advertising, and market data.

2.8 The Structural Break

2.8.1 Definition of Structural Break and its Historical Background

According to Gujarati (1999) a structural change means that the values of the parameters of the model do not remain the same through the entire time period. The classical test for structural change is typically attributed to Chow (1960). His famous testing procedure splits the sample into two sub periods, estimates the parameters for each sub period, and then tests the equality of the two sets of parameters using a classic F statistic. An important limitation of the chow test is that the break date must be known a priori (Hansen, 2001).

2.8.2 Empirical Findings on Structural Break and its Raison d'être

Bai *et al*. (1998) in Hansen (2001) attempted to date the alleged slowdown of the early 1970s. Using U.S. quarterly data for 1959 through 1995 on real output, consumption and investment, they found no evidence of structural change when examining the individual series with univariate models, but found strong evidence in a joint vector autoregression, in which the output, consumption and investment variables are regressed on lagged values of output, consumption and investment. Their estimate of the break date was the first quarter of 1969, and their 90 percent confidence interval put the break date between the second quarter of 1966 and the fourth quarter of 1971 (Hansen, 2001).

Structural change is pervasive in economic time series relationship, and it can be quite perilous to ignore. Inferences about economic relationships can go astray, forecasts can be inaccurate, and policy recommendations can be misleading or worse. The new tools developed in the past few years are useful aids in econometric model specification, analysis and evaluation (Hansen, 2001).

2.9 Review of Studies on International Trade Theories

According to Were *et al*. (2002), one of the underlying questions that need to be answered is what determines the supply of primary commodity exports. From the literature available, the factors that determine the supply of primary commodity exports include cost and accessibility of consumer goods, farm subsidies and taxes, research and extension, infrastructure, access to credit, among others (Alemayehu, 1999). Although literature on commodity export supply functions starts from structural equations, which accommodate a wide spectrum of these factors, the estimated reduced form equations are generally price-focused; they include either current or lagged (relative) prices. The price-focused supply models stem from Nerlove's (1958) model. Nerlove describes the dynamics of agricultural supply by maintaining the assumption that producers are influenced by their perception of normal price, which is captured through adaptive price expectation mechanism. Consequently, production is a function of prices and other adjustment costs.

Alemayehu (1999) in Were *et al*. (2002) has conducted a deep review of literature on the supply of primary commodity exports, which indicates a distinction between the long run (potential supply) and the short run (a proportion of potential supply). In this review for instance, Alemayehu (1999) in Were *et al*. (2002) noted that some studies define the

structural equations of supply as the sum of utilisation of potential output (the utilisation rate approach) and the potential output (potential supply approach). This has led to the potential supply approach and utilisation rate approach respectively. However, the reduced form model is specified as a function of current and lagged prices, exchange rate and a supply shock indicator. Such classification is typically used for perennial crops and minerals.

As indicated in Alemayehu (1999) in Were *et al.* (2002), models that include other factors other than price include Ady (1968). In this model, the existing acreage (stock of crop) in the previous period is included as additional explanatory variable. In the 'liquidity model', farmer's income is incorporated as an additional variable indicating capacity to invest. The latter relates investment to the difference between desired and actual level of capital. Such models have been summarised under models based on capital and investment behaviour theory presented in the Nerlovian adjustment model. Alternative forms of this theory arise in specifying the factors that determine the desired level of capital stock. These include capacity utilisation (capacity utilisation theory), net output or return to capital (neo-classical), internal cash flow (liquidity theory) and expected profit-based approach (Alemayehu, 1999 in Were *et al.*, 2002). Some studies consider supply as a function of expected price, expected opportunity cost, production costs, stock of output (trees in the case of perennial crops), potential of the industry and tax considerations (for example Kalaitzandonakes *et al*., 1992 in Were *et al.*, 2002). Others incorporate the dynamic effects of the exchange rate, the general price level, and an index of productivity (Bond, 1987).

In general, the emphasis in commodity supply modeling is on relative prices. Most studies on the exports of African countries tend to follow a similar approach. For small African countries, Rwegasira (1984) as cited in Alemayehu (1999) shows that for the period 1960s–1970s, the shortrun elasticities are high for annual crops while long-run elasticities are high for tree crops and minerals. Although there is a wide range of factors that have been identified as affecting supply of primary commodities, most studies empirically tend to narrow these factors to price variables, indicating the difficulty of quantifying non-price variables or obtaining reliable and complete set of data (Alemayehu, 1999; Mckay *et al*., 1998; Branchi *et al.,* 1999, in Were *et al.,* 2002).

In addition, there is a tendency to ignore the influence of the nonagricultural sector, therefore implicitly assuming that the interactions between the two sectors are insignificant. Nonetheless, the bias of literature on supply-side reflects the dominance of the small Country assumption, according to which countries have a negligible weight in the world market. But generally, time series studies have tended to produce rather low empirical estimates of elasticities (Mckay *et al*., 1998; Whitley, 1994; Ogbu, 1991 in Were *et al.,* 2002).

Conventional commodity models usually incorporate the real foreign income (of trading partners) and real exchange rate (proxy for relative prices) as explanatory variables in the estimation of the export supply functions in general (Ogun 1998; Klaassen 1999; Whitley, 1994; Ndung'u and Ngugi, 1999; Alemayehu, 1999; Balassa *et al*., 1989; Branchi *et al*., 1999, Mckay *et al*., 1998, in Were *et al.,* 2002). In the study on tea export done by Were *et al*., 2002 focus was made on the following explanatory variables: real exchange rate

(RER$K), real foreign income (income of major trading partners (*YTRADI*)) and total investment as a proportion of GDP (INVGDP).The inclusion of income and real exchange rate, as indicated above, is standard in trade models. The additional variable—investment to GDP ratio—is a proxy for capital formation to capture the supply constraints (Were *et al.*, 2002).

2.10 Previous Empirical Studies on International Trade

2.10.1 Some Time Series Export Related Studies

Afxentiou and Serletis (1991) in Sinoha (2006) tested the validity of ELG in 16 industrialized countries using annual data for the period 1950-1985. The countries included in the analysis were Austria, Belgium, Canada, Denmark, Finland, Germany, Iceland, Ireland, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, the UK, and the US. Time series properties were tested and the VAR model was used to test for causality. In the entire sample, the authors found no evidence of co-integration between GDP and exports. They found that, in general, only two countries supported either the ELG hypothesis or the growth-led export hypothesis. The ELG hypothesis was only supported in the US and economic growth-led export was supported in the US and in Norway.

Medina-Smith (2001) in Sinoha (2006) tested the ELG hypothesis for Costa Rica for the period 1950-1997 using a Cobb-Douglas production function. The variables included in the analysis were real GDP, real exports, real gross domestic investment, gross fixed capital formation (a proxy of investment) and population (proxy of labor force). The following tests were conducted: unit roots (DF and ADF tests), co-integration tests using

Cointegration Regression Durbin-Watson (CRDW), Engle-Granger methods, and Johansen's Maximum-likelihood approach. The author found evidence supporting the ELG hypothesis, implying that exports can explain both the short-run and long-run economic changes in Costa Rica.

Abdulai and Jaquet (2002) in Sinoha (2006) tested the ELG hypothesis for Côte- D'Ivoire. For the period 1961-1997, the authors examined the short-run and long-run relationship between economic growth, exports, real investments, and labor force. Time series techniques used were co-integration and ECM (Error Correction Model). The authors found evidence of one long-run equilibrium relationship among all variables. They also found causality, both in the short-run and in the long-run, flowing from exports to economic growth. Bidirectional causation between the variables was also found. It was concluded that Côte d'Ivoire's recent trade reforms (i.e., promoting domestic investment and recovering international competitiveness) contribute to export expansion, diversification, and, potentially, future economic growth in the nation.

According to Faridi (2012) a group of researchers like Jung and Marshall (1985); Darrat (1987); Chow (1987); Kunst and Marin (1989); Sung-Shen et al. (1990); Bahmani-Oskooee et al. (1991); Ahmad and Kwan (1991); Serletis (1992); Khan and Saqib (1993); Dodaro (1993); Jin and Yu (1995) and Holman & Graves (1995) examined the causality relationship between growth of export and economic growth using Granger causality test. The studies concluded that there existed some evidence of causality relationship between exports and growth. The main problem with causality test is that it is not useful when the original time series is not co integrated. Finally, the recent studies conducted to investigate

the impact of exports on growth applying the technique of co integration and error correction models.

Were *et al.,* 2002 found that the immediate price effect (depreciation of real exchange rate) was statistically insignificant while the same variable lagged one period was significant but negative. This could be explained by the fact that adjustments to price response in the short run are not likely to be considerable. Nonetheless, improvements in the investment as a proportion of GDP (both current and lagged) had a positive influence on volume of tea exports in the short run. Surprisingly, income of trading partners had an unexpected negative sign. May be this could have been explained by the shifting markets for the Kenyan commodities, especially with the rising economic integration and the decline in exports to the European Union.

According to Alam (2010) devaluation or not devaluation, floating or not floating has been a matter of tag-of-war for long time between the fund-banks and the intellectuals with conservative disposition in third-world countries. One of the merits the advocates of depreciation of local currency commonly put forward is its contribution to increased export earnings. In fact in the era of devaluation the authority in Bangladesh, like in many third world countries, used to place export as one of the foremost reasons of devaluing local currency against US$. In this analysis, the result showed that no causality run from depreciation of real exchange rate of Taka to export earning of Bangladesh. This result was in line with the findings of CPD and many other Bangladeshi researchers over the years (as mentioned in Hussain, 2000) who found Bangladesh’s export price inelastic and depreciation of Taka did not have much impact on export. So, for Bangladesh’s export to be

price elastic, policies that would have helped increase the share of domestic goods in exportable by the expansion of production base and that would have helped diversification of the pattern of the export items had to be prioritized. However, the impact of exchange rate depreciation might not have been same for all sub-sectors of export. This is why the relationship between exchange rate and various sub-sectors of export should have been analyzed and considered separately.

Nabli and Marie- Ange (2002) in Alam (2010) showed that exchange rate overvaluation caused huge loss in the export of MENA (Middle Eastern and North African) countries by decreasing their export competitiveness. They stated - “For the MENA region as a whole, exchange rate policy explains losses in competitiveness and in manufactured exports. RER overvaluation has reduced on average the ratio of manufactured exports to GDP by 18 percent a year. Manufactured exports which averaged 4.4 percent of GDP from 1970 to 1999 could have reached 5.2 percent of GDP if no overvaluation had taken place. These losses were more concentrated in the 1970s and 1980s than in 1990s due to the higher overvaluation of the currencies during those two sub-periods.”

2.11 The study’s Conceptual Framework

According to Ferris (1998) the quantity exported from a given nation is the dependent variable and has the following independent variables: Price in exporting Country, price in competing exporting countries, price in importing countries, world market price, population, purchasing power, production in importing nations, demands for inventory, consumption maintenance, (price inelastic) demand, border protection policies, export

subsidies from competing exporting nations, transportation costs, livestock numbers (for feed demand).

The study used the quantity of tea exported as the explained variable and the following different explanatory variables which affect tea export: the real exchange rate, the income of major trading partners, the total investment as a proportion of GDP, the tea world market price and world coffee market price. The figure 2.1 below provides a conceptual framework for the study.

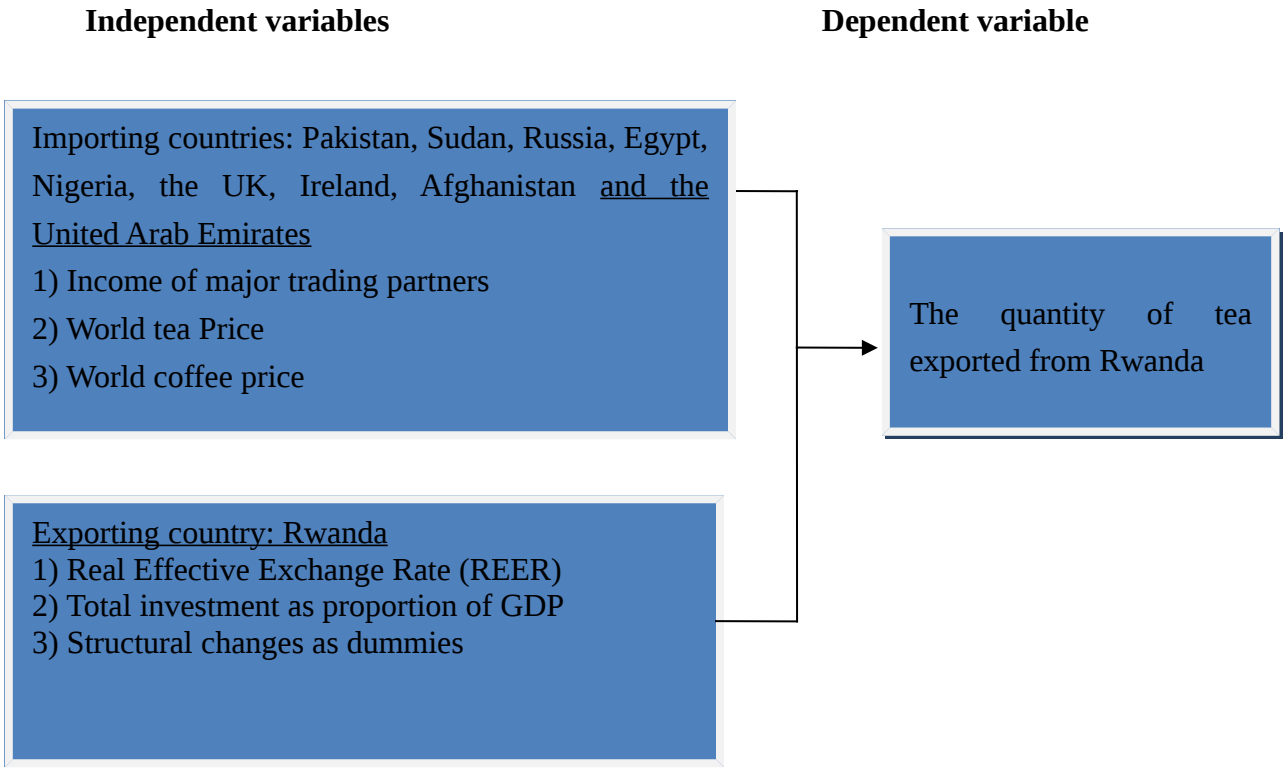


Figure 2.1: Study's Conceptual Framework

Source: Conceptualization by Author, 2014

CHAPTER THREE: METHODOLOGY

3.1 Overview

This methodology chapter describes the research design in section 3.2. It also provides information on the study area in section 3.3. The theoretical analytical framework upon which the study is based is developed in section 3.4 and it is a collection of interrelated ideas based on the theory of trade. Section 3.5 deals with the model specification for volume of tea exported and structural break analysis respectively. The last sections namely sections 3.6 and 3.7 deal with the types and sources of data, processing and analysis of data.

3.2 Research Design

The study applied a causal (explanatory) research design, with an objective to explain the cause-effect relationship between variables. Since the study conducted a time series data analysis, secondary data were collected from different sources like the following web sites: WITS, World Bank, FAOSTAT, National Statistics offices and NAEB office. The study investigated relationships between tea export as explained variable and the following different explanatory variables which affect tea export: the real exchange rate, the income of major trading partners, the total investment as a proportion of GDP, the world market price for both tea and coffee. To analyse data E-views, PC Give and SPSS were used as statistical packages.

3.3 Study Area

3.3.1 Location

Rwanda is located in Central Africa, east of Democratic Republic of the Congo and its geographic coordinates are 2. 00 S and 30. 00 E. Albeit its location, Rwanda is a member of East Africa Community (EAC).

At 26,338 square kilometers (10,169 sq mi), Rwanda is the world's 149th-largest country. It is comparable in size to Haiti or the state of Maryland in the United States. The entire country is at a high altitude: the lowest point is the Rusizi River at 950 meters (3,117 ft) above sea level. Rwanda is located in Central/Eastern Africa, and is bordered by the Democratic Republic of Congo to the west, Uganda to the north, Tanzania to the east, and Burundi to the south. It lies a few degrees south of the equator and is landlocked. The capital, Kigali, is located near the centre of Rwanda (Climate-zone.com, 2004).

3.3.2 Tea Plantations in Rwanda

Tea is grown in the high altitude 1500 – 2500 m above sea level areas of Rwanda, cold with an annual rainfall of 1500 -2000 mm per year. Tea is grown in acidic soil (ph: 4.5 – 5.5) with organic manure. It is grown in the different districts namely Rusizi, Nyamasheke, Karongi, Rustiro, Rubavu, Nyabihu, Ngororero, Gicumbi, Rulindo, Nyaruguru and Nyamagabe.

3.3.3 Hydrology

The watershed between the major Congo and Nile drainage basins runs from north to south through Rwanda, with around 80 per cent of the Country's area draining into the Nile and 20 per cent into the Congo via the Rusizi River. The Country's longest river is the Nyabarongo, which rises in the south-west, flows north, east, and southeast before merging with the Ruvubu to form the Kagera; the Kagera then flows to the north along the eastern border with Tanzania. The Nyabarongo-Kagera eventually drains into Lake Victoria, and its source in Nyungwe Forest is a contender for the as-yet undetermined overall source of the Nile. Rwanda has many lakes, the largest being Lake Kivu. This lake occupies the floor of the Albertine Rift along most of the length of Rwanda's western border, and with a maximum depth of 480 metres (1,575 ft), it is one of the twenty deepest lakes in the world. Other sizeable lakes include Burera, Ruhondo, Muhazi, Rweru, and Ihema, the last being the largest of a string of lakes in the eastern plains of Akagera National Park.

3.3.4 Relief of Rwanda

Mountains dominate central and western Rwanda; these mountains are part of the Albertine Rift Mountains that flank the Albertine branch of the East African Rift; this branch runs from north to south along Rwanda's western border. The highest peaks are found in the Virunga volcano chain in the northwest; this includes Mount Karisimbi, Rwanda's highest point, at 4,507 metres (14,787 ft). This western section of the Country, which lies within the Albertine Rift montane forests ecoregion, has an elevation of 1,500 metres (4,921 ft) to 2,500 metres (8,202 ft). The centre of the Country is predominantly rolling hills, while the eastern border region consists of savanna, plains and swamps (Mehta *et al.*, 2005).

3.3.5 Climate of Rwanda

Rwanda has a temperate tropical highland climate, with lower temperatures than are typical for equatorial countries due to its high elevation. Kigali, in the centre of the Country, has a typical daily temperature range between 12 °C (54 °F) and 27 °C (81 °F), with little variation through the year. There are some temperature variations across the Country; the mountainous west and north are generally cooler than the lower-lying east. There are two rainy seasons in the year; the first runs from February to June and the second from September to December. These are separated by two dry seasons: the major one from June to September, during which there is often no rain at all, and a shorter and less severe one from December to February. Rainfall varies geographically, with the west and northwest of the Country receiving more precipitation annually than the east and southeast (Mehta *et al.*, 2005).

3.4 Theoretical Framework

The international trade theory used in this work (Neoclassical Trade Theory) is based on the principle of comparative advantage of David Ricardo, which states that a country has a comparative advantage in producing a good if the opportunity cost of producing that good, in terms of another good, is lower in that country than it is in other countries. Neoclassical trade theory assumes two factors of production (labor and capital), equal technology in all countries, perfect competition, and constant returns to scale, and factor mobility between sectors but not between countries (Appleyard *et al*., 2001). In the neoclassical trade theory, trade can take place due to comparative advantage which is explained through differences in relative factor endowments-factor abundance (Heckscher-Ohlin theorem--HO). The

Heckscher-Ohlin model departs from Ricardian model in two fundamental ways. First, it assumes the existence of a second factor, capital, allowing for a much richer specification of production functions. Secondly, rather than assuming different technologies, the model rests on the notion of identical production functions in both nations. This assumption is made explicitly to neutralize the important possibility that trade is based on international technological variations in favor of possibility that trade is based solely on differences in supplies of capital and labor Markusen *et al.*, (1995). The Heckscher-Ohlin theorem states that a country will produce and export the good whose production makes intensive use of the relatively abundant factors of production before trade. This country should limit the production and increase the imports of the good whose production makes intensive use of the expensive factor of production before trade (Appleyard *et al*., 2001 in Were, 2002).

In the neoclassical trade theory, a country will gain from trade whenever its terms of trade (TOT) are different from its own relative autarky prices. A country with different terms of trade has the advantage of expanding the production of the factor abundant good, exporting the good more acceptable in other countries, and importing the good that is relatively more expensive to produce at home. The neoclassical trade theory will be evaluated in a neoclassical production function framework incorporating an additional factor of production (exports) into the production function. Exports are incorporated into the production function to capture their relationship with aggregate output. The augmented neoclassical production function is specified as follows:

$Y = F(K, L, EXP)$, where Y= aggregate output (real GDP), K is capital, L is labor force, and EXP is total real exports of goods and services. Because of their importance in

production, economic theory says that both capital and labor have positive effects on overall output. Because of its positive externalities, the ELG hypothesis says that exports must have a positive effect on aggregate output.

Conventional commodity models usually incorporate the real foreign income (of trading partners) and real exchange rate (proxy for relative prices) as explanatory variables in the estimation of the export supply functions in general (Ogun 1998; Klaassen 1999; Whitley, 1994; Ndung'u and Ngugi, 1999; Alemayehu, 1999; Balassa *et al*., 1989; Branchi *et al*., 1999, Mckay *et al*., 1998, among others) in Were *et al* (2002). This study adopted a similar approach with the following explanatory variables: real effective exchange rate (REER$FRws), foreign income (income of major trading partners (inc)), total investment as a proportion of GDP (invGDP), coffee price, tea price and dummies to capture structural changes variables with one standing for the presence of structural change and zero otherwise.

The inclusion of income and real exchange rate, as indicated above, is standard in trade models. The additional variables are investment to GDP ratio as a proxy for capital formation to capture the supply constraints and dummies to structural change variables as above indicated.

3.5 Model specification

This study estimated specific econometric models in order to test three hypotheses included in this study.

3.5.1 Quantities of Exported Tea and Variables which Affect Export Relationship

Y_t is considered as quantity of exported tea in year t and its implicit form is as follows:

Exported Volume = f(RER$Frws, INC, INVGDP, P, COFFPRICE, DUMMIES).

A linear regression model as explicit form of the above mentioned implicit form was used in this study and Were *et al.* (2002) used a similar model. Its log model can be written as follows:

$$Ln(Y_t) = \beta_1 ln(X_{1t}) + \beta_2 ln(X_{2t}) + \beta_3 ln(X_{3t}) + \beta_4 ln(X_{4t}) + \beta_5 ln(X_{5t}) + \alpha_i D_i + U_t \quad (3.1)$$

Where, Y_t= Quantity of exported tea at time t

Bi's = Regression coefficients (elasticity of tea export with respect to different factors)

α_i = Regression coefficients for dummy variables

REER$Frws is the real exchange rate with expected positive sign as response to depreciation

INC is the income of major trading partners with an expected positive sign

INVGDP is the total investment as a proportion of GDP with a positive expected sign

P is the tea world market price with a positive expected sign

COFFPRICE is the coffee world price with an expected positive sign

D_i represents dummies capturing the structural changes

In the estimation of this model, elasticity of production indicates the percentage by which the quantity of tea exported increases (decreases) with each 1-percent increase in the use of a particular explanatory variable.

3.5.2 Structural Break Analysis

In order to analyse structural breaks, recursive residual test and Chow test were conducted. According to Gujarati (1999), the OLS regressions and Chow test are used to capture the structural break. The model that was used to test hypothesis Ho_1 was as follows:

Time period before the structural change: $Y_t = \lambda_1 + \lambda_2 X_t + u_{1t}$ with n_1…..…… (3.2)

Time period after the structural change: $Y_t = \gamma_1 + \gamma_2 X_t + u_{2t}$ with n_2..... (3.3)

Entire time period: $Y_t = \alpha_1 + \alpha_2 X_t + u_t$ with $n = (n_1 + n_2)$…….…… (3.4)

Where,

Y_t is quantities of tea exported at time t

X_t stands for independent variables at time t. These are real effective exchange rate, income of major trading partners, total investment as a proportion of GDP, world market tea price and world market coffee price

$\lambda_1, \gamma_1, \alpha_1$ are intercepts

$\lambda_2, \gamma_2, \alpha_2$ are slopes

The *u*'s represent the error terms and the *n*'s represent the number of observations.

Regression (3.4) assumed that there was no difference between the two time periods and therefore estimated the relationship between quantity of tea exported and its determinants for the entire time period consisting of n observations. In other words, this regression assumed that the intercept as well as the slope coefficient remained the same over the entire period; that is, there was no structural change.

If this was in fact the situation, then $\alpha_1 = \lambda_1 = \gamma_1$ and $\alpha_2 = \lambda_2 = \gamma_2$.

Regressions (3.2) and (3.3) assumed that the regressions in the two time periods were different; that is, the intercept and the slope coefficients were different, as indicated by the subscripted parameters.

3.5.3 Time-Series Data Error Correcting Model

According to Stock (2007), if variables are co-integrated, their first differences can be modeled using a VAR, augmented by including error correction term as an additional regressor.

To test hypothesis Ho_2, the following vector error correction model was used:

$$\Delta Y_t = \beta_{10} + \beta_{11}\Delta Y_{t-1} + \cdots + \beta_{1p}\Delta Y_{t-p} + \gamma_{11}\Delta X_{it-1} + \cdots + \gamma_{1p}\Delta X_{it-p} +$$

$$\alpha_1(Y_{t-1} - \theta X_{it-1}) + u_{1t} \quad \text{..... (3.5)}$$

$$\Delta X_t = \beta_{20} + \beta_{21}\Delta Y_{t-1} + \cdots + \beta_{2p}\Delta Y_{t-p} + \gamma_{21}\Delta X_{it-1} + \cdots + \gamma_{2p}\Delta X_{it-p} +$$

$$\alpha_2(Y_{t-1} - \theta X_{it-1}) + u_t \quad \text{..... (3.6)}$$

Y_t was the quantity of tea exported and X_{it} was the independent variable (determinants of tea export). The subscript i stood for each determinant of tea export. α_1 and α_2 stood for

the coefficient of error correction term or the speed of adjustment toward long run equilibrium.

The term $Y_t - \theta X_{it-1}$ is the error correction term and the combined model in equations (3.5) and (3.6) is the vector error correction model. Past values of $Y_t - \theta X_{it}$ helped to predict future values of ΔY_t.

3.5.4 Granger Causality Equation

To test the third hypothesis Ho_3, the Granger causality model presented below was used

$$\Delta Y_t = a_1 + \sum_{j=1}^{n} \beta_t \Delta Y_{t-j} + \sum_{j=1}^{n} \gamma_t \Delta X_{t-j} + \varepsilon_t \quad \text{..... (3.7)}$$

ΔY_{t-1} is the lagged difference of the dependent variable at time t

ΔX_{t-1} is lagged difference of the independent variable at time t

The null hypothesis was $\gamma_j = 0$ for all j versus the alternative hypothesis that $\gamma_j \neq 0$ for at least some j. If the coefficients γ_s were statistically significant, then X caused Y.

3.6 Type and Sources of Data

To carry out this study, time series data for the period of 1982 to 2012 were collected for quantities of tea exported, Real effective exchange rate (REER FRws), foreign income (income of major trading partners (inc), total investment as a proportion of GDP (INVGDP), world tea price, world coffee price, and dummies to capture structural changes. Real Effective Exchange Rate was deflated to 2007 constant Rwandan Franc (2007=100); GDP deflator used was for 2005 constant Rwandan Franc (2005=100). Data were found on WITS web site, World Bank web site, FAOSTAT web site and NAEB office in Kigali

3.7 Data Processing and Analysis

This study used both descriptive and inferential statistics in the analysis. The software packages such as Pc-Give, SPSS and E-Views were used as tools for computation. The first stage of data processing and analysis was concerned with descriptive analysis of data to present the main characteristics of tea export in Rwanda and its determinants. The second stage of data analysis consisted of investigating relationship between quantity of tea exported and variables which affect it, using time series data in order to find out any presence of structural changes for the period of 1982 to 2012. Both recursive residual test and Chow test were conducted and model (3.2), (3.3) and (3.4) were used for Chow test.

The third stage of data analysis consisted of investigating both short term and long term relationship between quantity of tea exported and its determinants using (3.5) and (3.6) equations that constitute a VAR model. Both co-integration and Wald test were conducted to investigate long term and short term relationship respectively.

While dealing with time series data, it has to be made sure that the individual time series are either stationary or that they are co integrated otherwise the regression analysis will be spurious (Gujarati, 1999). Two or more time series are said to be co-integrated if they have a common stochastic trend (Stock *at al.*, 2007).

The empirical literature for unit root showed that almost all macro variables are non-stationary in level while their difference is stationary (Alemayehu *et al.*, 2012). This implies that almost all variables are integrated of degree one, implying that they are I (1). In this study, to test for unit root test Augmented Dickey-Fuller (ADF) test, Phillips-Perron test and correlogram test were conducted. To test for co-integration, Johansen Co-integration test was used. In the Johansen test, there are two tests statistics: The traces statistics and the maximum eigen value statistics. The trace statistic tested the null hypothesis “there were at most r co-integrating relations” against the alternative of “m” co-integrating relations, (meaning that the series were stationary), r = 0, 1,…, m-1. The maximum eigen value statistic tested the null hypothesis “there were r co integrating relations” against the alternative “they were r + 1 co integrating relations.

The two-step method put forward by Engle and Granger (1987) was used to test the mutual long term causalities of relevant indexes; if the long term causality was proved to exist, then their short term causalities were tested using Wald test.

The final stage of data analysis was to test for predictability content between export and factors of export using both model (3.7) and Granger causality test (F-test). Causality testing involved examining whether the lags of one variable can be included in another equation. To test for the direction of causation between export and factors of export, F-

statistic testing the hypothesis that the coefficients on all the values of one of variables in the equation (3.7) (for example, the coefficients on X_{1t-1}, X_{1t-2}, …, X_{1t-q1}) were zero. This null hypothesis implies that these regressors have no predictive content for Y_t beyond that contained in the other regressors, and the test of this null hypothesis is called the Granger causality test (Stock, 2007). Putting it in other words, according to Granger (1988) in Alam (2010), Granger causality test is used to examine whether the past value of a variable series X, will help to predict the value of another variable series at present, Y, taking into account the past value of the Y (Granger, 1988). In this study, Granger causality from determinants of tea export to quantities of tea exported was established when the coefficients of the lagged difference of dependent variables were found to be jointly statistically significant and therefore helped explain and predict quantities of tea exported, over and above what the lagged differences of quantities of tea exported could predict.

The study also carried out diagnostic tests in order to validate the results. The following tests relating to ordinary least square (OLS) assumptions were carried out:

(i) The assumption of linear relationship between explanatory and explained variables

(ii) The assumption of randomness of the error term

(iii) The assumption of zero mean of the error term

(iv) Then assumption of homoscedasticity or constant variance of error term

(v) The assumption of normality of error term

(vi) The assumption of zero covariance of error term and explanatory variables

(vii) The assumption of no-autocorrelation of between two error terms

(Viii) The assumption of no-multicollinearity between the explanatory variables (Gujarati, 1999).

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Overview

This chapter presents an analysis of data collected with both objectives and research hypotheses put into consideration. The study used secondary data that have been tabulated, analyzed, recorded as frequencies and percentages where applicable, and regression analysis was performed. Finally, structural change, co-integration and Granger causality results on tea export in Rwanda are discussed in detail.

4.2 Presentation

This part of the study is concerned with the presentation of descriptive statistics results of the secondary data that were used in this study.

4.2.1 Investment as Proportion of Gross Domestic Product in Rwanda (1982- 2012)

Intervals of investment as proportion of GDP were computed in order to get a picture of to which extent business expenditure on plant, equipment, inventories, and residential construction, all aggregated into gross domestic private investment (Branson, 2001) plays a role in Rwandan economy as per the table 4.1 below. Figures in intervals are percentages.

Table 4.1: Investment as Proportion of Gross Domestic Product in Rwanda (1982-2012)

Intervals of Investments as	Count	Percentage	Cumulative Count	Cumulative Percentage

proportion of GDP				
[5, 10[	1	3.23	1	3.23
[10, 15[	14	45.16	15	48.39
[15, 20[	11	35.48	26	83.87
[20, 25[	5	16.13	31	100.00
Total	31	100.00	31	100.00

Source: Computation from the Secondary Data, 2014

As shown in the table above 10 to 15 percent of Gross Domestic Product was oriented into investment at a probability of 0.45 followed by the interval of 15 to 20 with a probability of 0.35. As Griffiths e*t al.* (2012) noticed investment affects the supply side of the economy by raising its productive potential and thereby pushing outwards the productive frontier. There have been a number of studies as a generator of growth, though the results have not been conclusive. From 1985 up to 2005 the United Kingdom (UK) spent a relatively low share of total national output on investment (17%) but over the period in question, has achieved a respectable growth performance 2.6%. By way of contrast, Japan spent a relatively high share of total national output on investment (26.7) but has generated a disappointing level of growth 2.1%.

4.2.2 World Price of Tea Products (1982-2012)

Export sale was performed through auctioning of tea at the Mombasa international market, and by the way of direct sales with private buyers. Price figures in table 4.2 below are averages of both prices from auctioning and private buyers (NAEB, 2012). World price of tea for the period starting from 1982 up to 2012 descriptive statistics are presented in the table 4.2. First, the computation shows that for the period of 1982-2012, tea world price has been mainly oscillating between 1.5 and 2 United States Dollars at a probability of 0.17 and the lowest probability is 0.03 with the world price oscillating in the range of 2 and

2.5.This confirms what Nuwangira (2013) has noticed that Rwanda's tea export earnings and volumes may change over time. Second, during that period of 1982-2012, the mean of tea price was 1.82 USD with a maximum of 2.93 USD and a minimum of 1.35 USD.

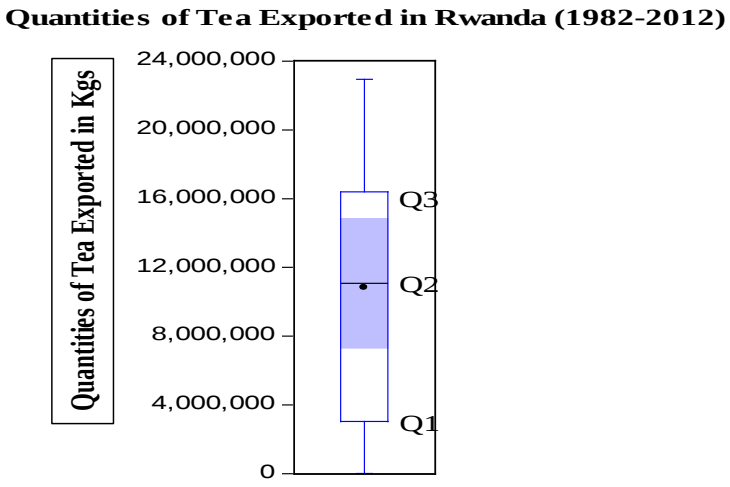
Table 4.2 World Price of Tea Products (1982-2012)

Intervals of Tea prices	Mean	Maximum	Minimum	Standard Error	Percentage
[1, 1.5[	1.44	1.47	1.35	0.04	7
[1.5, 2[	1.71	1.97	1.51	0.19	17
[2, 2.5[	2.18	2.27	2.02	0.14	3
[2.5, 3[	2.71	2.93	2.59	0.15	4
All	1.82	2.93	1.35	0.43	31

Source: Computation from Secondary Data, 2014

4.2.3 Quantity of Tea Exported from 1982 up to 2012 in Rwanda

The box plot splits the data set into quartiles. The body of the box plot consists of a box which goes from the first quartile (Q1) to the third quartile (Q3).Within the box, a horizontal line is drawn at Q2, the median of the data set. Two vertical lines, whiskers, extend from the front and the back of the box. The front whisker goes from Q1 to the smallest non-outlier in the data set, and the back whisker goes from Q3 to the largest non-outlier. In the figure below Q1, Q2, andQ3 are first, second and third quartiles respectively and divide data into four parts, each part having 25% of data. Between Q1 and Q3 there are 50% of data. The figure 4.1 below presents the results.



Source: Data Analysis in this Study, 2014

Figure 4.1: Box and Whisker plot of the quantity of tea exported in Rwanda (1982-2012)

Results in the figure show that the front Whisker goes from Q1 that is slightly below 4,000,000 Kg to the smallest non-outlier in the data set and the horizontal line is drawn at the Q2, the median of the data set which is about 12,000,000 Kg. The interquartile range (IQR) which is the middle half of a data set falls within the interquartile range. The interquartile range is represented by the width of the box (Q3 minus Q1) where 50 percent of observations are located. In the chart above, the interquartile range is equal to 16,000,000 minus 4,000,000 or about 12,000,000 (in kgs). The distribution is symmetric, meaning that observations are evenly split at the median. The interquartile range of 12,000,000 kgs is large and confirms what Nuwangira (2013) has put that Rwanda's tea export earnings and volumes may change over time and planning

4.2.3 Real Effective Exchange Rate in Rwandan Currency (1982- 2012)

As depicted in the appendix II, only four periods that were under the base year, all the remaining 27 periods had a real effective exchange rate being above the base year of 2007. According to Griffiths e*t al*. (2012) a fall (depreciation) in real exchange rate or its rise (appreciation) increases or decreases exports of a country respectively and it shows that Rwanda had advantages in importing goods rather than producing them. The real effective exchange rate had kept on appreciating which means that either the Rwandan currency had been devaluated or the price of goods has increased compared to world market prices of goods.

4.2.4 Income of Major Trading Partners of Rwanda (1982-2012)

Rwanda sells most (60 per cent) of its teas at the Mombasa auction, with a small percentage being bought by individual buyers (37 per cent), the major trading partners are Pakistan, Sudan, Russia, Egypt, Nigeria, the UK, Ireland, Afghanistan and the United Arab Emirates (Rajendran, 2013). In the table 4.4 the sum of income of those main trading partners (nominal GDP) in million USD is divided into three intervals, then mean of intervals, maximum and minimum figures within each interval are calculated. The study has used the sum of GDPs for all major trading partners in all analyses.

The table 4.3 shows that during the period of 1982-2012, the income of major trading partners had a mean of 7324908, a maximum of 98952239 and a minimum of 23276.86, all figures being in million USD. From the same table, it was depicted that exception done to

only three periods, other 28 out 31 periods were ranging between 2151578 and 23276.86 million of USD with a mean of 123016.3 million USD.

Table 4.3: Statistics of Income of Major Trading Partners of Rwanda (1982-2012)

Income in million US$	Mean	Maximum	Minimum	Standard Error	Observations
[0, 20000000[	123016.3	2151578.	23276.86	399444.0	28
[20000000, 40000000[	37563967	37563967	37563967	NA	1
[80000000, 100000000[	93031869	98952239	87111499	8372667.	2
All	7324908.	98952239	23276.86	23897322	31

Source: Computation from the Secondary Data, 2014

4.2.5 Coffee World Price During the Period of 1982-2012

This study has used raw data of coffee world price in all analyses. Coffee was considered in this study because it is a substitute product to tea, therefore, can influence tea demand and price Farris *et al* (1987). Some coffee world price statistics for the period starting from 1982 up to 2012 are presented in the table 4.4 showing that during the period of 1982-2012, the average price was1.09 USD and the maximum price was 3.58 USD. The lowest price of coffee during the entire period was 0.36 USD. A highest number of observations is located in the interval of 0 to 1 USD with 16 observations out of 31. The figures show that the coffee world price has been bouncing and as Taylor (2008) has put the reason for the price to bounce lies in a combination of inelastic demand and shifts in supply.

Table 4.4: Descriptive Statistics of Coffee World Price (1982- 2012)

Intervals of	Mean	Maximum	Minimum	Standard Error	Observation

coffee price					
[0, 1[	0.68	0.94	0.36	0.19	16
[1, 2[	1.30	1.81	1.00	0.27	13
[2, 3[	2.51	2.51	2.51	NA	1
[3, 4[	3.58	3.58	3.58	NA	1
All	1.09	3.58	0.36	0.66	31

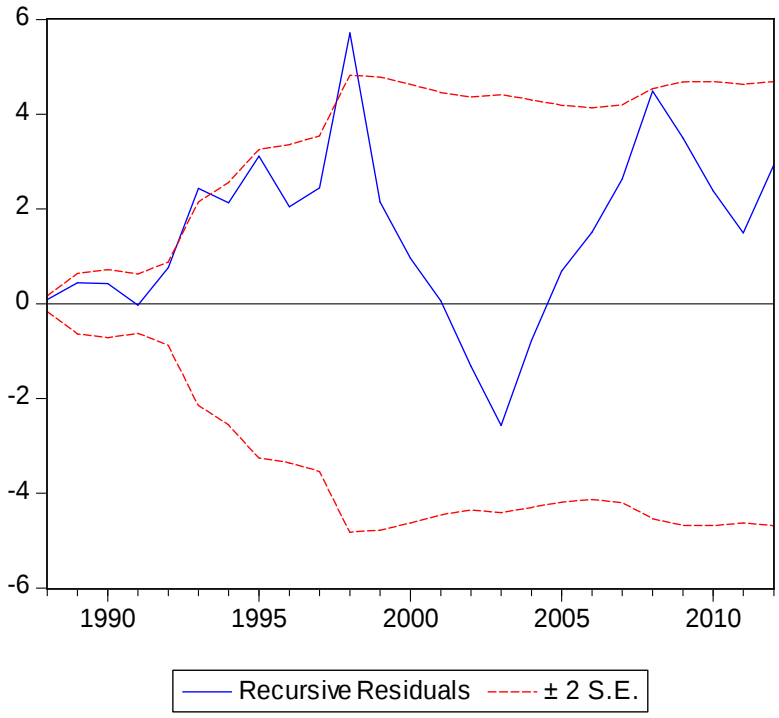
Source: Computation from the Secondary Data, 2014

4.3 Results Relating to Structural Change

By structural change, it is meant that the values of the parameters of the model do not remain the same through the entire time period (1982-2012).

4.3.1 Recursive Residual Test

The recursive residual test is used if the point at which the break in the underlying relationship might have occurred is unknown or not chosen by the researcher Gujarati (2005). The figure 4.2 below shows that during the periods starting from 1994 up to 1996 and 1998 up to 1999, there were structural changes.



Source: Data Analysis in this Study, 2014

Figure 4.2 : Stability Test Using Recursive Residuals

4.3.2 Chow Test

To confirm the results obtained using recursive residual test, Chow test that is used in case the date for any eventual structural change are known was conducted with a null hypothesis of no structural change at specified points and an alternative hypothesis that there was structural change at specified points.

Table 4.5 shows that structural changes occurred in the period starting from 1989 and ending in 1998 because the p-value is very low (0.000˂0.05) and the null hypothesis was rejected.

The reason behind this is related to the political insecurity that characterized the above concerned periods for a liberation war started in 1990 leading to Tutsi genocide in 1994 and its chock lasted up to 1996 or 2000 according to recursive residual and Chow test respectively. The period of 1996 up to 1999 was characterized by several wars perpetrated by rebels (abacengezi) in both the northern and Western parts of Rwanda where important tea plantations are found. The table 4.5 below summarises the above discussions.

Table 4.5: Results of Chow Tests for Structural Breaks

Year of structural break	F-statistic	Probability	No Existence of Structural Change
1989	224.6676	0.0000	No
1990	210.1675	0.0000	No
1991	203.1142	0.0000	No
1992	213.1093	0.0000	No
1993	162.5464	0.0000	No
1994	73.03376	0.0000	No
1995	42.06971	0.0000	No
1996	8.540034	0.0001	No
1997	6.054512	0.0011	No
1998	3.777934	0.0120	No
1999	2.441650	0.0640	Yes
2000	1.960147	0.1226	Yes

Source: Data Analysis in this Study, 2014

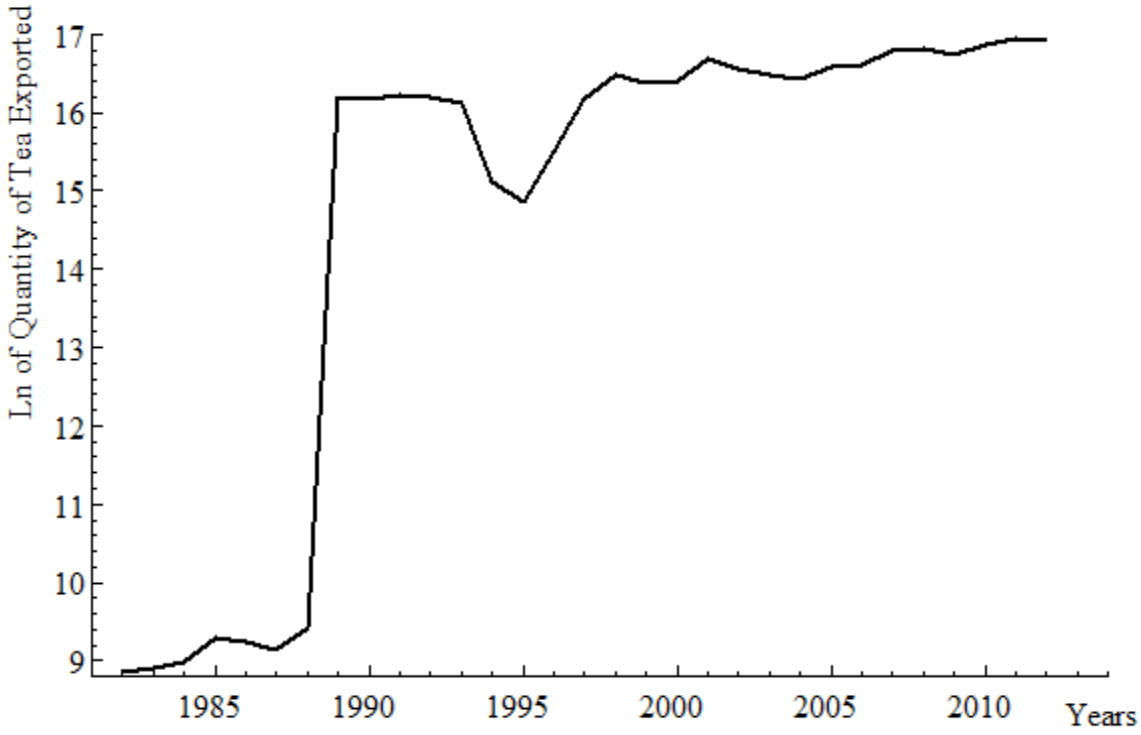
4.4 Trend of Variables Involved in the Study for the Period of 1982-2012

All graphs, from figure 4.3 to 4.8 depict that series are purely randomly trended hence nonstationary at level. However, a deterministic trend is found in quantity of tea exported starting from 1998 onwards. There is therefore a need for testing for unit roots.

4.4.1 Quantity of Tea Exported in Rwanda From 1982 up to 2012

The figure 4.3 of the quantity of tea exported in Rwanda indicates that from 1988 up to 1989 Rwanda tea export increased and that corresponds to the increase in income of the major trading partners. The graph also shows that from 1993 up to 1995 there was a decrease in quantity of tea exported and that is explained by the fact that during that period there was war and Tutsi genocide and economic activities were paralysed. The graph shows since 1998 the quantity of tea exported had an increasing trend; this confirms what has

been previously found stipulating that in 1998 the quantity exported increased compared to previous years and that was due to the relative political stabilisation in the northern part of Rwanda. Political instability in major trading partners can influence the demand and that was the case in 1998 because Pakistan was in foreign currencies shortage due to World Bank embargo and could not import tea. It had done nuclear trial (OCIR THE, 1998).



Source: Data Analysis in this Study, 2014

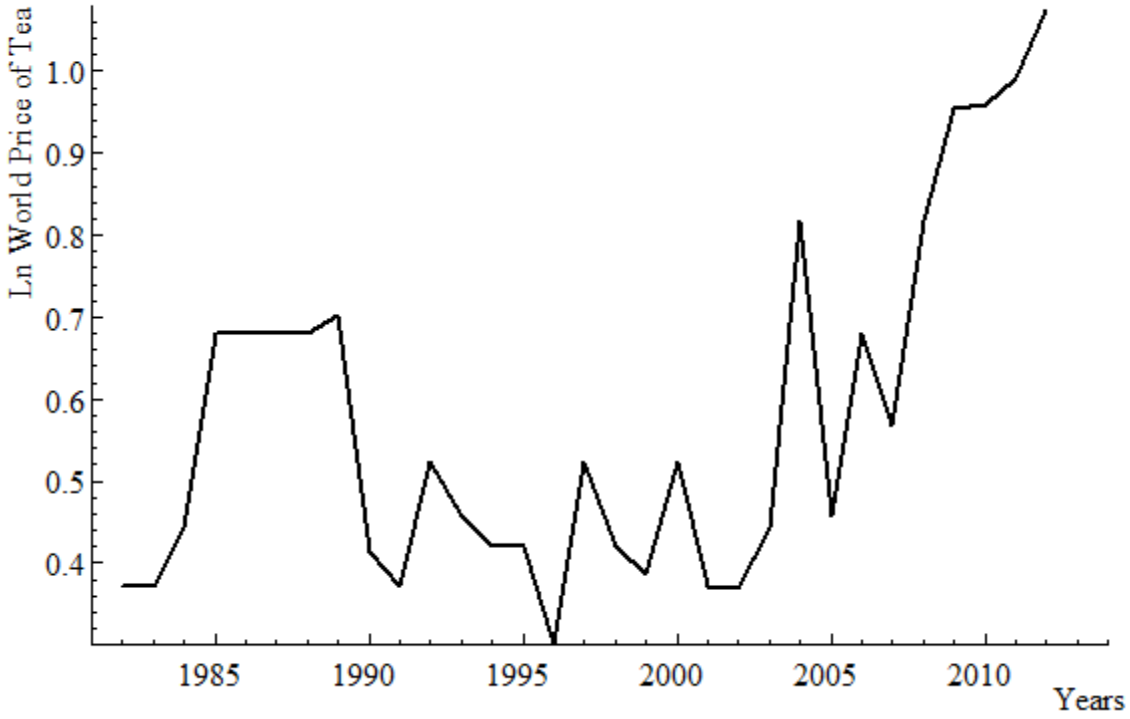
Figure 4.3: Graph of Quantity of Tea Exported in Rwanda from 1982 up to 2012

4.4.2 World Price of Tea Exported in Rwanda from 1982 up to 2012

The figure 4.4 depicts that the lowest price was incurred in 1996 one of the causes as highlighted in (OCIR THE, 1998) was the speculative trend on the behalf of producers and buyers resulting in a cobweb phenomenon (Nerlove, 1958). From 2007 up to 2012, there

was a continuous increase in exported tea price due to the government's strategy regarding tea that is two-fold: increase production and improve quality.

It is a sign that the government of Rwanda has started to implement her set goals of diversification and branding of its teas. The world black tea market was saturated, pushing down prices. Rwanda has started diversification into different varieties of teas and premium products (Alinda, 2012).



Source: Data Analysis in this Study, 2014

Figure 4.4: Graph of World Price of Tea from Rwanda for the Period of 1982-2012

4.4.3 Real Effective Exchange Rate in Rwanda from 1982 up to 2012

Griffiths e*t al*. (2012) opined that a fall (depreciation) in real exchange rate or its rise (appreciation) increases or decreases exports of a country respectively. Therefore, as the figure 4.5 of Real Exchange Rate depicts, the Real Exchange Rate started to depreciate in 1989 up to 1992 and from the beginning of 1994 up to 1996. Then the last depreciation in REER started in 1998 and ended in 2004, a period at which there was the lowest real effective exchange rate. The above mentioned periods coincided or were followed by a rise in the quantity of tea exported and this is in agreement with Kipici *et al.* (1997) who opined that depreciation of REER results in amelioration of a country's level of competitiveness. The two first periods correspond to SAPs implementation and political instability that resulted in 1994 Tutsi genocide. In the short run, a devaluation of Frws contributed to an increase in the quantity of tea that was exported (Griffiths *et al*., 2012).

Figure 4.5 also shows that at the beginning of 1992 up to 1994 there was an appreciation in the REER and the highest REER 1994. An appreciation of 1992 up to 1994 is explained by the fact that during that period of time, inflation and political instability might have resulted in decrease of productivity of tradable goods (relative lower domestic prices of tradable goods).

Source: Data Analysis in this Study, 2014

Figure 4.5: Graph of Real Effective Exchange Rate of Rwanda from 1982 up to 2012

4.4.4 Investment as Proportion of GDP in Rwanda from 1982 up to 2012

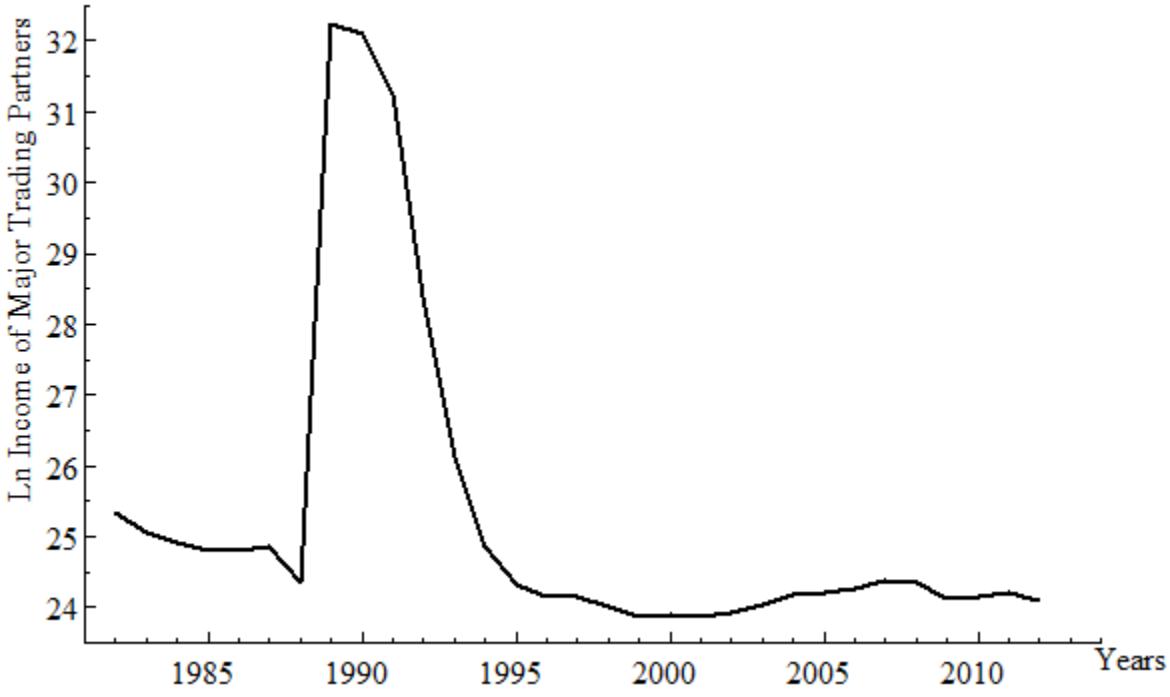
Figure 4.6 shows that 2008 and 2012 were years with a high investment as proportion of GDP. In the contrary, 1993 started a period where the investment decreased until it reached the lowest point in 1994 and that was during the Tutsi genocide period. In 1995 the investment as a proportion of GDP started to increased and the responsiveness in tea export was positive (increase in tea exported).

Source: Data Analysis in this Study, 2014

Figure 4.6: Investment as Proportion of GDP in Rwanda from 1982 up to 2012

4.4.5 Income of Major Trading Partners of Rwanda from 1982 up to 2012

As shown by figure 4.7, in 1988 started a recovery in Rwanda's major trading partners' economy reaching a boom in 1989, then followed by a recession in 1990. The war in Iraq may be a very good explanation of the recession. The year 1990 corresponded to stability in the quantity of tea exported and to depreciation in the REER.

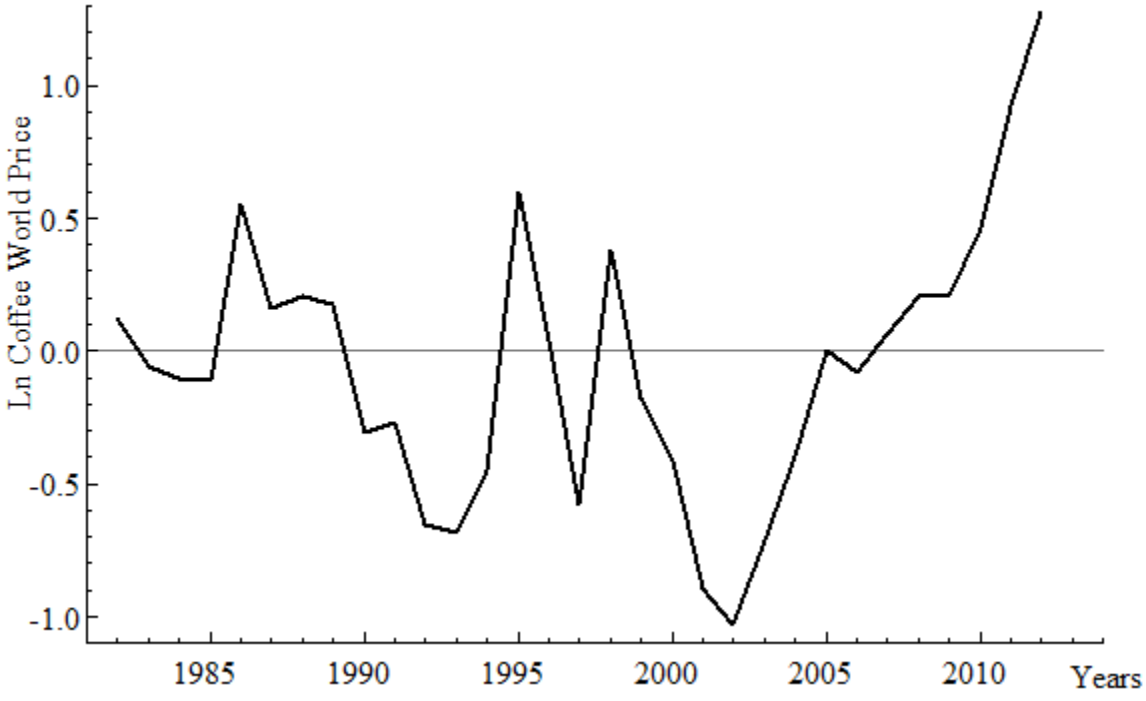


Source: Data Analysis in this Study, 2014

Figure 4.7: Graph of Income of Major Trading Partners of Rwanda (1982-2012)

4.4.6 World Coffee Price from 1982 up to 2012

The figure 4.8 shows that from 1986 up to 1993 there was a continuous decline of coffee price that ended in 1994. Another decline in coffee price occurred from 1998 up to 2002. Note that during the period starting from 1985 up to 1989 the price of tea was increasing and relatively higher compared to the one for coffee that was declining. However, starting from 1990 both prices declined due to either the Gulf war or the internal war that resulted in Tutsi genocide that resulted in world and Rwandan economic crises respectively.



Source: Data Analysis in this Study, 2014

Figure 4.8: Graph of World Price of Coffee (1982-2012)

4.5 Regression Analysis

The quantity of tea exported was regressed on investment as proportion of Gross Domestic Product, world price of tea, income of major trading partners, real exchange rate and world price of coffee.

4.5.1 OLS Model: Econometric Estimation Results and Discussion

An econometric analysis usually follows three criteria: economic prior knowledge, statistical and econometric criteria. The first indicates that the interpretation of the results is in line with economic theory in terms of signs and magnitude of the estimates. As Gujarati

(2005) has put, the model should be consistent with theory*;* that is, it must make good economic sense. The second criteria that the statistical rules were not tampered with and finally that the econometric principles were respected, specifically OLS assumptions and the rules of the estimation techniques. Results of the OLS model regression presented in Table 4.6 indicate that from the statistical point of view:

The R^2 of 0.54 is statistically significant, since the computed *F* value of about 3.30 is significant, as its p-value is almost zero (0.01). As Gujarati (2005) has put, *F* statistic tests the hypothesis that all the slope coefficients are simultaneously zero; that is, all the explanatory values jointly have no impact on the regressand. Therefore, all independent variables in the model jointly influenced the dependent variable.

The model estimation shows that only real effective exchange rate was significant among other six variables and that is a sign of existing multicollinearity in independent variables.

The Durbin-Watson statistic for this regression as shown in table 4.6 was 0.65. This statistic was not within the acceptable range from 1.50 to 2.50, indicating that the residuals were serially correlated. However as Gujarati (2005) has put R^2 of that is less than d indicates that the estimated regression is not spurious.

Table 4.6: OLS Model Estimation

Variable	Coefficient	Standard Error	t-statistic	Probability
Constant	83.19	22.37	3.72	0.00
Coffee price	-0.39	1.42	-0.28	0.78
Income of major trading partners	0.19	0.22	0.88	0.39
Investment as proportion of GDP	-6.04	4.45	-1.36	0.19
Tea price	5.02	3.66	1.37	0.18
REER	-12.30	2.98	-4.13	0.00
Dummy for 2001-2004	-1.38	1.99	-0.69	0.49
Dummy for 1988-1989	-1.04	2.24	-0.47	0.65
Dummy for 1992-1995	0.08	1.49	0.05	0.96

R-squared	0.546	Mean dependent var	14.71
Adjusted R-squared	0.380	S.D. dependent var	3.109
S.E. of regression	2.447	Akaike info criterion	4.865
Sum squared resid	131.759	Schwarz criterion	5.282
Log likelihood	-66.415	Hannan-Quinn criter.	5.001
F-statistic	3.303	Durbin-Watson stat	0.655
Prob(F-statistic)	0.012		

Source: Computation from Secondary Data, 2014

4.5.2 Diagnostic Tests

The model estimation started by carrying a diagnostic test for multicollinearity. Results on multicollinearity test are provided in table 4.7. Following Studenmund (2001) in Ndayitwayeko (2014), any coefficient of correlation analysis on explainable variables less

than 0.80 does not lead to multicollinearity problem. A simple correlation test shows the highest correlation between two variables is -0.71, that is, tea world price (lnp) and investment as proportion of GDP and it is less than 0.80.

The highest correlation among all variables is 0.74 showing that investment as proportion of GDP and world tea price are highly related. And two variables are the source of multicollinearity detected in the regression model. As tea world price has higher p-value than investment as proportion of GDP, it should have been removed from the model. However as tea world price and investment as proportion of GDP are not perfectly multicollinear because one is not a perfect linear function of the other. As Stock *et al.* (2007) have put imperfect multicollinearity does not pose any problems for the theory of OLS estimators; indeed, a purpose of OLS is to sort out the independent influences of the various regressors when these regressors are potentially correlated.

Considering the above results, the model can be used without eliminating any regressor because as Kothari (2004) has noticed the prediction for the dependent variable can be made even when multicollinearity is present, but in such a situation enough care should be taken in selecting the independent variables to estimate a dependent variable so as to ensure that multi-collinearity is reduced to the minimum.

Table 4.7: Results of Multicollinearity Test

	D0104	D8889	D9295	Lncoffprice	Lninc	Lninvgdp	Lnp	Lnreer
D0104	1.00							
D8889	-0.10	1.00						

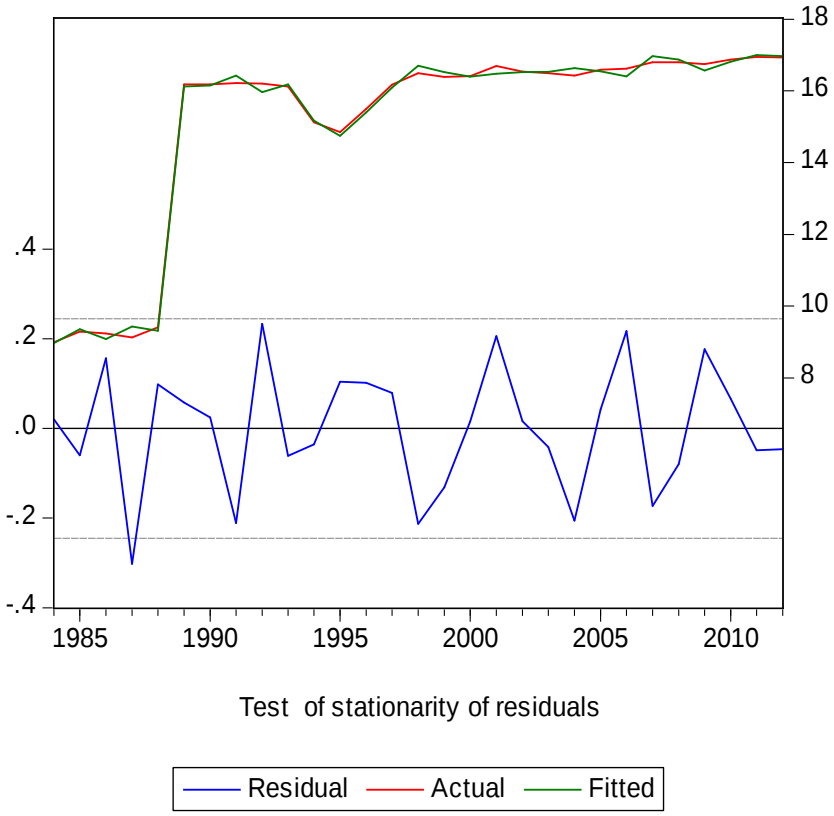
D9295	-0.148	-0.10	1.00					
Lncoffprice	-0.54	0.12	-0.19	1.00				
Lninc	-0.21	0.34	0.11	-0.12	1.00			
Lninvgdp	-0.23	-0.16	-0.28	0.57	-0.18	1.00		
Lnp	-0.14	0.14	-0.22	0.61	-0.16	0.74	1.00	
Lnreer	-0.43	0.32	-0.02	0.17	0.14	-0.27	-0.14	1.00

Source: Computation from Secondary Data, 2014

4.5.3 Time Series Properties

4.5.3.1Test of Stationarity of Residuals

As Gujarati (2005) has noticed, broadly speaking, a stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed. Stock (2007) noticed that the idea that the historical relationships can be generalized to the future is formalized by the concept of stationarity. As the figure 4.9 below shows residuals of the model are not stationary and consequently, a test for stationarity was performed using unit root test.



Source: Data Analysis in this Study, 2014

Figure 4.9: Test of Stationarity of Residuals

4.5.3.2 Unity Root Tests

Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests are used to test for stationarity of the data. Both tests were done to check the order of integration of these variables. The results obtained are presented in Table 4.8. Based on the Phillips-Perron (PP) test statistic, it was seen that all variables have a unit root (non stationary) at level and stationary after first difference (integrated of order one) however, the standard Augmented Dickey-Fuller (ADF) showed that out of six variables, five had a unit root meaning that lnreer I(1), lnp I(1), lninvgdp I(1), lncoffprice I(1), and lninc I(2), while lnexp was I(0)

variable. Noticeably, with a mixture of I (0), I (1) and I (2) variables in ADF unit root test, it would have not been possible to perform the Johansen procedure of co-integration. This should have given a good justification for using the bounds test approach, or ARDL model, which was proposed by Pesaran *et al*. (2001). However the correlogram test was carried out to check out if variables having different levels of integration in ADF behaved the same way with correlogram test. Both PP and Correlogram tests confirmed that all variables were stationary at first difference I (I) allowing to do the Johansen cointegration test.We also allowed for linear deterministic trend for variables. Table 4.8 below presents the above results.

Table 4.8: Results of Augmented Dickey- Fuller and Phillips-Perron Tests

variables	ADF	I(d)	PP	I(d)
Lnexp	-17.95 (-2.99)	I(0)	-5.14 (-2.97)	I(1)
Lncoffprice	-5.94(-2.97)	I(I)	- 5.96 (-2.97)	I(1)
Lnp	-7.95 (-2.97)	I(1)	-7.99 (-2.97)	I(1)
Lnreer	-4.98 (-2.97)	I(1)	-5.69 (-2.97)	I(1)
Lninvgdp	-7.82 (-2.97)	I(1)	-8.42 (-2.97)	I(1)
Lninc	-3.87 (-2.99)	I(2)	-4.68 (-2.97)	I(1)

Source: Computation from Secondary Data, 2014

NB: dummies were not included in unit root analysis.

4.5.3.3 Johansen Co-integration Test

To find out whether there was a long run relationship among variables Johansen co-integration test was carried out and all variables had to be at level form. Other preconditions to perform the above-mentioned test were that variables had to be non-stationary at level but when converted into first differenced they had to become stationary and integrated of the same order. Phillips –Perron test allowed running the co-integration test.

The null hypothesis in Johansen co-integration test was that there was no co-integrating equation against the alternative hypothesis (H_1) stipulating that there was at most one co-integrating equation. Both trace and maximum eigenvalue showed that there were three co-integrating equations because Max-eigen statistic of 17.26 is less than 21.13 and trace statistic of 3.31 is less than 3.84 (the critical value at 5%), with p-values greater than 0.05 (see appendix VI). Therefore, co-integration relationships reflected the long term balanced relationship between relevant variables (they moved together in the long run). Consequently, restricted VAR meaning Vector Error Correction Model was run to test for the short run relationship. If variables were not co-integrated, unrestricted VAR model would been run (Engle and Granger, 1987 in Alam, 2010).

Table 4.9 below shows the results of co-integration test.

Table 4.9: Results of Co-integration Test

		Trace test				Max-Eigen test		
Hypothesized n of CEs	**Eigen value**	**Trace Statistic**	**Critical values 5%**	**Prob ****	**Hypothesized n of CEs**	**Max-Eigen Statistic**	**Critical values 5%**	**Prob ****
r=0*	0.969	236.888	95.75	0.000	r=0*	97.376	40.078	0.000
r≤ 1*	0.896	139.511	69.819	0.000	r≤ 1*	63.391	33.877	0.000
r≤ 2*	0.781	76.120	47.856	0.000	r≤ 2*	42.490	27.584	0.000
r≤ 3*	0.461	33.629	29.797	0.017	r≤ 3	17.266	21.132	0.160
r≤ 4*	0.373	16.364	15.495	0.037	r≤ 4	13.0575	14.264	0.077

r≤ 5	0.111	3.306	3.841	0.069	r≤ 5	3.306	3.841	0.069

NB: Trace test indicated 5 cointegrating eqn(s) and Max-eigenvalue test indicated 3 cointegrating equation(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level and ** are MacKinnon-Haug-Michelis (1999) p-values. N of CEs denotes number of co-integrating equations.

4.5.3.3.1 Long -Run Elasticities in Co-integrating Equation

To run the VECM model, three steps were involved: Lag order selection, Johansen test of co-integration and VECM. The optimal number of lags to be included in the model was found to be two (see appendix X)

Table 4.10 below (see appendix VIII) presents the following results: if the price of coffee increases by one percent, in the long run, then the quantity of tea exported goes up by 10.44%. The results match with economic theory because tea and coffee are substitutes. Farris *et al.* (1987) showed that two goods are substitutes if as the price of one goes up, more of the other is purchased, ceteris paribus.

If the income of major trading partners goes up by one percent, the quantity of tea exported increases by 5.89% corresponding to the economic theory of consumption stipulating that if income goes up consumption also goes up. Given that tea is a perennial crop, the results above presented are true for the long run.

In case there is one percent increase of investment as proportion of GDP in Rwanda, the long run response is that the quantity of tea exported increases by 35.30 percent. One percent increase in tea world price leads to 56.24% decrease in quantity of tea exported.

The same increase in real exchange rate (appreciation of one percent of REER) results in 0.82 percent increase in quantity of tea exported. Although it is statistically insignificant with a t-value of 0.59 and not conclusive, this view is in disagreement with findings of De Broeck *et al.* (2001) whose study concluded that there is a clear evidence of productivity-based exchange rate movement (Balassa-Samuelson effect).

Table 4.10: Long -Run Elasticities in Co-integrating Equation

Variables	Coefficients	Standard Error	t-statistic
Ln of Quantity of Tea Exported	1.00		
Ln of Income of Major Trading Partners	5.89	0.45	13.01
Ln of Investment as Proportion of GDP	35.30	2.55	13.85
Ln of Tea World Price	-56.24	2.73	-20.56
Ln of Real Effective Exchange Rate	0.82	1.38	0.59
Ln of Coffee World Price	10.44	0.80	13.02
Constant	-231.51		

Source: Data Analysis in this Study, 2014

4.5.3.3.2 Estimation of the Equation in VECM

The short run elasticity was reported in table 4.11. The coefficients for quantity of tea exported for the one year before (quantity of tea exported lagged once) at 5% level of significance are positive and significant while the coefficients of Income of major trading partners lagged once and is only significant at 10% level of significance with an

unexpected negative sign. Coefficients of a dummy for the period 1988-1989 included after examination of both the recursive residual and Chow tests depicted instability in the regression has a positive sign and significant at 10% level of significance. The dummy can be motivated based on several events that occurred during that period because as GOR (2004) opined mid-80's several famines broke out hitting especially populations whose farms were small in regions where the soil was less fertile. As in that period cash crops markets were declining, particularly that of coffee and quinquina, economic and financial imbalances rose, obliging the Country to negotiate a Structural Adjustment Programme (SAP) with Bretton-Woods institutions. The SAPs and decline in coffee price in mid-80's might have led to a depreciation of REER and an increase in the quantity of tea exported, given that focus was made on tea instead of coffee and the depreciation of REER in producer country motivate export. The prices' effect (appreciation of real exchange rate) lagged one period was statistically insignificant and negative. This could be explained by the fact that adjustments to price response in the short run are not likely to be considerable. Were *et al.* (2002) obtained the same results and concerning coffee and tea that are perennial crops, real exchange rate lagged once had a negative effect while the second lag had a positive effect. Arguably, the latter captures the sluggish response of coffee to prices. The above argument applies in this study where a negative effect was obtained, in the short run, with a positive effect of real exchange rate, in the long run.

The improvements in the investment as a proportion of GDP (lagged once) had a negative influence on volume of tea exports, nevertheless, a two years previous investment has a positive elasticity on this being attributed to the fact that tea is a perennial crop it has a sluggish responsiveness to investment. The results partly confirm Were *et al.* (2002) study

that improvements in the investment as a proportion of GDP (both current and lagged) had a positive influence on volume of tea exports in the short run. However, the results in this study showed that the negative effect of investment as proportion of GDP was statistically insignificant in both lags. Results for the income of major trading partners lagged once although insignificant, have an unexpected negative sign, however, a two year previous period income of trading partners has a positive impact on quantity of tea exported even if it is not statistically significant in the short run. Positive and significant elasticity of quantity of tea exported was found in the long-run (table 4.10). Likewise, Were and colleagues in 2002 found the same results and mentioned that short-run changes in the Country's GDP growth might not yield a significant positive response on its imports as would in the long run. The markets for exports of a given Country might be also changing (Were *et al.*, 2002).

A two-year lagged effect of coffee price had an expected negative sign although not statistically significant, whereas a one-year elasticity of coffee price was positive but also not significant.

Coefficients for dummies of period 1992-1995 and 2001-2004 had negative signs and were insignificant. Results for other variables both lagged once and twice showed that they were not significant with a mixed results regarding the signs (expected and unexpected signs were obtained). The error term was negative but not significant because the p-value was greater than 0.05 with a relatively low speed of adjustment of about 6%–suggesting that about 6% of deviation from long-run equation was made up within one time period.

Therefore, there was no long run causality (independent variables did not have influence on the dependent variable in the long run).

To sum up, the quantity of tea exported was elastic to investment as a proportion of GDP used as a proxy for supply constraints, world price of coffee, world tea price and income of major trading partners in the long run. Tea export was inelastic to real effective exchange rate in the long run. Tea export was found to be elastic to Investment, world price of tea, world price of coffee and income of major trading partners and significant at 5% level of significance. Therefore, they should be priorities while establishing tea export strategies in the long run. In the short run, tea export was elastic to SAPs in latter 80's, decline of tea world price in 2001-2004, and all other variables either lagged once or twice were influencing tea export, exception made for coffee for which tea export was proved to be inelastic both one and two year lagged. However, only SAPs and income of major trading partners for two previous years were statistically significant at 5% level of significance.

The impact of liberation war and its aftermaths as captured by a dummy (1992-1995) on tea exports was not evident. The results indicated that this period had not profound negative effects on the quantity of tea exports with a coefficient of -0.8 and a p-value of 0.75 (statistically insignificant at 10% level of significance). Income of major trading partners' elasticity of tea export ($e_{exp/inc}$) was 5.89; showing that tea was behaving like a luxury good. As Nicholson (2003) has put, income elasticity of demand is greater than one for luxury goods.

The Error Correction Term in the table 4.11 of -0.06 and p-value of 0.38 is insignificant meaning that there is no long run relationship among all variables. To have a long run

relationship, the coefficient of the Error Term should be negative with a p-value less than 0.05 as Kennedy (2003) has put. The insignificant and negative error term with a relatively low speed of adjustment of about 6%, suggests that only about 6% of deviation from long-run equation is made up within one time period.

Table 4.11 contains information relating to the goodness of fit for the model that was used in the study. The regression equation of quantity of tea exported on different independent variables is a good model to be used in predicting because R-squared is very high and only 77% of variations in quantities of tea exported being explained by variations in variables included in the model.

Given the fact that F-statistic was greater than 0.05, it was showing that the independent variables jointly had no influence on quantity of tea exported at 5% level of significance but significant at 10% level of significance (see appendix IX).

Table 4.11: Vector Error Correction Model

Variables	Coefficients	Standard Error	t-Statistic	Probability
Constant	0.28	0.44	0.64	0.54
D(Lnexp(-1)	1.95	0.79	2.45	0.03
D(Lnexp(-2)	-0.96	0.68	-1.41	0.19

D(Lninc(-1)	-1.38	0.66	-2.10	0.06
D(Lninc(-2)	1.02	0.65	1.56	0.15
D(LninvGDP(-1)	-2.09	3.5	-0.65	0.53
D(LninvGDP(-2)	0.51	2.11	0.24	0.81
D(Lnp(-1)	-3.54	3.31	-1.07	0.31
D(Lnp(-2)	-3.75	2.16	-1.74	0.11
D(Lnreer(-1)	-1.20	3.32	-0.36	0.73
D(Lnreer(-2)	0.36	2.74	0.13	0.90
D(Lncoffprice(-1)	0.79	0.83	0.95	0.36
D(Lncoffprice(-2)	-0.88	0.76	-1.15	0.27
ECT	-0.06	0.06	-0.92	0.38
D0104	-1.07	1.25	-0.86	0.41
D8889	2.05	1.05	1.96	0.08
D9295	- 0.80	2.40	-0.33	0.74
R-squared	0.77	F-Statistic	2.26	
Adjusted R-squared	0.43	Log likelihood	-26.31	
Sum Squared Residuals	10.74	Akaike AIC	3.094	
S.E. Equation	0.99	Schwarz SC	3.90	

Note: ‘D’ at the start of the variable acronym indicates the first difference of the variable. D8889, D9295 and D0104 are dummy variable for structural changes. ECT is the Error Correction Term.

Source: Data Analysis in this Study, 2014

4.5.3.4 Wald Test Results for Short Run Causation

Appendix VII presents results on short run causation. The probability of Chi square statistic was less than 5% for joint influence of tea export lagged once and twice on current export of tea. Thus it can be jointly said that the lag 1 and lag 2 of quantity of tea exported jointly affected the export in short run. The probability of Chi square statistic was less than 10% for income of major trading partners lagged once and twice. Thus it can be jointly said that the lag 1 and lag 2 of income of major trading partners jointly affected the export of tea in short run.

4.5.3.5 Granger Causality Test of Quantity of Tea Exported on its Determinants

After testing for co-integration among six variables under study, the co-integration results showed that causality on integrated and co-integrated series—ECMs was applicable in this

study. The tables 4.12a and 4.12b below summarize the results obtained in tests of predictive content (Granger causality tests) in appendix XI.

Table 4.12a shows that the F-statistic testing the null hypothesis that coefficient on lnexpt-1 is zero in the REER equation was 5.06 and had a p-value less than 0.05 was rejected, so the quantity of tea exported was a useful predictor of changes in REER given one lag in REER. The results differ from those of Alam (2010) found that REER lagged once was not a good predictor of export. It was proved that bidirectional Granger causality existed between the quantity of tea exported and dummy for the period 1988-1989. SAPs and decline in the price of coffee in 80's as substituted by the dummy contained information that was useful for forecasting changes in the quantity of tea exported and vice versa.

The Granger predictability tests of one year lag are presented in tables 4.12a below.

Table 4.12a: Granger Predictability Test Results for Variables Lagged Once

Variable A	Variable B	F- statistic	probability	Decision on the null hypothesis. Yes if Ho is true and no otherwise
Lninc	lnexp	0.23	0.64	yes
Lnexp	lninc	2.89	0.10	yes
lninvgdp	lnexp	0.15	0.70	yes
Lnexp	lninvgdp	1.03	0.32	yes
lncoffprice	lnexp	0.41	0.53	yes
Lnexp	lncoffprice	0.00	0.95	yes
Lnp	lnexp	0.60	0.44	yes
Lnexp	lnp	0.04	0.84	yes
lnreer	lnexp	0.00	0.98	yes
Lnexp	lnreer	(5.06)**	0.03	no
D0104	lnexp	0.00	0.94	yes
Lnexp	D0104	0.28	0.60	yes
Lnexp	D8889	(6.77)***	0.01	no
D8889	lnexp	(21.35)***	0.00	no
Lnexp	D9295	0.34	0.56	yes
D9295	lnexp	2.23	0.15	yes

*Note: * significance at 0.1level, ** significance at 0.05level, *** significance at 0.01leve,*
Source: Analysis from Secondary Data in this Study, 2014

The null hypothesis (Ho) is that variable A does not Granger cause variable B

The table 4.12b below shows that both REER and quantity of tea exported F-statistic was 2.98 with p-value less than 0.1 so the quantity of tea exported was granger causing real exchange rate at 10% level. This contradicts with findings of study carried out by Alam (2010) that RER did not Granger cause export both in the short and long run. This does not necessarily mean that a change in quantity of tea exported of the two previous years will cause a change in the real exchange rate rather it means that the past values of quantity of tea exported appear to contain information that is useful for forecasting changes in real exchange rate, beyond that contained in the past values of the REER (Stock *et al.*, 2007). It was proved that bidirectional Granger causality existed between the quantity of tea exported and dummy for the period 1988-1989. SAPs and decline in the price of coffee in 80's as substituted by the dummy contained information that was useful for forecasting changes in the quantity of tea exported and vice versa.

The Granger predictability tests of two years lag are presented in tables 4.12b below.

Table 4.12b: Granger Causality Results for Variable Lagged Twice

Variable A	Variable B	F- statistics	probability	Decision on the null hypothesis. Yes if Ho is true and no otherwise
Lninc	lnexp	0.39	0.68	Yes
Lnexp	lninc	1.97	0.16	Yes
lninvgdp	lnexp	0.04	0.96	Yes
Lnexp	lninvgdp	0.17	0.84	Yes
lncoffprice	lnexp	0.28	0.76	Yes
Lnexp	lncoffprice	0.84	0.45	Yes
Lnp	lnexp	0.29	0.75	Yes
Lnexp	lnp	1.97	0.16	Yes
Lnreer	lnexp	0.06	0.94	Yes
Lnexp	lnreer	(2.98)*	0.07	No
D0104	lnexp	0.00	0.99	Yes

Lnexp	D0104	0.19	0.83	Yes
Lnexp	D8889	(6.82)***	0.00	No
D8889	lnexp	(72.70)***	0.00	No
Lnexp	D9295	0.19	0.82	Yes
D9295	lnexp	0.16	0.86	Yes

*Note: * significance at 0.1level, ** significance at 0.05level, *** significance at 0.01leve,*
Source: Analysis of Secondary Data in this Study, 2014

The null hypothesis (Ho) is that variable A does not Granger cause variable B and F-test was applied

The granger causality tests in both lagged once and twice variables proved that independence was suggested between the sets of quantity of tea exported and other independent variables meaning that coefficients were not statistically significant in both regressions.

4.5.3.6 Estimation of the Model

R-squared was 0.77>0.50, Prob (F-statistic) of 0.087< 0.1 meaning that 77% of variations in the quantity of tea exported were explained by variations in independent variables included in the model however the latter jointly could influence the dependent variable (quantity of tea exported) at 10% level of significance. R-square of 77% allowed concluding that the model was good (see appendix IX).

4.5.3.7 Diagnostic Tests of the Model

The results of diagnostic tests produced by e-views are shown in Appendices XII. This appendix presents three tests, that is, Autoregressive Conditional Heteroskedasticity (ARCH), Breusch-Godfrey Serial Correlation LM and Jarque-Bera test of normality and from which Table 4.13 on residuals diagnostic tests was derived.

Table 4.13 Residuals Diagnostic Tests

Test	Khi-squared	Probability	Jarque-Bera	Decision
ARCH test	3.44	0.06	-	No heteroscedasticity
BGP test	0.78	0.01	-	No serial correlation
Jarque-Bera test	-	0.90	0.22	Residuals in the series are normally distributed

NB: ARCH test: Autoregressive Conditional Heteroskedasticity
BG test: Breusch-Godfrey Serial Correlation LM
Jarque-Bera test: Jarque-Bera test of normality

Source: Analysis from Secondary Data in this Study, 2014

To test if the two or more consecutive errors in the data were related, the LM test has been carried out. The results showed that $\chi 2$ statistic is equal to 0.78 with $p= 0.012 > 0.01$. The null hypothesis (H_O): $\rho = \rho 2 = \ldots = \rho p = 0$; was not rejected, therefore, the conclusion was that there was serial correlation in the data.

According to Autoregressive Conditional Heteroscedastiticity test a $\chi 2$ statistic of 3.44 with $p=0.06$ it was found out that there is no problem of heteroskedasticity in the data. All diagnostic tests permitted to conclude that the model was good in forecasting.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This chapter begins with the summary of findings on empirical tests of the validity of the tea export influenced by price of tea, price of coffee, rainfall, real exchange rate, and investment as proportion to GDP and income of major trading partners' hypotheses. It proceeds to the conclusion on the study and finally provides recommendations of policies

and strategies to be undertaken to improve tea export in Rwanda, including the nature of further research to bridge knowledge gaps in tea export in Rwanda.

5.2 Summary of Findings

This study aimed to analyze tea export in Rwanda from 1982 up to 2012. Secondary data were obtained from NAEB office, WITS, FAOSTAT and World Bank database. Four time series techniques were used: Both Recursive Residuals and Chow tests, unit root tests (ADF, PP and correlogram tests), a co-integration test (Johansen's procedure), and Granger-causality tests (F-Statistic tests).

Structural changes were found to have occurred due to either positive or negative externalities namely the Structural Adjustment Programs (SAPs) of the Bretton-Wood institutions, the Gulf war, and liberation war and its aftermaths during the period that started in 1990 and ended in 1998. Both long run and short run relationship were evidenced by successive tests where PP and correlogram tests indicated that all were integrated of order one, a co-integration test (Johansen's procedure) with both Trace and Maximum - Eigen tests confirmed that at least three equations were co-integrated. Results on co-integration allowed conducting Error Correction Model test and The ECT was negative but with a p-value of 0.38 greater than 0.05 meaning that there was no long run relationship among all variables included in the model. Investment elasticity of tea export and income elasticity of tea export were confirmed to be priorities while establishing tea export strategies in the long run. In the short run, tea export was elastic to SAPs in latter 80's, decline of tea world price in 2001-2004, and all other variables either lagged once or twice

were influencing tea export, exception made for coffee for which tea export was proved to be inelastic both one and two year lagged.

The impact of liberation war and its aftermaths as captured by a dummy (1992-1995) on tea exports was not evident. The results indicated that this period had no profound negative effects on the quantity of tea exports with a coefficient of -0.8 and a p-value of 0.75 (statistically insignificant at 10% level of significance. Income of major trading partners' elasticity of tea export ($e_{exp/inc}$) was 5.89. Finally, predictive content tests were performed estimating bidirectional causation between tea export and its determinants. Unidirectional causation was flowing from the quantity of tea exported to the real effective exchange rate. Bidirectional causation was proved to exist between the quantity of tea exported and the dummy for 1988-1989 periods in both one and two -year periods of time (lags).

5.3 Conclusions

Given that agriculture sector is the stronghold of the economy of Rwanda, boosting both tea production and export may have positive effects on her economic growth and development.

The findings of this study confirm a presence of structural changes between quantities of tea exported and its determinants due to both SAPs along with a decline in world coffee price in latter 80's.

The study provides new findings; that in the long term, investment as a proportion of GDP used as a proxy for supply constraints, world price of coffee, world tea price and income of major trading partners significantly influence tea export. In the short run, SAPs, the decline in world price of coffee in latter 80's and one year previous income of major trading partners influenced tea export.

The result of non causality in the long term among all variables may be possible because prior to later 80s it was pre-SAPs economy period thus export was totally controlled one. Short run causality is possible because after 80s, in short period a decline in world tea price may lead to increase in export in the sense that the demand increases.

The quantity of tea exported predicts the real effective exchange rate more than the latter can do. Additionally, a bi-directional predictive content exist between the quantity of tea exported and SAPs in latter 80's implying that implementation of the economic policy may help in prediction of tea export.

5.4 Recommendations

This study has examined factors likely to have influenced tea export volumes for the period of 1982-2012. The list of factors that influence tea export is long and varied. Various macro and micro level issues on tea production, consumption and exportation has to be addressed. Several researches may be done on both micro and macroeconomic policies such exchange rate policy, trade policy, tariff policy, taxation policy, fiscal expenditure policy and monetary policy, Interest rate policy and findings help to solve problems related to price volatility of tea.

5.4.1 Policies and Strategies to Improve Tea Export

Given the fact that tea was behaving like a luxury good, there is a need for the Government to help in improving investments in tea factories, both in terms of expanding factory capacity to process green leaf, but also in terms of processing other tea products to ensure product diversification and value addition to tea leaves because the value of the commodities produced is constrained in part by the characteristics of domestic demand-levels and growth rates of populations and incomes, changes in tastes and preferences, and farmers' willingness to substitute various agricultural commodities with tea.

Government and citizens' contribution in implementing measures that can maintain and promote political stability should be strengthened in order to avoid disturbances in tea production, processing and export. This is also the backbone of sustainable investment for both local and external investors consider risks involved in investing their capital.

The three most common objectives that are efficiency (the allocation of resources to effect maximal national output), income distribution (the allocation of the benefits of agricultural production to preferred groups or regions), and food security (the short-run stability of food prices at levels affordable to consumers, reflecting the adequacy of food supplies, and the long-run guarantee of adequate human nutrition) should be considered by the policy makers whilst establishing macroeconomic policies such as prices, quotas and others.

Public investments should continue or even be increased in agricultural sector to boost productivity and reduce costs to combat competition. Investments should be oriented in agricultural research to develop new technologies, in infrastructure (roads, irrigation, ports,

marketing facilities), in specific agricultural projects to increase productive capacity and demonstrate new technologies, and in education and training of agriculturists to upgrade the human capital in the sector.

Mitigating price risks and uncertainties induced by price volatility, requires all stakeholders to prioritise ease forward selling or contracting and widening niche markets for tea products.

5.5 Suggestions for Further Research

Some of the limitations associated with this study include the nature of the data and the sample size used. In the variables used as determinants of tea export, labor and production were not included in the model. Thus, the effect of tea export determinants should be empirically re-examined including those factors.

Rwanda is currently committed to crop intensification and trade liberalization by developing agricultural and commercial policies that facilitate boosting production and movement of goods and services. As this continues to take place and as more data become available, further studies in tea export will help boosting tea export and consequently its economic growth.

REFERENCES

Alam, R. (2010). The Link between Real Exchange Rate and Export Earning: A Cointegration and Granger Causality Analysis on Bangladesh. International Review of Business Research Papers Vol.6, No.1 February 2010, Pp.205-214

Alemayehu, G., *et al*. (2012) "Applied Time Series Econometrics: A Practical Guide for Macroeconomic Researchers with a Focus on Africa", University of Nairobi Press

Alinda, F. and Abbot, P. (2012). "Agricultural Policy and Institutional framework for Transformation of Agriculture, Economic Development and Poverty Reduction in Rwanda" Kigali, Rwanda, pp xiii – xiv

Baumol, W.J. and Blinder, A.S. (2001). "Macroeconomics principles and Policy", Harcourt College Publishers, pp 400-403

Bo, S. and Geoffrey, R. (1994). "International economics", Macmillan press ltd, USA, pp xxxvii -90

Branson, W. H. (2001). "Macroeconomic Theory and Policy", second edition

Climate.com (2004), "Climate Information for Rwanda-Climate Zone (online) available on www.climate-zone.com

Cramer, G and Clarence, N. J. (1994). "Agricultural Economics and Agribusiness", USA, sixth edition, pp 438

De Broeck, M. and Slϕk, T. (2001). "Interpreting Real Exchange Rate Movements in Transition Countries", Helsinki, BOFIT discussion papers, No 7, pp 21

Faridi, M. Z. (2012). Contribution of Agricultural Exports to Economic Growth in Pakistan, Pak. J. Commer. Soc. Sci. Vol. 6 (1), 1334

Farris, M. and Happel, S. (1987). "Modern Managerial Economics", Scott, Foresman and Company, USA, pp 101

Ferris, J. N. (2005). "Agricultural and commodity analysis", 2nd edition, Michigan State University press, USA, pp 8-50

Global tender (2014). "Rwanda economy business opportunities in Rwanda government" available on www.globaltenders.com/economy-rwanda.htm

Government of Rwanda (2010). "National Agricultural Policy", Kigali, Rwanda, pp18

Government of Rwanda (2011). " Rwanda National Export Strategy (NES)", Kigali, Rwanda, pp8 – 31

Griffiths, A. and Wall, S.(2012). “Applied Economics”, twelfth edition, Ashford Colour Press, Great Breatain, Hampshare, 527-529

Gujarati, D. (1999). “Essentials of econometrics”, 2nd edition, Mc Graw Hill, USA, pp248-305

Gwartney, J. D. and Richard, L. S. (1995). “Economics, Private and public choice”, seventh edition, The Dryden press, Harcourt Brace College Publishers, USA, Orlando, pp 866-868

Hansen, B. (2001). “The new econometrics of structural change: Dating breaks in U.S. labor productivity”, Vol 15, No 4, pp 123-127

Kennedy, P. (2003). “A Guide to Econometrics”, fifth edition, MPG Books, United Kingdom, Cornwall, pp 323-366

Kimbugwe, D. B., Banerjee, S. and Gyawali, B.R. (2010). “Testing the Export-Base Theory in Alabama: An Ongoing Case Study”, Orlando, USA, pp 7-8

Kıpıcı, N. and Kesriyeli, M. (1997). “The Real Exchange Rate definitions and calculations”, Ankara, Turkey, No: 97/1, p2

Kipng’Etich, L. N. (2007). “Impact of maintenance of tea processing machines on quality of black tea: A case study of Unilever Tea Kenya limited”, M. Phil. Thesis. Moi University, 2007, pp 38

Kombo, D. K., Delno, L. A. and Tromp (2006). “Proposal and thesis writing”, Paulines Publicaions, Africa, Nairobi, Kenya, pp48-61

Kónya, L. (2002). “Exports and Growth: Granger-Causality Analysis on OECD Countries with a Panel Data Test and Bootstrap Critical Values.” School of Applied Economics, Victoria University (online) available on http://members.optusnet.com.au/lkonya/Paper02.pdf#search='Exports%20and %20Growth%3A%20GrangerCausality%20Analysis%20on%20OECD%20Countries

Kothari, C.R. (2004). “Research methodology-Methods and Techniques”, Second revised edition.

Markusen, R. J., Melvin, R. J., William, H. K. and Keith, E. M. (1995). “International trade, theory and evidence”, McGraw-Hill, USA,pp4-120

Mehta, Hitesh, Katee, Christine (2005). “Virunga Massif Sustainable Tourism Development Plan” available on http://en.wikipedia.org/wiki/Geography_of_Rwanda

Mudida, R. (2009). “Modern Economics”, second edition, Focus Publishers ltd, Nairobi, Kenya,pp 254

Mujahid, H. (2012). “Export Trend in Global Tea Trade: A Cross Countries Analysis With Reference To Sri Lankan and Indian Tea Industry”, UMT 11th International Annual Symposium on Sustainability Science and Management 09th – 11th July 2012, Terengganu, Malaysia

Mupenzi, J. P., Ge, J., Habiyaremye, G., Nadege, T. L. and Nzayisenga, T. (2011). “Tea land Degradation in Rwanda: Case study of Gicumbi District”, IPCBEE vol.1 (2011), IACSIT Press, Singapore, p 60

NAEB (1998). “ Annual Report 2012 ”, Kigali, Rwanda

NAEB (2012). “ Statistics Report 2012 of Coffee, Tea and Horticulture”, Kigali, Rwanda, p17

NAEB (2012). “Rwanda Tea Sector Presentation”. Available on http://www.jetro.go.jp/ext_images/world/africa/seminar_reports/pdf/20121129_Rwanda.pdf

Ndayitwayeko, W. (2014). “Analysis of Trade Flows of Burundi’s Food Products”(Unpublished MPhil thesis), Moi University, Eldoret, Kenya, pp 100

Nicholson, W. (2003). “Microeconomic Theory, Basic Principles and Extensions”, Thomson Learning Academic Resource Centre, USA, eith edition, pp 176-179

Nuwangira, S. (2013). “Rwanda’s Tea Export Receipts Decline”, New Times, on June 18, 2013 available on http://in2eastafrica.net/rwanda-tea-export-receipts-decline/

Parkin, M. (1993). Study Guide. Macroeconomics, second edition, pp 68

Rajendran S. (2013). News from African Countries, IAFCCI/SR/INF-MEC/AUGUST/ on http://www.indoafrican.org/new/images/userfiles/circulars%202013/Africa%20Circular%20August%201-15%202013.pdf

Sevcan, G. and Hacer, S. KARAALP (2012). “Exports and economic growth: A sectoral analysis for Turkey” international journal of economics and finance studies Vol 4, No 2, 2012 ISSN: 1309-8055 (Online) available http://www.sobiad.org/eJOURNALS/journal_IJEF/archieves/2012_no_2_new/sevcan_gunes.pdf. 2002

Seyoum, B. (2009). “Export-Import Theory”, Practices, and Procedures, Routledge 270 Madison Ave, New York, NY 10016,pp 69

Sinoha, R. L. (2006). “Export-led growth in southern Africa”, MSc thesis, Louisiana State University and Agricultural and Mechanical College, Louisiana State, USA, pp 1-74

Stock, H. J. and Waston, W. M. (2007). “Introduction to Econometrics”, Second edition, Pearson International Edition, Boston, pp 469-610

Taylor, T. (2008). Principles of Economics, Economics and the Economy. Second edition, Freeload Press,USA,

Thompkins and Gwen (2009). In Kenya, Tea Auction Steeped In Tradition, Gentility: NPR. npr.org. Retrieved 18 September 2009.online available

Times Higher Education Supplement. (2002). Oxford Dictionary of Economics, pp 136-165

Tyler, G. (2013). An African Success Story – the development of a Competitive Tea Export Industry, CCAA Paper pp 2(online) available on http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1215457178567/Ch5_Tea.pdf

Walstad, W.B. and Bingham, R.C. (2005). Study Guide to Accompany Economics, pp468-483

Were, M., Alemayehu, G. and Karingi, N. S. (2012). Analysis of Kenya’s Export Performance: An Empirical Evaluation, KIPPRA Discussion Paper No. 22 November 2002 (online) available on http://www.kippra.org

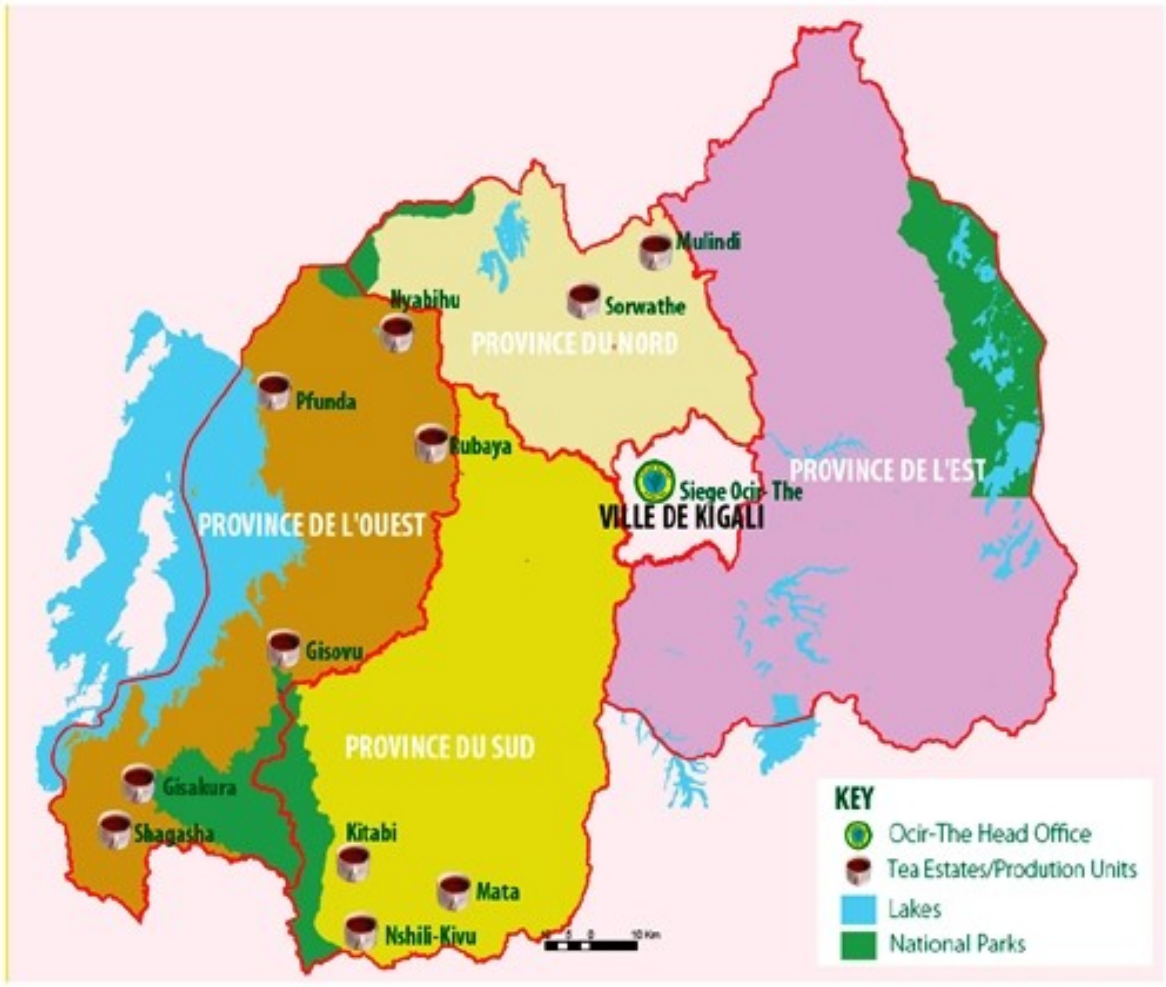
World Bank (2011). “Rwanda *economic update-Spring” edition* Kigali, Rwanda.

World Resources Institute (WRI) (2006). "Agriculture and Food: Country profile – Rwanda". EarthTrends: The Environmental Information Portal” available http://earthtrends.wri.org/text/agriculture-food/country-profile-153.html. Retrieved 2012-02-16

Yelwa, M. and Diyoke, K. O. (2013). “An empirical investigation of export-led growth amongst some selected ECOWAS countries: an alternative to FDI?” European Journal of Management Sciences and Economics, 1(1), pp 33

APPENDICES

Appendix I: Maps of Study Area



Map of Rwanda Showing **Tea Factories Location**

Source: http://world.silk.co/page/Rwanda, 2014

Appendix II: Real Effective Exchange Rate (1982-2012)

Real Exchange Rate	Count	Percent	Cumulative Count	Cumulative Percent
85.98343	1	3.23	1	3.23
90.47787	1	3.23	2	6.45
93.12950	1	3.23	3	9.68
98.94968	1	3.23	4	12.90
100.0000	1	3.23	5	16.13
103.6891	1	3.23	6	19.35
106.4088	1	3.23	7	22.58
106.6618	1	3.23	8	25.81
108.3219	1	3.23	9	29.03
110.5279	1	3.23	10	32.26
113.0552	1	3.23	11	35.48
115.8426	1	3.23	12	38.71
116.3014	1	3.23	13	41.94
116.5409	1	3.23	14	45.16
118.3946	1	3.23	15	48.39
119.6075	1	3.23	16	51.61
126.7000	1	3.23	17	54.84
128.6400	1	3.23	18	58.06
136.8589	1	3.23	19	61.29

Appendix II: Tabulation of Real Effective Exchange Rate in Rwandan currency (1982-2012)

Real Exchange Rate	Count	Percent	Cumulative Count	Cumulative Percent
138.8052	1	3.23	20	64.52
138.8467	1	3.23	21	67.74
146.7936	1	3.23	22	70.97
147.9520	1	3.23	23	74.19
155.9369	1	3.23	24	77.42
156.3002	1	3.23	25	80.65
156.4555	1	3.23	26	83.87
156.5053	1	3.23	27	87.10
158.9589	1	3.23	28	90.32
162.7087	1	3.23	29	93.55
164.9976	1	3.23	30	96.77
165.7122	1	3.23	31	100.00
Total	31	100.00	31	100.00

Source: Computation from the Secondary Data, 2014

Appendix III: Chow Tests

Chow Breakpoint Test: 1989
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 1982 2012

F-statistic	224.6676	Prob. F(6,19)	0.0000
Log likelihood ratio	132.5541	Prob. Chi-Square(6)	0.0000
Wald Statistic	1348.006	Prob. Chi-Square(6)	0.0000

Chow Breakpoint Test: 1994
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 1982 2012

F-statistic	73.03376	Prob. F(6,19)	0.0000
Log likelihood ratio	98.60132	Prob. Chi-Square(6)	0.0000
Wald Statistic	438.2026	Prob. Chi-Square(6)	0.0000

Chow Breakpoint Test: 1998
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 1982 2012

F-statistic	3.777934	Prob. F(6,19)	0.0120
Log likelihood ratio	24.34383	Prob. Chi-Square(6)	0.0005
Wald Statistic	22.66760	Prob. Chi-Square(6)	0.0009

Chow Breakpoint Test: 1999
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 1982 2012

F-statistic	2.441650	Prob. F(6,19)	0.0640
Log likelihood ratio	17.71870	Prob. Chi-Square(6)	0.0070
Wald Statistic	14.64990	Prob. Chi-Square(6)	0.0232

Chow Breakpoint Test: 2000
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables

Equation Sample: 1982 2012

F-statistic	1.960147	Prob. F(6,19)	0.1226
Log likelihood ratio	14.93595	Prob. Chi-Square(6)	0.0208
Wald Statistic	11.76088	Prob. Chi-Square(6)	0.0675

Appendix IV: Unit Root Tests

Null Hypothesis: LNEXP has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.861851	0.3449
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNEXP) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.143829	0.0002
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNEXP has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.95548	0.0001
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNP has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.259557	0.6348
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNP) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.991412	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.576850	0.8610
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNREER has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.880883	0.3363
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNREER) has a unit root
Exogenous: Constant
Bandwidth: 15 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.694464	0.0001
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNREER has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.938507	0.3111
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNREER) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.984175	0.0004
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNINVGDP has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.723697	0.4096
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNINVGDP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.417467	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNINVGDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.819664	0.3642
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNINVGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.826356	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNINC has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.048279	0.2659
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNINC) has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.681927	0.0008
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNINC has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.404899	0.5628
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNINC) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.689091	0.0899
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNINC,2) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.874789	0.0071
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNCOFFPRICE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.132285	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Appendix V: Test of Unit Root Using Correlogram in the Dependent Variable

(i) Correlogram of the Dependent Variable at Level

Sample: 1982 2012
Included observations: 31

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |****** |	. |****** |	1	0.849	0.849	24.592	0.000
. |***** \	. *| . \	2	0.690	-0.112	41.385	0.000
. |**** \	. *| . \	3	0.537	-0.070	51.927	0.000
. |*** \	. | . \	4	0.396	-0.060	57.855	0.000
. |**. \	. *| . \	5	0.248	-0.125	60.275	0.000
. |* . \	. | . \	6	0.119	-0.048	60.851	0.000
. | . \	. *| . \	7	0.004	-0.068	60.852	0.000
. | . \	. |**. \	8	0.011	0.337	60.857	0.000
. | . \	. *| . \	9	0.002	-0.130	60.857	0.000
. | . \	. | . \	10	-0.014	-0.056	60.866	0.000
. | . \	. | . \	11	-0.028	-0.029	60.907	0.000
. | . \	. *| . \	12	-0.046	-0.096	61.019	0.000
. *| . \	. *| . \	13	-0.088	-0.109	61.460	0.000
. *| . \	. | . \	14	-0.133	-0.064	62.524	0.000
. *| . \	. |* . \	15	-0.165	0.170	64.260	0.000
. *| . \	. *| . \	16	-0.179	-0.066	66.452	0.000

(i) Corelogram of First Difference

Date: 05/14/14 Time: 12:14
Sample: 1982 2012
Included observations: 30

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.009	0.009	0.0027	0.959
. *| . |	. *| . |	2	-0.075	-0.075	0.1956	0.907
. *| . |	. *| . |	3	-0.074	-0.073	0.3926	0.942
. | . |	. | . |	4	-0.022	-0.026	0.4097	0.982
. *| . |	. *| . |	5	-0.182	-0.195	1.6758	0.892
. *| . |	. *| . |	6	-0.096	-0.111	2.0459	0.915
. |* . |	. | . |	7	0.077	0.042	2.2957	0.942
. |* . |	. | . |	8	0.093	0.048	2.6732	0.953
. | . |	. | . |	9	0.034	0.020	2.7248	0.974
. | . |	. | . |	10	-0.032	-0.052	2.7744	0.986
. | . |	. | . |	11	-0.019	-0.041	2.7922	0.993
. | . |	. | . |	12	0.018	0.033	2.8098	0.997
. | . |	. | . |	13	-0.048	-0.019	2.9401	0.998
. | . |	. | . |	14	-0.033	-0.018	3.0067	0.999
. | . |	. | . |	15	-0.031	-0.057	3.0701	1.000
. | . |	. | . |	16	0.003	-0.036	3.0705	1.000

Appendix (VI) Co-integration Test

Date: 06/05/14 Time: 22:46
Sample (adjusted): 1985 2012
Included observations: 28 after adjustments
Trend assumption: Linear deterministic trend
Series: LNEXP LNINC LNINVGDP LNP LNREER LNCOFFPRICE
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 *	0.969123	236.8876	95.75366	0.0000
At most 1 *	0.896064	139.5110	69.81889	0.0000
At most 2 *	0.780742	76.11963	47.85613	0.0000
At most 3 *	0.460241	33.62945	29.79707	0.0172

At most 4 *	0.372706	16.36376	15.49471	0.0369
At most 5	0.111375	3.306225	3.841466	0.0690

Trace test indicates 5 cointegrating eqn(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 *	0.969123	97.37655	40.07757	0.0000
At most 1 *	0.896064	63.39138	33.87687	0.0000
At most 2 *	0.780742	42.49019	27.58434	0.0003
At most 3	0.460241	17.26569	21.13162	0.1598
At most 4	0.372706	13.05753	14.26460	0.0769
At most 5	0.111375	3.306225	3.841466	0.0690

Max-eigenvalue test indicates 3 cointegrating eqn(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):

LNEXP	LNINC	LNINVGDP	LNP	LNREER	LNCOFFPRICE
-0.045057	-0.614630	-8.877021	15.17403	3.128379	-3.665119
-0.272752	0.196877	-16.82240	8.767671	-10.43059	5.419827
0.478548	0.711884	-15.73691	16.01131	11.87607	-2.556053
-0.188368	0.002536	1.735174	3.603898	4.104259	-0.686093
0.007896	0.373153	3.289874	5.728113	0.479397	-2.931052
0.653522	-0.127935	2.756041	3.958340	11.63392	-0.815683

Unrestricted Adjustment Coefficients (alpha):

D(LNEXP)	0.465697	0.255012	-0.035528	0.351844	-0.311932	-0.126033
D(LNINC)	0.876212	0.232857	-0.213881	0.398638	-0.435632	-0.148287
D(LNINVGDP)	-0.047482	-0.011683	-0.011396	-0.047036	0.002891	-0.010959
D(LNP)	-0.042685	-0.049826	-0.063632	0.020113	0.007104	-0.013381
D(LNREER)	0.001168	0.048298	-0.031978	0.013551	0.003827	0.003365
D(LNCOFFPRICE)	0.076470	-9.59E-05	-0.058341	-0.029708	0.132029	-0.050376

1 Cointegrating Equation(s): Log likelihood 89.75202

Normalized cointegrating coefficients (standard error in parentheses)

LNEXP	LNINC	LNINVGDP	LNP	LNREER	LNCOFFPRICE
1.000000	13.64110	197.0165	-336.7723	-69.43123	81.34364
	(1.06296)	(26.5635)	(25.2614)	(11.1252)	(7.30747)

Adjustment coefficients (standard error in parentheses)

D(LNEXP)	-0.020983
	(0.01045)
D(LNINC)	-0.039480
	(0.01317)

D(LNINVGDP)	0.002139
	(0.00096)
D(LNP)	0.001923
	(0.00124)
D(LNREER)	-5.26E-05
	(0.00080)
D(LNCOFFPRICE)	-0.003446
	(0.00332)

2 Cointegrating Equation(s): Log likelihood 121.4477

Normalized cointegrating coefficients (standard error in parentheses)

LNEXP	LNINC	LNINVGDP	LNP	LNREER	LNCOFFPRICE
1.000000	0.000000	68.47804	-47.45436	32.83080	-14.78427
		(7.66032)	(7.58801)	(3.34497)	(2.17173)
0.000000	1.000000	9.422887	-21.20929	-7.496613	7.046934
		(1.84226)	(1.82487)	(0.80444)	(0.52229)

Adjustment coefficients (standard error in parentheses)

D(LNEXP)	-0.090538	-0.236025
	(0.06132)	(0.14315)
D(LNINC)	-0.102992	-0.492702
	(0.07893)	(0.18427)
D(LNINVGDP)	0.005326	0.026884
	(0.00580)	(0.01354)
D(LNP)	0.015514	0.016426
	(0.00667)	(0.01558)
D(LNREER)	-0.013226	0.008791
	(0.00340)	(0.00794)
D(LNCOFFPRICE)	-0.003419	-0.047020
	(0.02037)	(0.04756)

3 Cointegrating Equation(s): Log likelihood 142.6928

Normalized cointegrating coefficients (standard error in parentheses)

LNEXP	LNINC	LNINVGDP	LNP	LNREER	LNCOFFPRICE
1.000000	0.000000	0.000000	19.29249	34.69319	-15.40149
			(3.15790)	(2.43961)	(1.56698)
0.000000	1.000000	0.000000	-12.02462	-7.240340	6.962003
			(1.07486)	(0.83037)	(0.53335)
0.000000	0.000000	1.000000	-0.974719	-0.027197	0.009013
			(0.05136)	(0.03968)	(0.02549)

Adjustment coefficients (standard error in parentheses)

D(LNEXP)	-0.107540	-0.261317	-7.864817
	(0.12247)	(0.21293)	(5.47055)
D(LNINC)	-0.205344	-0.644960	-8.329548
	(0.15460)	(0.26879)	(6.90570)
D(LNINVGDP)	-0.000127	0.018771	0.797375
	(0.01147)	(0.01994)	(0.51242)
D(LNP)	-0.014937	-0.028873	2.218484
	(0.00946)	(0.01645)	(0.42273)
D(LNREER)	-0.028529	-0.013974	-0.319609

	(0.00489)	(0.00851)	(0.21860)		
D(LNCOFFPRICE)	-0.031339	-0.088552	0.240896		
	(0.03980)	(0.06920)	(1.77795)		

4 Cointegrating Equation(s): Log likelihood 151.3257

Normalized cointegrating coefficients (standard error in parentheses)

LNEXP	LNINC	LNINVGDP	LNP	LNREER	LNCOFFPRICE
1.000000	0.000000	0.000000	0.000000	11.64307	-7.605641
				(4.91694)	(2.61071)
0.000000	1.000000	0.000000	0.000000	7.126336	2.103010
				(3.06933)	(1.62971)
0.000000	0.000000	1.000000	0.000000	1.137370	-0.384858
				(0.24596)	(0.13060)
0.000000	0.000000	0.000000	1.000000	1.194772	-0.404087
				(0.25196)	(0.13378)

Adjustment coefficients (standard error in parentheses)

D(LNEXP)	-0.173816	-0.260425	-7.254306	10.00152	
	(0.11716)	(0.19281)	(4.96580)	(4.81772)	
D(LNINC)	-0.280435	-0.643950	-7.637840	13.34943	
	(0.15102)	(0.24853)	(6.40097)	(6.21009)	
D(LNINVGDP)	0.008733	0.018652	0.715760	-1.174904	
	(0.00964)	(0.01587)	(0.40876)	(0.39657)	
D(LNP)	-0.018726	-0.028822	2.253384	-2.030909	
	(0.00949)	(0.01562)	(0.40236)	(0.39036)	
D(LNREER)	-0.031082	-0.013939	-0.296095	-0.022001	
	(0.00472)	(0.00776)	(0.19997)	(0.19401)	
D(LNCOFFPRICE)	-0.025743	-0.088628	0.189347	0.118337	
	(0.04179)	(0.06878)	(1.77147)	(1.71865)	

5 Cointegrating Equation(s): Log likelihood 157.8544

Normalized cointegrating coefficients (standard error in parentheses)

LNEXP	LNINC	LNINVGDP	LNP	LNREER	LNCOFFPRICE
1.000000	0.000000	0.000000	0.000000	0.000000	-7.673518
					(3.89653)
0.000000	1.000000	0.000000	0.000000	0.000000	2.061465
					(0.92721)
0.000000	0.000000	1.000000	0.000000	0.000000	-0.391489
					(0.11607)
0.000000	0.000000	0.000000	1.000000	0.000000	-0.411052
					(0.12166)
0.000000	0.000000	0.000000	0.000000	1.000000	0.005830
					(0.15829)

Adjustment coefficients (standard error in parentheses)

D(LNEXP)	-0.176279	-0.376824	-8.280525	8.214733	-0.330473
	(0.10658)	(0.18814)	(4.55665)	(4.50521)	(3.03605)
D(LNINC)	-0.283874	-0.806507	-9.071014	10.85408	-0.800497
	(0.13487)	(0.23808)	(5.76608)	(5.70098)	(3.84188)
D(LNINVGDP)	0.008755	0.019731	0.725272	-1.158342	-0.353677
	(0.00963)	(0.01701)	(0.41191)	(0.40726)	(0.27445)
D(LNP)	-0.018670	-0.026171	2.276754	-1.990218	-0.283556

	(0.00943)	(0.01664)	(0.40312)	(0.39857)	(0.26859)
D(LNREER)	-0.031051	-0.012511	-0.283506	-8.17E-05	-0.822444
	(0.00468)	(0.00826)	(0.20011)	(0.19785)	(0.13333)
D(LNCOFFPRICE)	-0.024700	-0.039361	0.623705	0.874613	-0.511274
	(0.03637)	(0.06420)	(1.55484)	(1.53728)	(1.03597)

Appendix VII: Wald Test for Short Run Causality

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	3.202771	(2, 11)	0.0801
Chi-square	6.405542	2	0.0406

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	1.947906	0.795050
C(3)	-0.956116	0.677210

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.870286	(2, 11)	0.0993
Chi-square	5.740571	2	0.0567

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	-1.378828	0.656807
C(5)	1.016718	0.650329

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.407118	(2, 11)	0.6752
Chi-square	0.814236	2	0.6656

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	-2.293134	3.504556
C(7)	0.512607	2.108237

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.531052	(2, 11)	0.2590
Chi-square	3.062104	2	0.2163

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	-3.541038	3.309143
C(9)	-3.747488	2.157434

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.071516	(2, 11)	0.9314
Chi-square	0.143033	2	0.9310

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(10)	-1.196476	3.323434
C(11)	0.361596	2.744495

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.011043	(2, 11)	0.1802
Chi-square	4.022086	2	0.1338

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(12)	0.792639	0.834138
C(13)	-0.880138	0.765428

Restrictions are linear in coefficients.

Appendix VIII Vector Error Correction Test

(i) Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 06/05/14 Time: 22:49
Sample (adjusted): 1985 2012
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LNEXP(-1)	1.000000
LNINC(-1)	5.893780 (0.45291) [13.0130]
LNINVGDP(-1)	35.30151 (2.54929) [13.8476]
LNP(-1)	-56.23662 (2.73533) [-20.5593]
LNREER(-1)	0.818441 (1.38357) [0.59154]
LNCOFFPRICE(-1)	10.44436 (0.80209) [13.0214]

C	-231.5108					
Error Correction:	D(LNEXP)	D(LNINC)	D(LNINVGDP)	D(LNP)	D(LNREER)	D(LNCOFFPRICE)
CointEq1	-0.059052	-0.129869	0.002125	0.013341	-0.004659	-0.061039
	(0.06419)	(0.08435)	(0.00597)	(0.01076)	(0.00551)	(0.02285)
	[-0.91991]	[-1.53956]	[0.35570]	[1.24002]	[-0.84495]	[-2.67106]
D(LNEXP(-1))	1.947906	2.422189	0.000177	-0.126969	-0.007492	-0.082618
	(0.79505)	(1.04475)	(0.07399)	(0.13325)	(0.06829)	(0.28303)
	[2.45004]	[2.31844]	[0.00239]	[-0.95283]	[-0.10970]	[-0.29191]
D(LNEXP(-2))	-0.956116	-0.516916	-0.273013	-0.101822	0.090131	0.009605
	(0.67721)	(0.88990)	(0.06303)	(0.11350)	(0.05817)	(0.24108)
	[-1.41185]	[-0.58087]	[-4.33177]	[-0.89708]	[1.54940]	[0.03984]
D(LNINC(-1))	-1.378828	-1.410853	-0.004312	0.004517	0.014778	0.311448
	(0.65681)	(0.86309)	(0.06113)	(0.11008)	(0.05642)	(0.23382)
	[-2.09929]	[-1.63466]	[-0.07054]	[0.04104]	[0.26193]	[1.33202]
D(LNINC(-2))	1.016718	0.932249	0.211530	-0.004996	-0.101106	0.262144
	(0.65033)	(0.85458)	(0.06052)	(0.10900)	(0.05586)	(0.23151)
	[1.56339]	[1.09089]	[3.49497]	[-0.04584]	[-1.80991]	[1.13232]
D(LNINVGDP(-1))	-2.293134	-0.327010	-0.708570	-0.195736	0.777265	1.828053
	(3.50456)	(4.60522)	(0.32616)	(0.58738)	(0.30104)	(1.24758)
	[-0.65433]	[-0.07101]	[-2.17247]	[-0.33324]	[2.58196]	[1.46528]
D(LNINVGDP(-2))	0.512607	2.481558	-0.595856	0.171415	0.185490	0.580344
	(2.10824)	(2.77037)	(0.19621)	(0.35335)	(0.18109)	(0.75051)
	[0.24314]	[0.89575]	[-3.03687]	[0.48511]	[1.02427]	[0.77327]
D(LNP(-1))	-3.541038	-6.424536	0.035250	-0.096524	-0.261033	-1.562470
	(3.30914)	(4.34844)	(0.30797)	(0.55463)	(0.28425)	(1.17802)
	[-1.07008]	[-1.47744]	[0.11446]	[-0.17403]	[-0.91832]	[-1.32636]
D(LNP(-2))	-3.747488	-4.751794	-0.183632	0.038632	-0.050066	-0.717378
	(2.15743)	(2.83501)	(0.20079)	(0.36160)	(0.18532)	(0.76802)
	[-1.73701]	[-1.67611]	[-0.91457]	[0.10684]	[-0.27016]	[-0.93406]
D(LNREER(-1))	-1.196476	-1.756224	0.587766	0.490710	-0.299074	-0.542950
	(3.32343)	(4.36722)	(0.30930)	(0.55702)	(0.28548)	(1.18311)
	[-0.36001]	[-0.40214]	[1.90030]	[0.88095]	[-1.04762]	[-0.45892]
D(LNREER(-2))	0.361596	1.910854	-0.118545	-0.086978	-0.479633	0.631294
	(2.74450)	(3.60645)	(0.25542)	(0.45999)	(0.23575)	(0.97701)
	[0.13175]	[0.52984]	[-0.46411]	[-0.18909]	[-2.03451]	[0.64615]
D(LNCOFFPRICE(-1))	0.792639	1.227076	0.006876	-0.008637	-0.019021	-0.360957
	(0.83414)	(1.09611)	(0.07763)	(0.13981)	(0.07165)	(0.29694)
	[0.95025]	[1.11948]	[0.08858]	[-0.06178]	[-0.26546]	[-1.21557]
D(LNCOFFPRICE(-2))	-0.880138	-0.920897	0.018142	0.012367	-0.043618	-0.357489
	(0.76543)	(1.00582)	(0.07124)	(0.12829)	(0.06575)	(0.27248)
	[-1.14986]	[-0.91556]	[0.25467]	[0.09640]	[-0.66340]	[-1.31196]

C	0.283267	-0.334396	0.142915	0.129454	-0.022510	-0.028632
	(0.44542)	(0.58531)	(0.04145)	(0.07465)	(0.03826)	(0.15856)
	[0.63596]	[-0.57131]	[3.44757]	[1.73405]	[-0.58832]	[-0.18057]
D0104	-1.073110	-0.958100	-0.032372	0.135452	-0.213326	-0.752664
	(1.25399)	(1.64783)	(0.11670)	(0.21017)	(0.10772)	(0.44641)
	[-0.85576]	[-0.58143]	[-0.27738]	[0.64447]	[-1.98045]	[-1.68605]
D8889	2.048470	2.165693	-0.290540	0.058034	0.009271	-0.604377
	(1.04700)	(1.37583)	(0.09744)	(0.17548)	(0.08994)	(0.37272)
	[1.95651]	[1.57410]	[-2.98169]	[0.33071]	[0.10308]	[-1.62153]
D9295	-0.803840	-0.479571	0.050455	-0.386959	0.009796	2.114597
	(2.39981)	(3.15352)	(0.22334)	(0.40222)	(0.20614)	(0.85431)
	[-0.33496]	[-0.15208]	[0.22591]	[-0.96206]	[0.04752]	[2.47522]
R-squared	0.766759	0.763739	0.819501	0.573268	0.835388	0.732981
Adj. R-squared	0.427499	0.420088	0.556957	-0.047434	0.595953	0.344589
Sum sq. resids	10.73696	18.54029	0.092998	0.301616	0.079223	1.360674
S.E. equation	0.987971	1.298261	0.091947	0.165589	0.084865	0.351707
F-statistic	2.260094	2.222422	3.121388	0.923580	3.488990	1.887219
Log likelihood	-26.31110	-33.95867	40.17310	23.70101	42.41734	2.608865
Akaike AIC	3.093650	3.639905	-1.655222	-0.478644	-1.815524	1.027938
Schwarz SC	3.902489	4.448743	-0.846383	0.330195	-1.006686	1.836777
Mean dependent	0.283572	-0.030125	0.013160	0.022589	-0.008934	0.049248
S.D. dependent	1.305739	1.704829	0.138139	0.161796	0.133510	0.434434

Determinant resid covariance (dof adj.)	2.38E-10
Determinant resid covariance	8.73E-13
Log likelihood	150.3515
Akaike information criterion	-3.025106
Schwarz criterion	2.113397

Appendix IX: Vector Error Correction Model for Tea Export as Dependent Variable

Dependent Variable: D(LNEXP)
Method: Least Squares
Date: 06/05/14 Time: 22:55
Sample (adjusted): 1985 2012
Included observations: 28 after adjustments
D(LNEXP) = C(1)*(LNEXP(-1) + 5.89378025425*LNINC(-1) + 35.3015114457*LNINVGDP(-1) - 56.2366230692*LNP(-1) + 0.818441214224*LNREER(-1) + 10.4443586457*LNCOFFPRICE(-1) - 231.510782589) + C(2)*D(LNEXP(-1)) + C(3)*D(LNEXP(-2)) + C(4) *D(LNINC(-1)) + C(5)*D(LNINC(-2)) + C(6)*D(LNINVGDP(-1)) + C(7) *D(LNINVGDP(-2)) + C(8)*D(LNP(-1)) + C(9)*D(LNP(-2)) + C(10) *D(LNREER(-1)) + C(11)*D(LNREER(-2)) + C(12)*D(LNCOFFPRICE(-1)) + C(13)*D(LNCOFFPRICE(-2)) + C(14) + C(15)*D0104 + C(16) *D8889 + C(17)*D9295

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.059052	0.064193	-0.919915	0.3773
C(2)	1.947906	0.795050	2.450042	0.0322
C(3)	-0.956116	0.677210	-1.411846	0.1857
C(4)	-1.378828	0.656807	-2.099291	0.0597
C(5)	1.016718	0.650329	1.563390	0.1463
C(6)	-2.293134	3.504556	-0.654329	0.5263
C(7)	0.512607	2.108237	0.243145	0.8124
C(8)	-3.541038	3.309143	-1.070077	0.3075
C(9)	-3.747488	2.157434	-1.737012	0.1103
C(10)	-1.196476	3.323434	-0.360012	0.7257
C(11)	0.361596	2.744495	0.131753	0.8976
C(12)	0.792639	0.834138	0.950250	0.3624
C(13)	-0.880138	0.765428	-1.149863	0.2746
C(14)	0.283267	0.445420	0.635957	0.5378
C(15)	-1.073110	1.253989	-0.855757	0.4104
C(16)	2.048470	1.047001	1.956513	0.0763
C(17)	-0.803840	2.399814	-0.334959	0.7440

R-squared	0.766759	Mean dependent var	0.283572
Adjusted R-squared	0.427499	S.D. dependent var	1.305739
S.E. of regression	0.987971	Akaike info criterion	3.093650
Sum squared resid	10.73696	Schwarz criterion	3.902489
Log likelihood	-26.31110	Hannan-Quinn criter.	3.340920

F-statistic	2.260094	Durbin-Watson stat	2.130514
Prob(F-statistic)	0.087177		

Appendix X: Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: LNEXP LNCOFFPRICE LNINC LNINVGDP LNP LNREER
Exogenous variables: C
Date: 05/16/14 Time: 16:32
Sample: 1982 2012
Included observations: 29

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-113.7681	NA	9.77e-06	8.328832	8.658869	8.432196
1	25.62582	201.8808	2.12e-08	2.094771	4.735066	2.921678
2	118.5819	89.75066*	2.01e-09*	-0.936680*	4.013874*	0.613772*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix XI: Granger Causality Test

(i) Granger Causality Test with Variable Lagged once

Pairwise Granger Causality Tests
Date: 06/05/14 Time: 23:17
Sample: 1982 2012
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
D8889 does not Granger Cause D0104	30	0.05066	0.8236
D0104 does not Granger Cause D8889		0.11020	0.7425
D9295 does not Granger Cause D0104	30	0.11077	0.7418
D0104 does not Granger Cause D9295		0.11077	0.7418
LNCOFFPRICE does not Granger Cause D0104	30	2.56210	0.1211
D0104 does not Granger Cause LNCOFFPRICE		0.00064	0.9800
LNEXP does not Granger Cause D0104	30	0.28159	0.6000
D0104 does not Granger Cause LNEXP		0.00518	0.9432
LNINC does not Granger Cause D0104	30	0.31863	0.5771
D0104 does not Granger Cause LNINC		0.05950	0.8091
LNINVGDP does not Granger Cause D0104	30	0.99488	0.3274
D0104 does not Granger Cause LNINVGDP		9.1E-06	0.9976
LNP does not Granger Cause D0104	30	2.00721	0.1680
D0104 does not Granger Cause LNP		0.04353	0.8363
LNREER does not Granger Cause D0104	30	0.40463	0.5301
D0104 does not Granger Cause LNREER		4.63938	0.0403
D9295 does not Granger Cause D8889	30	0.11020	0.7425
D8889 does not Granger Cause D9295		0.05066	0.8236
LNCOFFPRICE does not Granger Cause D8889	30	0.27149	0.6066
D8889 does not Granger Cause LNCOFFPRICE		0.61464	0.4399
LNEXP does not Granger Cause D8889	30	6.76679	0.0149
D8889 does not Granger Cause LNEXP		21.3550	8.E-05
LNINC does not Granger Cause D8889	30	2.38650	0.1340
D8889 does not Granger Cause LNINC		76.5878	2.E-09
LNINVGDP does not Granger Cause D8889	30	0.04306	0.8372
D8889 does not Granger Cause LNINVGDP		0.09904	0.7554
LNP does not Granger Cause D8889	30	0.23528	0.6315
D8889 does not Granger Cause LNP		1.59608	0.2173
LNREER does not Granger Cause D8889	30	1.14239	0.2946
D8889 does not Granger Cause LNREER		0.01663	0.8984
LNCOFFPRICE does not Granger Cause D9295	30	3.60092	0.0685
D9295 does not Granger Cause LNCOFFPRICE		0.17163	0.6819
LNEXP does not Granger Cause D9295	30	0.33976	0.5648
D9295 does not Granger Cause LNEXP		0.31696	0.5781

LNINC does not Granger Cause D9295	30	7.09510	0.0129
D9295 does not Granger Cause LNINC		1.45524	0.2382
LNINVGDP does not Granger Cause D9295	30	0.17126	0.6823
D9295 does not Granger Cause LNINVGDP		0.97126	0.3331
LNP does not Granger Cause D9295	30	0.42924	0.5179
D9295 does not Granger Cause LNP		2.23492	0.1465
LNREER does not Granger Cause D9295	30	0.13568	0.7155
D9295 does not Granger Cause LNREER		0.29703	0.5902
LNEXP does not Granger Cause LNCOFFPRICE	30	0.00329	0.9547
LNCOFFPRICE does not Granger Cause LNEXP		0.41134	0.5267
LNINC does not Granger Cause LNCOFFPRICE	30	1.95813	0.1731
LNCOFFPRICE does not Granger Cause LNINC		1.00085	0.3260
LNINVGDP does not Granger Cause LNCOFFPRICE	30	1.97382	0.1714
LNCOFFPRICE does not Granger Cause LNINVGDP		1.24069	0.2752
LNP does not Granger Cause LNCOFFPRICE	30	12.3008	0.0016
LNCOFFPRICE does not Granger Cause LNP		0.80632	0.3771
LNREER does not Granger Cause LNCOFFPRICE	30	0.00479	0.9454
LNCOFFPRICE does not Granger Cause LNREER		1.92678	0.1765
LNINC does not Granger Cause LNEXP	30	0.22917	0.6360
LNEXP does not Granger Cause LNINC		2.89349	0.1004
LNINVGDP does not Granger Cause LNEXP	30	0.15482	0.6971
LNEXP does not Granger Cause LNINVGDP		1.03147	0.3188
LNP does not Granger Cause LNEXP	30	0.60386	0.4439
LNEXP does not Granger Cause LNP		0.04231	0.8386
LNREER does not Granger Cause LNEXP	30	0.00138	0.9707
LNEXP does not Granger Cause LNREER		5.15005	0.0314
LNINVGDP does not Granger Cause LNINC	30	0.17534	0.6787
LNINC does not Granger Cause LNINVGDP		0.04155	0.8400
LNP does not Granger Cause LNINC	30	0.73419	0.3991
LNINC does not Granger Cause LNP		2.30025	0.1410
LNREER does not Granger Cause LNINC	30	2.76163	0.1081
LNINC does not Granger Cause LNREER		0.85478	0.3634
LNP does not Granger Cause LNINVGDP	30	4.41748	0.0450
LNINVGDP does not Granger Cause LNP		8.73799	0.0064
LNREER does not Granger Cause LNINVGDP	30	1.34819	0.2558
LNINVGDP does not Granger Cause LNREER		6.38824	0.0176
LNREER does not Granger Cause LNP	30	1.24315	0.2747
LNP does not Granger Cause LNREER		0.36470	0.5509

(ii) Granger Causality Test with Variable Lagged Twice

Pairwise Granger Causality Tests
Date: 06/05/14 Time: 23:14
Sample: 1982 2012
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D8889 does not Granger Cause D0104	29	0.04753	0.9537
D0104 does not Granger Cause D8889		0.13597	0.8735
D9295 does not Granger Cause D0104	29	0.08960	0.9146
D0104 does not Granger Cause D9295		0.08960	0.9146
LNCOFFPRICE does not Granger Cause D0104	29	1.13124	0.3392
D0104 does not Granger Cause LNCOFFPRICE		0.12415	0.8838
LNEXP does not Granger Cause D0104	29	0.18898	0.8290
D0104 does not Granger Cause LNEXP		0.00422	0.9958
LNINC does not Granger Cause D0104	29	0.21905	0.8049
D0104 does not Granger Cause LNINC		0.08365	0.9200
LNINVGDP does not Granger Cause D0104	29	0.49270	0.6170
D0104 does not Granger Cause LNINVGDP		0.08494	0.9188
LNP does not Granger Cause D0104	29	1.04008	0.3688
D0104 does not Granger Cause LNP		0.37309	0.6925
LNREER does not Granger Cause D0104	29	0.33802	0.7165
D0104 does not Granger Cause LNREER		2.23891	0.1284
D9295 does not Granger Cause D8889	29	0.13597	0.8735
D8889 does not Granger Cause D9295		0.04753	0.9537
LNCOFFPRICE does not Granger Cause D8889	29	1.66983	0.2094
D8889 does not Granger Cause LNCOFFPRICE		0.45863	0.6376
LNEXP does not Granger Cause D8889	29	6.81685	0.0045
D8889 does not Granger Cause LNEXP		72.6987	7.E-11
LNINC does not Granger Cause D8889	29	1.79336	0.1880
D8889 does not Granger Cause LNINC		86.3678	1.E-11
LNINVGDP does not Granger Cause D8889	29	0.00346	0.9966
D8889 does not Granger Cause LNINVGDP		0.13481	0.8745
LNP does not Granger Cause D8889	29	0.61824	0.5473
D8889 does not Granger Cause LNP		3.95464	0.0328
LNREER does not Granger Cause D8889	29	1.14339	0.3355
D8889 does not Granger Cause LNREER		1.43395	0.2581

LNCOFFPRICE does not Granger Cause D9295	29	1.56527	0.2296
D9295 does not Granger Cause LNCOFFPRICE		0.22491	0.8002
LNEXP does not Granger Cause D9295	29	0.19358	0.8253
D9295 does not Granger Cause LNEXP		0.15696	0.8556
LNINC does not Granger Cause D9295	29	8.03658	0.0021
D9295 does not Granger Cause LNINC		0.21043	0.8117
LNINVGDP does not Granger Cause D9295	29	1.96205	0.1625
D9295 does not Granger Cause LNINVGDP		1.24034	0.3072
LNP does not Granger Cause D9295	29	0.43930	0.6496
D9295 does not Granger Cause LNP		0.99551	0.3843
LNREER does not Granger Cause D9295	29	0.44617	0.6453
D9295 does not Granger Cause LNREER		0.42455	0.6589
LNEXP does not Granger Cause LNCOFFPRICE	29	0.83795	0.4449
LNCOFFPRICE does not Granger Cause LNEXP		0.27805	0.7597
LNINC does not Granger Cause LNCOFFPRICE	29	0.97090	0.3931
LNCOFFPRICE does not Granger Cause LNINC		0.36889	0.6954
LNINVGDP does not Granger Cause LNCOFFPRICE	29	6.91634	0.0042
LNCOFFPRICE does not Granger Cause LNINVGDP		0.54120	0.5890
LNP does not Granger Cause LNCOFFPRICE	29	5.63212	0.0099
LNCOFFPRICE does not Granger Cause LNP		0.08106	0.9224
LNREER does not Granger Cause LNCOFFPRICE	29	5.60420	0.0101
LNCOFFPRICE does not Granger Cause LNREER		1.89821	0.1717
LNINC does not Granger Cause LNEXP	29	0.39198	0.6800
LNEXP does not Granger Cause LNINC		1.97372	0.1609
LNINVGDP does not Granger Cause LNEXP	29	0.03986	0.9610
LNEXP does not Granger Cause LNINVGDP		0.17376	0.8416
LNP does not Granger Cause LNEXP	29	0.28985	0.7510
LNEXP does not Granger Cause LNP		1.96951	0.1614
LNREER does not Granger Cause LNEXP	29	0.05861	0.9432
LNEXP does not Granger Cause LNREER		2.98295	0.0697
LNINVGDP does not Granger Cause LNINC	29	0.13897	0.8710
LNINC does not Granger Cause LNINVGDP		0.50548	0.6095
LNP does not Granger Cause LNINC	29	0.44509	0.6460
LNINC does not Granger Cause LNP		2.29608	0.1223
LNREER does not Granger Cause LNINC	29	1.16148	0.3300
LNINC does not Granger Cause LNREER		0.52270	0.5995
LNP does not Granger Cause LNINVGDP	29	0.58481	0.5650
LNINVGDP does not Granger Cause LNP		8.20551	0.0019

LNREER does not Granger Cause LNINVGDP	29	1.07309	0.3578
LNINVGDP does not Granger Cause LNREER		3.91307	0.0338
LNREER does not Granger Cause LNP	29	0.65284	0.5296
LNP does not Granger Cause LNREER		0.25150	0.7797

Appendix XII: Residuals Diagnostic Test

(i) Heteroscedasticity Test Using Autoregressive Conditional Heteroskedasticity Test

Heteroskedasticity Test: ARCH

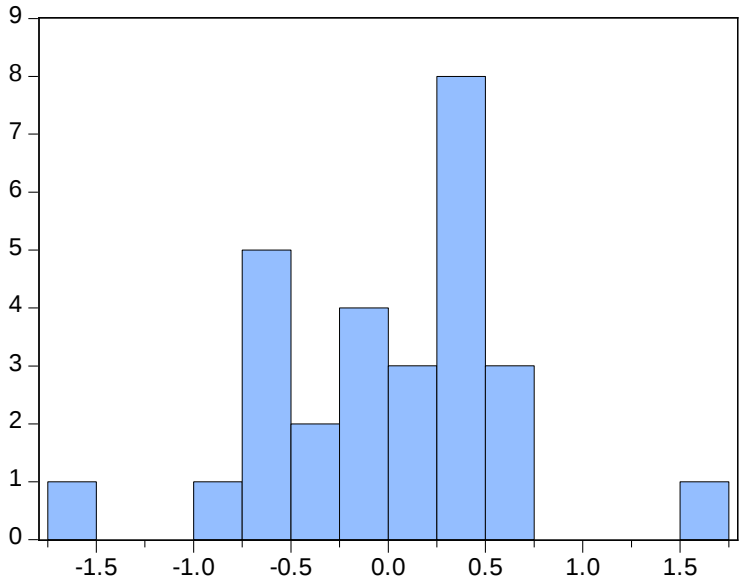
F-statistic	3.650615	Prob. F(1,25)	0.0676
Obs*R-squared	3.440296	Prob. Chi-Square(1)	0.0636

(ii) Serial Correlation Test Using Likelihood Maximum Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.055335	Prob. F(2,9)	0.1840
Obs*R-squared	8.779014	Prob. Chi-Square(2)	0.0124

(iii) Normality Test Using Jarque-Bera Test



Series: Residuals	
Sample 1985 2012	
Observations 28	
Mean	3.41e-16
Median	0.049466
Maximum	1.554152
Minimum	-1.554152
Std. Dev.	0.630607
Skewness	-0.094147
Kurtosis	3.391797
Jarque-Bera	0.220453
Probability	0.895631