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Determinants of export diversification in Rwanda

By

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DECLARATION

I declare that ***''Determinants of Export Diversification in Rwanda''*** has not been previously presented for any academic degree or assessment at any educational institution. I also confirm that all the references and sources used in this study have been appropriately cited and acknowledged through proper referencing methods.

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Signature: 

Date: 22 November 2023

ABSTRACT

Since Rwanda gained independence in 1962, the country's export diversification has become a crucial tool for enhancing economic development, economic growth, and Balance of payment. This is why Rwanda expanded the list of not only export products but also the economic integration blocks. However, the country's export still needs to be of a better standard. The export diversification factors still need to be investigated for more efficient export policies. The purpose of this research is to determine the factors that contributed to Rwanda's export diversification using time series data from 1980 to 2014. In this study, the ADF and PP tests were utilized to assess the stationarity properties of the unit root test, the ARDL model was conducted to test the co-integrating amongst the variables, while the estimated short-run ECM was also derived.

The empirical results demonstrated that trade openness, terms of trade, and GDP per capita, have insignificant negative impacts on export diversification both in the short and long term, while infrastructure has a significant positive impact on export diversification. However, FDI had an insignificant positive influence on the country's export diversification. The study employed a TY causality test to examine the causal link among underlying variables. The test demonstrated that there is unidirectional causality among FDI, human capital, and export diversification. Also, there is no causality in terms of trade, GDP per capita, trade openness, and export diversification. The study recommends that to boost export diversification in Rwanda, the government should implement policies and strategies that enhance infrastructure. Furthermore, policymakers should aim to establish a stable macroeconomic foundation, which serves as a cornerstone for export diversification.

Keywords: Diversification, Rwanda, ARDL model, Theil index.

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LIST OF ABBREVIATIONS

ADF	Augmented-Dickey Fuller
ARDL	Autoregressive distributed lag
BNR	National Bank of Rwanda
ECI	Economic Complexity Index
EDPRS	Economic Development and Poverty Reduction
FGLS	Feasible Generalized Least Squares
GDP	Gross Domestic Products
GMM	Generalized Method of Moments
HS	Harmonized System
IMF	International Monetary Fund
NARDL	Nonlinear Autoregressive Distributed Lag
NES	National Export Strategy
OLS	Ordinary Least Square
PP	Phillips-Peron
SBC	Schwartz-Bayesian Criteria
SIC	Schwarz Information Criteria
TEL	Telephone
TY	Toda-Yamamoto
UN	United Nations
VAR	Vector Autoregressive Distributed Lag
WDI	Word Development Indicators

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CHAPTER ONE: INTRODUCTION

1.1 Background and Rationale of the study

Rwanda's main exports have been tungsten, pyrethrum, tea, tin, and coffee, their prices have been volatile in the global market. This has caused the inability to cover national export needs on the international market (MINECOFIN, 2000). Furthermore, from 1980 to 2014, tea and coffee constituted the major of country's total exports (IMF, 2000). During the period, only 5% of the country's export products were exported to African countries, while for developed countries, exports grew to the size of 80% on total national exports. In 2001, Rwanda exported 106 out of more than 10,000 commodities under the European Union tariff classification (IMF, 2000). In addition, only 12 commodities were exported to the USA and 2 to Japan (Gobind et al., 2005). In 2013 the country's exports of goods and services constituted $ 1.3 billion (IMF, 2015) from $373 million in 2008 (BNR, 2016). Most of the country's export was based on primary commodities for foreign exchange, and this consequently resulted in a decrease in the terms of trade.

Meanwhile, diversification is the major strategy for changing commodities and export patterns (Agosin & Manuel, 2007). This strategy is regarded as the means of transforming raw materials into finished. Export diversification usually plays a major role in reducing risks of unpredictable product price volatility and higher prices of foreign exchange and has significant consequences on macroeconomic factors (Noureen & Zafar, 2014). In the case of Rwanda, it has been proved that economic growth is positively affected by diversifying exports (MINECOFIN, 2000). This is why, after the 1994 Tutsi Genocide, national export diversification measures have been adopted to reduce the price volatility that had persisted long before (IMF, 2000). It has been reported (IMF, 2000) that Rwanda's GDP has consistently improved, and this shows that lowering the price volatility on exports has been a key indication of the country's higher GDP growth.

Rwanda gained independence in 1962 when the level of GDP per capita was significantly lower than that of other African nations. At that time, the country's exports relied on primary

commodities (IMF, 2016). The country's financial sources for importing capital goods have been steadily dependent on export revenues from their primary products. In the global market, the price of primary commodities has consistently fluctuated, and the country's export scale has been intensively dependent on a few commodities. Hausman & Chauvin (2015) indicated the path of export diversification in Rwanda. In their work, they adopted an economic complexity index (ECI) to analyse the data gathered from COMTRADE from 1989 to 2010. Their research outcomes proved that tin, tea, and coffee constituted of 82 % of Rwanda's total exports. It has also been revealed that more than 100 traded products do not optimize transportation costs, and this has exerted a substantial adverse effect on the nation's limited resources.

The above-mentioned state of export is detrimental to the trade balance and discourages direct foreign investment in the country. Rwanda's export revenues are still steadily dependent on limited primary commodities including Coffee, Pyrethrum, and Tin. Out of these, Coffee and Tea contain 80% of the sum of exports (MINICOM, 2013). Dependency on a few primary commodities of export products causes a low level of export revenues and negative effects on the trade balance. Since 1962, Rwanda adopted export diversification measures to improve its economy, and this has been working. However, investigation of how to improve these measures is the subject of this research.

1.2 Objectives of the Study

The objective of this research is to explore the primary factors influencing export diversification in Rwanda, with the following specific objectives:

- To investigate the existence of a long-term relationship between export diversification and its determinants in Rwanda.
- To examine the existence of a short-term relationship between export diversification and its determinants in Rwanda.
- To explore the existence of a short-term causality from export diversification to its determinants in Rwanda.

1.3 Relevance of the study

Many different studies have been carried out to evaluate the significance of Rwanda's export diversification and how it supports the nation's macroeconomic goals. Rwanda's agriculture has been extensively explored due to its location advantages to supply many markets. However, the overwhelming body of literature on export diversification has only focused on one sector of the economy (agriculture) while Rwanda's export diversification sectors have received little attention. This study incorporates more sectors and investigates the magnitude of Rwanda's export diversification to the global market. The findings of this research will furnish the necessary guidance to Rwandan policymakers to improve trade and build a strong competitive market. Furthermore, it will provide recommendations on the strategies that can be deployed to improve Rwanda's export diversification and hence the national economy.

1.4 Outline of the study

This research is structured with five chapters. Chapter One offers an introductory overview of the study. Chapter two reviews the literature on the conceptual, theoretical, and empirical framework of the investigation. Then, Chapter Three presents the description of the data used as well as the methodology that was followed. Chapter Four provides an analysis of the results estimated empirically using the models set out in Chapter Three. Finally, Chapter Five discusses the summary, conclusion, and policy suggestions.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of research works examining the factors influencing export diversification. The chapter consists of four key Sections: Section 2.2 offers definitions of key concepts. Section 2.3 covers an overview of Rwanda's export sector; Section 2.4 addresses the theoretical framework focusing on theories related specifically to export diversification and Section 2.5 is an overview of past empirical studies on export diversification. Lastly, the conclusion is presented in Section 2.6.

2.2 Conceptual framework

2.2.1 Defining diversification

The definition of diversification depends on its measurements. In this study, the concentration index is the preferred measure. The concentration index shows if the country's main export revenues are derived from a small range of commodities or whether the revenues remain consistently through a range of export goods (Balavac, 2012). Export can grow at the value of existing products and can grow in the number of geographical destinations or expand in the number of commodities traded (Cadot et al., 2011).

Meanwhile, it is well known that diversification comes with new products into new markets by processing internal business development through accusation with intensive changing administration structure, together with systems and other management processes (Dennis & Shepherd, 2007). One major reason why a country would need to diversify its exports is to minimize the risk of using surplus cash, build shareholder value, exploit better and additional opportunities, efficient capital allocation, and build corporate brand equity (Alemu, 2008).

2.2.2 Nature of export diversification

It is generally recognized amongst economists that exports constitute a major factor in the development and growth of economies. The overall growth of developing countries can be produced not only by expanding the amount of capital and labour in the economy but also by increasing exports (Mazen & Daoud, 2015). The expansion of exports can be attained both at the extensive level and at the intensive level. Export at the extensive margin is reached when there is a higher number of geographical destinations or an expansion in the number of commodities traded whereas the intensive margin is reached when there is an expansion in the quantity of existing exported goods and services (Seid, 2001). The increase in exports at the extensive margin is also regarded as export diversification. Export diversification occurs over three main methods linking exporting new commodities to existing markets, exporting new commodities to new markets, and exporting the existing commodities to the new partners (Newfarmer, 2007).

2.2.3 Measuring diversification

Numerous indicators are used to assess export diversification, but the Gini, Herfindahl, and Theil indices, which capture inequality and concentration, are among the most widely employed measures for evaluating export diversification or concentration. However, Cadot et al. (2011) contended that the measure is favored when the data is at a higher level of disaggregation. These indices provide a comprehensive view of the entire export size distribution, making them responsible for changes in all aspects of the distribution (Balavac, 2012). This study employs the Theil entropy index as the favored measure of concentration. Thus, the mathematical presentation of the Theil entropy index follows Cadot et al. (2011), and Balavac (2012). The Theil index is calculated as follows:

$$T = \frac{1}{n}\sum_{i=1}^{n} \frac{Xi}{\mu} ln\left(\frac{Xi}{\mu}\right) \text{ where } \mu = \frac{\sum_{i=1}^{n} xi}{n} \quad (2.1)$$

The Theil index is negatively correlated to the level of export diversification which means if the value of the Theil index is zero, it is perfect diversification (i.e., equal distribution between *n* groups of individuals or export lines) and it reaches the maximum value if perfect concentration exists when the export of another export line is equal to zero (i.e., concentrated on one group of

individuals or export line).

Due to the complexity of equation 2.1, the author transforms it into derivative form to indicate how the distribution occurs as follows:

$$\frac{\partial F}{\partial X1} \approx \frac{1}{n\mu} \ln\left(\frac{X1}{\mu}\right) \quad (2.2)$$

Subsequently, the average of total export and the total number of export commodities (respectively) is positive, the sign of the derivative depends on variability if there is an increase, there is a decrease in concentration while, if an increase, there is an increase in concentration which will cause the value of the Theil index to increase. In other words, the more the Theil index is close to zero, the more diversified the export basket is, while a higher Theil index designates concentration.

Since this present study uses extensive and intensive margin trade data from IMF (2019) to construct a diversification index for the country, the study follows Cadot et al. (2013) to decompose the Theil index into subgroups such as between (T_B) and within (T_W) components:

$$T_B = \sum_{J=1}^{j} \frac{\mu_j}{n} \frac{n_j}{n} \left[\frac{1}{nj} \sum_{i£j}^{j} \frac{xi}{\mu_j} \, ln \left(\frac{xi}{\mu_j}\right)\right] \quad (2.3)$$

$$T_W = \sum_{J=1}^{j} \frac{\mu_j}{n} \frac{n_j}{n} \, ln \left(\frac{xi}{\mu_j}\right) \quad (2.4)$$

where,

T = $T_B + T_W$

J= groups of individuals

nj = numbers of groups individuals (export lines)

μ_j = Average value on export lines

The Theil between components (equations 2.3) gives us the index of export lines related to the export diversification of the existing products. Hence, a lower value is equivalent to a larger variety

of commodities being exported. Further, Theil within is a component related to export diversification at the existing trade partners.

2.2.4 Type of export diversification

Export diversification can be concentric (vertical) or horizontal. Concentric diversification requires a process of moving from traditional export commodities to non-traditional commodities (Aberg, 2014). Horizontal diversification consists of raising the number of commodities by introducing new commodities to the existing export market. On the company's level, it can be defined that vertical diversification is when a business seeks out new items that have marketing and technology overlaps with its current product lines. In contrast, horizontal diversification by looking for new current customers who are technologically unrelated to existing products (Agosin & Manuel, 2007).

2.3 Overview of Rwanda's export sector

2.3.1 Traditional Export Commodities

According to the National Bank of Rwanda (2017), Rwandan traditional exports comprise mainly primary products such as coffee, tea, pyrethrum, hides, skins, and traditional minerals like tin, wolfram, coltan, and cassiterite. The country's traditional export sector is heavily dominated by three products such as coffee, tea, and traditional minerals. However, these three products have had their dominance of traditional export since independence. Over the last eight years, 2001-2008, the three products accounted for over 69 % of all exports.

The dependence on Rwandan traditional export commodities as the major source of export revenue caused the country's external economic setbacks like occasional decreases in terms of trade (Malunda, 2012). The exports of coffee, minerals, and tea have been the three main export products in Rwanda over the years since its independence. However, earnings from coffee in percentage steadily rose from 23 % in 1982 to the higher point of 54 % in 1996. Yet, it started decreasing from 33% in 1998 and then increased to a higher percentage of 49 % in total exports in 2008. The revenue from tea has conquered the export sector of Rwanda. Nevertheless, the domination of tea

continues to decrease even if Rwanda's export enlarges. The share of revenue from tea declined progressively from 46 % in 1998 to 23 % in 2001. It rose again to 34 % in 2002 and then decreased again to 20% in 2014 (MINICOM, 2009).

2.3.2 Non-traditional merchandise export

Rwanda's non-traditional export sector is mostly made of 10,000 commodities which are classified into three sub-sectors namely handicrafts and fashion, agriculture and processing, and semi-processing products (MINECOFIN,2000). Agricultural products generally contain horticultural, and floriculture, fresh fruits such as bananas, avocados, passion fruits, strawberries, mangoes, and pineapples, flowers such as roses, agapanthus, calla lilies, tuberoses, alstroemeria, ornamental sunflowers and Zantedeschia flowers as well as vegetables like green pepper, carrot, chili paper, fresh beans, hot paper, onions, tomatoes, and nuts such as macadamia. Other agricultural non-traditional export products include parsley, lemongrass, ginger, garlic, and celery. Processing and semi-processing products comprise processed horticulture such as pineapple juice, dried pineapple, mango juice, dried vegetables, canned vegetables, and passion fruit juice as well as beverages (i.e., alcoholic beverages and non-alcoholic beverages). Wood products, pottery, hand textiles, basketry, mats, woven products, hand-loomed products, and embroidery are in the handicrafts sector while jewellery products, footwear, and clothing fall under fashion. Rwanda's non-traditional service exports mostly include financial services, health services, education, and tourism which is the biggest contributor to the country's export earnings (MINICOM, 2015).

Likewise, Rwanda's non-traditional merchandise exports represent an increase of $3.8 million in 2004 to the amount of $155.3 million in 2016 (BNR,2017). Meanwhile, there is a remarkable increase in export earnings in non-traditional commodities from $1 million in 2004 to $20 million in 2016. Over the past 13 years, non-traditional commodities have risen steadily from $ 400 million in 2007 to $1.6 billion in 2016. The highest increase occurred in 2012 with 51%. In 2006 there was a decrease of 4.02 % amounting to $11 million. The reason why there is a drop in Rwanda's competitiveness in the global market is due to the increase in transport costs and production costs during the period. In 2014 and 2016, revenues from the sector rose from $27.8% million and $41.4% to $119.4 million and $390 million, respectively. In 2006 there was a decrease in export

revenues by 86 million to $ 68 million (MINICOM,2015).

2.3.3 Destination of Rwanda's Exports

Rwanda has later implemented export diversification reforms that aim to extend its different markets, including regional markets, such as the member countries of COMESA, EAC, CEPGL, and ECCAS. Export diversification reforms involved deepening regional integration in the EAC and strengthening investment and export promotion ties with the wider East and South Asia region while continuing to invest in growing ties with existing trade partners. This has been materialized by joining the Economic Central African States (ECCAS) in 2016, after a temporary suspension from participation in 2007. Note that Rwanda has been accepted as a member of CEPGL since its creation in 1976 (DRC, Burundi) and a member of the COMESA free trade area since 2004 (MINICOM, 2015). For years, Sub-Sahara has been the ruling destination of Rwandan exports. The country's export has mainly been non-traditional products and coffee. Between 2002 and 2010 period, the top 13 imports of Rwandan export products were from Uganda, Kenya, Tanzania, China, India, Netherlands, Belgium, Germany, the UK, DRC, the US, and Switzerland. The main export partner of Rwanda in 2010 was Switzerland 22.65% with a trade value of 54,374.11 million, followed by Kenya with a total import of 39,304.36 representing 16.37% of the total export of Rwanda. Within the SSA partners, Belgium had the top export of 11.16% followed by China with 7%, and then Eswatini with 4.90%. The SSA share of total exports increased to 42977.84 million representing 83.81% and then reduced to 26066.41 million, representing 48.17% from Rwanda in 2001 to 2003 respectively (IMF,2013).

2.3.4 Non-traditional export by destination

The performance of the Rwandan market of non-traditional export sector indicated that DRC and EAC markets accounted for 41% and 29% respectively and these two partners continue to be the major export of Rwanda's non-traditional export products up to date. However, the rest of other African nations and the rest of the world countries accounted for 3% and 26% respectively of non-traditional exports from Rwanda (MINICOM, 2015).

2.4 Theoretical literature

2.4.1 International Trade Theories

Given the objectives of this research, as stated in section one, many theories or models have been developed and put forward to explain and improve benefits derived from international trade between countries. One of these theories is the mercantilism that dominated the European practice of trade in the 16th century. However, mercantilism is not a good theory to explain the determinants of export product diversification in Rwanda, because mercantilism theory often emphasizes the dominance of one state towards another (La Haye, 2008).

In essence, other scholars such as Brems (1986) and Helpman (1999) argued that mercantilists' focus was on the accumulation of wealth through export and colonization, as well as discouraging imports. Therefore, based on this argument, the theory of international trade is well positioned to provide a lens under which export diversification in Rwanda can be analysed since the proponents of this theory and other ant-mercantilism economists like Adam Smith and David Ricardo emerged to become renowned as formal and standard theorists trade theories (Samen, 2010).

On the international trade theory, as reported by Samen (2010) Smith briefly argued that because of limited resources, regulation could not be used to achieve higher wealth or outputs. Smith's argument, another theory of absolute advantage was developed when Smith (1986) insisted that in international trade, countries improve and capitalize on the economic gain, only when each country concentrates or specializes where the goods production and services has an absolute advantage. In Smith's (1986) view, this provides the basis for lowered costs of labour and emphasis on effective competition across nations. In this regard, according to Samen (2010), trade should be allowed to flow freely based on the demand of the market and the nations' wealth measured in terms of living conditions, not simply by looking at the economic aspects or indicators.

By taking the theory of free trade further, Samen (2010) noted that economist David Ricardo formulated another theory, namely comparative advantage. This theory demonstrates the country's capacity to produce one commodity efficiently, compared to its competitor. This production ability

brings the issue of opportunity cost into the picture. In essence, according to Smith (1986), If a country lacks a clear-cut advantage in any area, it may possess something that offers improved prospects for enhancing national income expectations through trade and specialization. What this means is that a country must seek to produce or export products or services that incurred lower costs of production in comparison with goods or services produced in other countries (Mohr et al., 2007).

To explain the trade patterns, the opponents of absolute advantage are sometimes of the view that it is counterintuitive. For instance, researchers such as Meysen (2013) and Suranovic (2015) held a different view from Ricardo's assumption that comparative advantage could only increase due to variability on labour market among partners. According to these scholars, international trade reveals changes in all factors of production, not merely one factor of labour.

The view of a factor of production led theorists Bertil Ohlin and Eli Heckscher to develop a Heckscher- Ohlin (HO) model to explain comparative advantage further. In the H-O model, Brems (1986) postulated that a nation will produce the goods associated with a lower opportunity cost of production. It means that a country specializes in where the lowest opportunity cost exists to diversify its exports. Likewise, in incorporating all inputs of production in the H-O model, Krugman & Obstfeld (2003) suggested that trade rises through the uneven geographical distribution of production. Given that nations have distinct resource endowments, in the H-O model, countries must specialize and export goods and services that are produced more efficiently with factors of production that the nation is highly endowed if one can assume that it is a competitor or trading partner will use the same technology in production. This led Mohr et al. (2007) to conclude that such kind of trading patterns and relations will increase each partner's competitiveness and export diversification.

In resource endowment, Porter (1990) added the concept of competitive advantage, which attributes success in trade between countries to other factors that must be considered because of their influence on export diversification for the countries, these are issues such as exchange rate,

trade agreements, technology, skills, history, and culture. From this vantage point, Helpman (1999) identified the free trade agreement and exchange rate to be some of the major hindrances of trade between importing and exporting countries.

However, from this viewpoint, Mohr, et al. (2007) contended that a trade agreement, on one hand, is an instrument used by many countries to regulate tariffs and other trade restrictions or a way of dictating terms of exchange of goods and services between trading partner, while exchange rate according to Brems (1986) on other hand is used to regulate price unit of goods in the domestic currency. In a nutshell, one would conclude that the export diversification drivers in Rwanda are affected by many factors, and from the international trade theoretical framework this research will examine the export diversification drivers in Rwanda after reviewing the literature on export diversification.

2.4.2 Prebisch-Singer theory

This theory posits that in the long term, the cost of raw materials will decrease in contrast to the cost of finished products. The trade, for countries with primary product dependency (rich countries), will decline. This means that primary product-dependent countries will need to export high quantities to only afford low quantities of imports (processed products), due to the likely long-run decline in terms of trade. This is because primary goods such as coal, coffee, oil, and copper often have a lower income elasticity of demand, while manufactured goods (from rich countries) will often have a higher income elasticity of demand. This is why there is inequality in the structure of the global market. To resolve these inequalities, developing countries should use export revenues to diversify their export sector (Shabana & Zafar, 2014).

2.4.3 Endogenous Growth Theory

The theory posits that when a nation experiences a greater rate of human capital accumulation, it can efficiently produce in sectors where it holds a comparative advantage (Dornbusch et al., 2008). Furthermore, the theory contends that countries exhibiting greater diversification are directly associated with an increase in export variety, which, in turn, positively impacts human capital accumulation (Mayer, 1996). This theory also maintains that as a country's level of human capital

accumulation rises, its export diversification increases, leading to greater productivity and bolstered economic growth.

2.5 Review of past empirical studies

Globally there have been ample researchers exploring the determinants of diversifying exports in different regions and nations employing different explanatory variables. However, there is a scarcity of empirical literature locally. Meanwhile, there are no common factors that determine export diversification. Each country has its own factors. In this part, the author presents a review of past empirical studies.

2.5.1 International Studies

Bebczuk & Berrettoni (2006) analyzed the variables that influence export diversification in a set of 56 developing and developed nations from 1962 to 2002. The study utilized random and fixed effect estimators. The dependent variables included in the model were the ratio of GDP, GDP per capita, the net of foreign direct investment, infrastructure and access to credit, fuel export, and agricultural export. The results indicated that the ratio of GDP, GDP per capita, fuel export, and infrastructure (telephone line), was strongly and positively linked with export diversification while access to credit, and net foreign direct investment were strongly negatively linked with export diversification in 56 countries. The research also discovers a U-shaped correlation between export diversification and economic development which means concentration rises at the higher level of income while diversification rises at the lower level of income.

Alemu (2008) evaluated the factors influencing horizontal and vertical export diversification for the data sample of 41 East Asia and Sub-Saharan African countries spanning from 1975 to 2004. Utilizing estimation of feasible generalized least squares (FGLS) technique to assess the factors affecting horizontal and vertical export diversification in Sub-Saharan African countries. The study found that foreign direct investment, human capital (level of education), infrastructure development, population size, domestic investment, trade openness, and income per capita, are the most important factors of export diversification. Unfortunately, the oil wealth is negatively affected

by diversification while land resource increases by it. Also, export diversification was strongly affected by political instability in sub-Saharan countries while the rate of exchange and foreign aid have mutual effects on export diversification.

Kamuganga (2012) explored the factors of export diversification in Africa at the HS 6-digit export level, period of 1995 to 2009 with a conditional logit method. The empirical results revealed that regional trade agreements enhance export diversification through new products and new market margins. Further, his study confirmed that cost, procedure, and time exports has a negative effect on diversifying African exports. Finally, he recommends that African countries should develop and strengthen regional trade agreements to encourage export diversification.

With the purpose of assessing essential factors that determine export diversification in developing countries like South Africa, Namibia, Botswana, Swaziland, and Lesotho (hereafter SACU), Seabe & Mogotsi (2012) employed the GLS and OLS estimators to scrutinize the importance of diversifying export on economic growth. Their study utilized longitudinal panel data spanning 1995-2008, and their results confirm that GDP per capita, investment, trade openness and financial development exert an enormous effect on export diversification in SACU economies.

Aigheyisi (2018) empirically examines factors driving export diversification in ECOWAS countries over the period span from 1995 to 2015. In particular, he assessed the effect of real GDP, gross capital formation, inflation, and financial institutions within the FMOLS estimator. The study found that an increase in gross capital formation and real GDP rises export diversification (discourages export concentration) while an expand in the financial institution adversely impacts export diversification thus enhancing export concentration in ECOWAS countries.

Khan et al. (2021) empirically analyzed the causal nexus of China's export diversification and foreign direct investment through the Melitz technique. The study employed data spanning from 1987 to 2017 on foreign direct investment, institution quality, GDP growth rate, exchange rate, and ICT (information, communication, and technology). The methodology deployed in the study

utilized Granger causality and VECM techniques to evaluate their results. The Granger causality test reveals that there is bidirectional causality among underlying variables. Further, the ARDL bound test and VECM tests confirmed that FDI and diversification are negatively correlated in the short and long terms in China.

Duru & Ehidiamhen (2018) utilized the ordinary Least Squares (OLS) analysis and ARDL bound tests methodologies together with the Hershman index (HI) over the period 1980-2016 to examine the interrelationship between economic growth and export diversification in Nigeria. Their study uncovered that the GDP growth rate and exports (i.e., Goods and services) had positive but insignificant effects on Nigeria's economic growth. Also, Ifeakachukwu & Alao (2018) exhibited how the monetary policy affected export diversification for the period 1962-2014 in Nigeria. Utilizing an ordinary least squares (OLS) estimator, the study explored that monetary policy had an insignificant impact on diversification. From the OLS estimator, the research explored that monetary policy played an important role in diversifying exports. The study recommended that the country must invest in sectors like manufacturing, mining, and tourism sectors.

Lee & Zhang (2021) empirically analyzes the impact of volatility and economic growth in diversifying export in a low-income and small income, using data spanning from 2001 to 2015. Their study used a method of GMM estimator, and its results show that export diversification (i.e., products and industries) enhances economic growth while reducing economic volatility. They further argued that the benefits of export diversification vary by the nation's size and level of income, whereas diversification in markets tends to play a significant part in economic growth and stability.

Ullah & Bilal (2019) explored the effect of gender inequality on export diversification in Pakistan. Utilizing annual data covering the period of 1982-2016, GMM instrumental variables were employed to estimate the results of the study. In cooperation with the Breusch-Pagan test, White test, and Johansen test, the outcome of the study suggested that gender inequality, terms of trade, demographic factors, GDP per capita, and trade openness were the key factors determining export

diversification in the long run. According to the results, the study recommends Pakistan policymakers should consider macroeconomic variables such as demographic factors, terms of trade, trade openness, and the real effective exchange rate when establishing policies concerning diversification.

Baleska-Spasova (2014) and Maysen (2013) have constructed a diagram of determinants of export diversification, based on secondary data. These determinants were identified and clustered into two major categories on a national or international level. At national level, identified factors depend on the characteristics of the industry. It is competitiveness, and factors specific to firms, marketing as well as export strategies to trade policies, whereas on an international level, the most frequent determinants include micro-economic factors such as exchange rate, regional or global trade agreements, and tariffs.

Arawomo et al. (2014) assess the effect of FDI on export concentration (diversification) in Nigeria. Here, the Herfindahl-Hirschman Index (HHI) has been empirically used for analysing data for 4-4-digit Standard International Trade Classification (SICT), on product classification, to investigate export diversification in Nigeria. It has been found that GDP per capita and trade openness have an impact on export diversification, while domestic investment promotes export diversification and foreign direct investment discourages investment. Another study conducted in Nigeria by Ifeakachukwu & Alao (2018) investigated how monetary policy influence diversification in Nigeria. The study utilized descriptive and Ordinary Least Square (OLS) techniques for 52 years (1962-2014). The study found that Nigeria's monetary policy has no influence.

Elhiraika et al. (2014) examined export diversification in Africa. Using the Generalized Method of Moments (GMM), estimators for analysing time series data for 53 African countries over a period of 16 years (1995-2011). It has been revealed that public investment, human capital, and infrastructure have a significant impact on diversification. A study has been conducted in SSA countries by Cabral & Veiga (2010) on export diversification in the region. The study uses regression for analysing data for 48 SSA countries over a period of 45 years (1960-2005). Results

indicated that good governance is the only factor influencing sophistication and diversification in the region, while corruption, transparency, and accountability are constraints for sophistication and diversification.

Using separate regressions on disaggregated trade data for 48 SSA countries for a recent period of 45 years Cabral & Veiga (2010) conducted a study on political and economic factors that determine successful export sophistication and export diversification strategies. They found that better governance and human capital important determinants for both the success of sophistication and diversification strategies. In contrast, it was also found that the level of transparency, accountability, and corruption are important factors in limiting the level of sophistication and diversification of exports.

Aigheyisi (2018) studied diversification in the ECOWAS sub-region. The paper employed the Feasible Generalized Least Squares (FGLS) estimator method using data from 1995 to 2015. The empirical results indicated that inflation, real GDP per capita, and financial institutions influence export diversification. Meanwhile, gross capital formation and real GDP per capita reduce export concentration and hence enhance export diversification. It was also found that increasing credit for the private sector has negative effects on export diversification and positive impact on export concentration. Here, inflation has been found to diminish the export concentration.

2.5.2 Local studies

In Rwanda, Maniriho & Nilsson (2018) examined the main factors that determine income diversification among all households. They used the binary logit panel model and the maximum likelihood technique to evaluate panel data for surveys of 2011-2014 from a sample of 3839 households across the country. Their results reveal that pull factors had a positive impact on income diversification among all household members (i.e., Education, internet connection, market access, and urbanization), whereas push factors had a negative effect on income diversification (i.e., risks and seasonality). The study recommends professional training on urbanization through the development of infrastructure and internet access (phones and wireless) to enhance household

income. Also, Hausman & Chauvin (2015) indicated the path of export diversification in Rwanda. In their work, they adopted an economic complexity index (ECI) to analyse the data gathered from COMTRADE from 1989 to 2010. Their research outcomes proved that tin, tea, and coffee constituted 80 % of the country's total exports. It has also been revealed that more than 100 traded products do not optimize transportation costs, and this has exerted a substantial adverse effect on the nation's limited resources.

2.6 Conclusion

In general, the literature on diversification is very extensive and the number of studies on diversification is overwhelming. However, the challenges are that in all the above-mentioned studies the focus was on wide regions and sometimes did not cover countries like Rwanda. This would cause drawing decisions on wide regions that are not necessarily applicable to smaller portions of them. Meanwhile, to the best author's knowledge, there have been no studies focusing on small countries such as Rwanda, yet such country's economies would greatly benefit from such studies.

CHAPTER THREE: RESEARCH METHODS AND METHODOLOGY

3.1 Introduction

This section presents econometric techniques employed to investigate the determinants of export diversification in Rwanda during the period spanning from 1980 to 2014. The section consists of three key parts. The first part explored data sources and descriptions of variables used in the study. The second part developed an empirical model and estimation procedures to address the research objectives outlined in Chapter One. Finally, the third part presented the diagnostic tests and conclusion.

3.2 Data type and sources

Annual time series data from 1980 to 2014 was used in this study. This period has been chosen due to the data availability and the time window where economic fluctuations were no longer taking place. The data consist of annual values for national foreign direct investment, trade openness, human capital, terms of trade, GDP per capita, and infrastructure as the key factors of export diversification. Two data sets were used: (1) the data set accessed from the WDI database, and (2) data for 4-digit SITC (Rev.1) from the UN COMTRADE database analyzed in the E-VIEWS 12 software package.

3.3 Definition of variables

3.3.1 Export diversification (Theil index)

Balavac (2012) declared that there are no metrics to measure export diversification. However, there are three commonly known indices used to measure export diversification, such as the Theil index, the Gini index, and the Herfindhal index. All these indices are correlated Cadot et al. (2011). In this study, regarding the requirements of existing data, the author utilised the Theil index as a proxy variable of the concentration index to determine export diversification in Rwanda. The Theil index ranges between one and zero, inclusively. The closer to one is the index, the more highly diversified the exported commodities are. However, if the export occurs by many commodities groups, then,

the Theil index is small the more export is concentrated. According to Cadot et al. (2011), the Theil index (TI) is mathematically presented as follows:

$$TI_t = \frac{1}{n}\sum_{i=1}^{n}\frac{Ev_i}{\overline{Ev}}\ln\frac{Ev_i}{\overline{Ev}} \quad (3.1)$$

where,

Ev_i: export value, with *i* ranging from 1 to the total number *n* of products,

$\overline{Ev}$: Average export value.

t =1980, 1981, 1982 …2014.

The average export value is given as:

$$\overline{Ev} = \frac{1}{n}\sum_{i=1}^{n} Ev_i$$

In this study, the author calculated the export concentration index for a time spanning 1980-2014 using the Theil index (TI) as a preferred measure. This will convey as a regressive function of the determinants of export diversification including gross domestic products per capita (GDPPC), human capital (HC), infrastructure (TEL), terms of trade (TOT), trade openness (TOP), and foreign direct investment (FDI).

3.3.2 Gross domestic product per capita (GDPPC)

The reason for including GDPPC as an explanatory variable in this research is to demonstrate how personal income affects their capacity to produce and buy different products. It was demonstrated that between diversification and income per capita, there is a positive correlation. Imbs &Wacziarg (2003) demonstrated a positive correlation between income per capita and export diversification. This indicates that there should be a positive correlation between GDP per capita and diversification. Therefore, Elhiraika & Mbate (2014) have confirmed that developing countries which Rwanda is among have highly specialized in exporting few commodities or few groups of products. Conversely, Parteka & Tamberi (2008) detect a negative impact of GDPPC on export

diversification. Nevertheless, in this study, it is expected that the Theil Index will exhibit an inverse correlation with GDPPC.

3.3.3 Human Capital (HC)

Human capital is a proxy variable of secondary school enrolment which is a primary determinant of diversification (Jetter & Hassan, 2013). As revealed in the empirical diversification literature, countries with a higher rate of secondary education in the labour force, boost their income due to positive terms of trade shocks that increase diversification (Agosin et al., 2013). Nonetheless, Elhiraika et al. (2012) confirmed that human capital (HC) had a statistically significant influence on export diversification. Yet, the authors (Agosin et al., 2012) discovered a strong positive effect. Therefore, in this study, HC is expected to have a positive link with diversification.

3.3.4 Terms of trade (TOT)

The TOT is an explanatory variable that measures how many imports a country can buy for a unit of its exports, representing an index of export prices over import prices (Carbaugh, 2013). An increase in the country's terms of trade leads the country to buy more exports compared to imports. However, if export prices fall compared to import prices, there will be a deterioration in TOT. Furthermore, a favorable TOT has been influenced by the exchange rate, which, due to the increase in currency value, negatively affects the country's import prices but not directly the price of export commodities. Therefore, TOT is expected to experience a significant positive link with the Theil index (diversification index). Elhiraika & Mbate (2014) confirmed that there are positive effects of human capital on export diversification.

3.3.5 Foreign direct investment (FDI)

It represents a long-term investment made by private companies in developing countries through foreign direct investment (Tundel et al., 2014). FDI is defined as short- and long-term assets in BOP. The study illustrates net foreign direct investment inflow as % of GDP. The hypothesis of the study is that FDI has a negative effect on export diversification. This explanatory variable has

also been employed by Adeoye (2009) and Acheampong & Osei (2014), although they found contrasting results.

3.3.6 Infrastructure (TEL)

In this study, TEL represents a proxy for infrastructure, standing for telephone lines per 100 persons. Infrastructure development in Rwanda reduces production costs, increases productivity, and maximizes profitability. Moreover, in this study, infrastructure development is considered as a potential factor in diversifying exports. Therefore, Canning & Bennathan (2000) found that infrastructure, specifically in telecommunications, enhances diversification. However, Kamuganga (2012) also indicated that a rise in infrastructure significantly increases the level of diversification, while a decrease in TEL will decrease the level of diversification. The expected relationship between the Theil index and infrastructure is positive.

3.4 Explanatory variables description

Table 1: Measurement

Explanatory variables	Measurement	Source
GDPPC	GDP per capita (millions in Dollars)	WDI-database
HC	The ratio of gross secondary school enrollment (index)	WDI-database
TOT	An index price of export over import prices (2000 =100)	WDI-database

TOP	The tototal xports nd imports normalized by GDP	WDI-database
FDI	Net inflows (% of GDP)	WDI-database
TEL	Mobile telephone lines per 1000	WDI-database

Source: World Development Indicators database.

3.5 Econometric model specification

The past empirical studies investigating the key determinants of export diversification have been a challenging exercise due to the absence of a theoretical model that encompasses all the main determinants. Nevertheless, the author has developed an econometric model inspired by previous studies such as Bebczuk & Berrettoni (2006), Cadot et al. (2011), Agosin et al. (2012), Parteka & Tamberi (2013), and Shabana & Zafar (2014). These studies support the idea that a higher value of export specialization is associated with a lower level of GDP per capita. Consequently, the base model is defined as follows:

$$\mathrm{TI} = \mathrm{f}(\mathrm{GDPPC}) \tag{3.2}$$

There is an inverse relationship between the Theil index and GDPPC. Previous empirical works, such as Munemo (2007), de Benedictis et al. (2009), and Elhiraika & Mbate (2014), suggested that equation (3.2) can take the form as follows:

$$TI_t = f\,(\mathrm{GDPPC_t}, \mathrm{HC_t}, \mathrm{TOT_t}, \mathrm{TOP_t}, \mathrm{FDI_t}, \mathrm{TEL_t}) \tag{3.3}$$

Equation (3.3) can be transformed into the log form to make a clear interpretation for GDPPC, HC, TOT, TOP, REER, and TEL which is written as follows:

$$LTI_t = b_0 + b_1 LGDPPC_t + b_2 LHC_t + b_3 LTOT_t + b_4 LTOP_t + b_5 LFDI_t + b_6 LTEL_t + \mu_t \quad (3.4)$$

3.6 Model estimation

To estimate correlation between export diversification and macroeconomic indicators in Rwanda, various models are available for this purpose. These include Engle & Granger (1987), Pesaran et al. (2001), Phillips & Hansen (1990), and Johansen & Juselius (1990). However, in this study, the author utilizes the model suggested by Pesaran et al. (2001) as it best reveals the co-integration vectors for the determinants under consideration. The model is referred to as ARDL model. The study employs PP and ADF tests to evaluate the presence of unit roots and to check the stationarity of variables in order to ensure that no variables integrated in order two.

3.6.1 Selecting optimal lag

There are different criterions for selecting optimal lag length in the series, such as the Hannan-Quinn criterion (HQ), Schwarz information criterion (SIC), and Akaike information criterion (AIC). Accordingly, this study selects the lag length based on AIC, as it has the lowest values among the criteria and is considered the best criterion for estimating lag length in a small sample size. In doing so, the ARDL co-integration technique $(q+1)^n$ for selecting an optimal lag length. Where, q represents lag numbers, and n is the number of variables in the study.

3.6.2 Unit root test

The study utilized unit root tests to assess the stationarity of variables. Stationarity of the series is indicated when the variance, mean, and covariance remain constant (Mahadeva & Robinson, 2004). The series is considered non-stationary if its statistical properties rotate over time. To examine this, both the ADF and PP tests were employed. Nevertheless, the representation of the ADF test for estimation is as follows:

$$\Delta Y_t = b_0 + b_{1t} + \psi Y_{t-1} + \sum_{i=1}^{q} \delta_i \Delta Y_{t-1} + \mu_t \quad (3.5)$$

Where, α_0, α_1, and δ_i are the estimated parameters, ε_t is the disturbance term. If H_0: $\psi = 0$ means that there is non-stationarity in the series, H_1: $\psi < 0$ means that there is stationarity. However, if

the ADF test is unable to discover non-stationarity, it contains a higher level of serial correlation and does not examine non-normality or heteroscedasticity. However, the PP test in this study is considered a distribution-free test (nonparametric test) because, in our data, we do not need a normal distribution. Therefore, the PP test is generalized as follows:

$$\Delta Y_t = \mu + \tau_2 + Y_{t-1} + (t - \frac{T}{2}) = b_0 + \sum_{i=1}^{q} \psi \Delta Y_{t-i} + v_t \quad (3.6)$$

3.6.3 ARDL bound to co-integration

The ARDL model suggested by Pesaran et al. (2001), is employed in this study as the most suitable co-integration technique for detecting the presence of co-integration between variables, given our data's small sample size. Consequently, ARDL-bound co-integration emerges as the preferred model for handling variables that are integrated at order one and zero. Therefore, ARDL is chosen over other co-integration techniques such as Engle & Granger (1987), Johansen (1988), and Johansen & Juselius (1990), as it proves to be an appropriate cointegration method for identifying the co-integrating vectors, especially when dealing with small data sample sizes.

In this model, each variable maintains a long-run relationship equation. When a co-integrating vector is identified, the ARDL model for the co-integrating vector is re-parameterized through an ECM. This re-parametrized feedback provides insights into both the long-run relationships and short run dynamics of the explanatory variables under investigation. Re-parameterization is feasible because ARDL shares the same form as the ECM and possesses a dynamic single-model equation. The choice of the test is made because the ARDL bound co-integration is demonstrated to be more effective for datasets with a small sample size, as our current study is from 1980 to 2014. In contrast to other co-integration techniques, the ARDL model aids us in estimating co-integration between the variables under consideration using an OLS-based lag model.

Furthermore, the ARDL model detects the presence of short and long-term associations, even if the order of the series is unknown. It solves the problem of endogeneity in macroeconomics. The author formulated Equation (3.3) in the ARDL model as:

$$\Delta LTI_t = b_0 + b_1 LTI_{t-1} + b_2 LGDPPC_{t-1} + b_3 LHC_{t-1} + b_4 LTOT_{t-1} + b_5 LTOP_{t-1} + b_6 LFDI_{t-1} + b_7 LTEL_{t-1} + \sum_{i=0}^{q} \delta_{2i} LHC_{t-i} + + \sum_{i=0}^{q} \delta_{2i} LGDPPC_{t-i} + \sum_{i=0}^{q} \delta_{5i} LTOP_{t-i} + \sum_{i=0}^{q} \delta_{6i} LFDI_{t-i} + \sum_{i=0}^{q} \delta_{7i} LTEL_{t-i} + \mu_t \quad (3.7)$$

3.6.4 The Long-run estimates of the ARDL model

If there is co-integration among the variables under investigation, the estimated long-run ARDL model is expressed in the following form:

$$\Delta LTI_t = b_0 + \sum_{i=0}^{q} \theta_1 \Delta LTI_{t-i} + \sum_{i=0}^{q} \theta_2 \Delta LGDPPC_{t-i} + \sum_{i=0}^{q} \theta_3 \Delta LHC_{t-i} + \sum_{i=0}^{q} \theta_4 \Delta TOT_{t-i} + \sum_{i=0}^{q} \theta_5 \Delta LTOP_{t-i} + \sum_{i=0}^{q} \theta_6 \Delta LFDI_{t-i} + \sum_{i=0}^{q} \theta_7 \Delta LTEL_{t-i} + \mu_t \quad (3.8)$$

3.6.5 The Short-run estimates of ARDL-ECM

Based on the information gathered above, there is co-integration among the variables under investigation. The authors checked the short-run dynamics by employing ECM to designate the speed of adjustment for the restoration of the equilibrium in the long run relationship. This can be adjusted in the equation (3.8) as follows:$\Delta LTI_t = b_0 + \sum_{i=0}^{q} \psi_1 \Delta LTI_{t-i} + \sum_{i=0}^{q} \psi_2 \Delta LGDPPC_{t-i} + \sum_{i=0}^{q} \psi_3 \Delta LHC_{t-i} + \sum_{i=0}^{q} \psi_4 \Delta TOT_{t-i} + \sum_{i=0}^{q} \psi_5 \Delta LTOP_{t-i} + \sum_{i=0}^{q} \psi_6 \Delta LFDI_{t-i} + \sum_{i=0}^{q} \psi_7 \Delta LTEL_{t-i} + \sum_{i=0}^{q} \theta ECM_{t-i} + \mu_t \quad (3.9)$

3.6.6 Causality test

The author adopts the causality test of Toda & Yamamoto (1995) to derive a Modified Wald test based on the chi-squared (χ^2) distribution. This test is used to assess if the parameters of the VAR model (k) significantly differ from zero. The lag length was selected based on the AIC, considered the best criterion for small sample sizes, where k = ($q + d_{max}$), and the degrees of freedom equal ($q + d_{max}$). The VAR model for Toda and Yamamoto causality between two variables is modified as follows:

$$Y_t = \mu_0 + \sum_{i=1}^{q} b_{1t} Y_{t-i} + \sum_{i=q+1}^{d_{max}} b_{2t} Y_{t-i} + \sum_{i=1}^{q} \beta_{1t} X_{t-i} + \sum_{i=q+1}^{d_{max}} \beta_{2t} X_{t-i} + \varepsilon_{1t} \quad (3.10)$$

$$X_t = \psi_0 + \sum_{i=1}^{q} \delta_{1t} X_{t-i} + \sum_{i=q+1}^{d_{max}} \delta_{2t} X_{t-i} + \sum_{i=1}^{q} \theta_{1t} Y_{t-i} + \sum_{i=q+1}^{d_{max}} \theta_{2t} Y_{t-i} + \varepsilon_{2t} \quad (3.11)$$

Where: q is an optimal lags length.

d_{max} stands the maximum order of integration on the VAR model.

ε_{1t} and ε_{2t} stand for the error's terms.

The bivariate for the VAR model on the equation (3.10), H_0 and H_1 are modified as follows:

H_0: Y_t does not cause X_t to grow, if $\sum_{j=1}^{i} \delta_{1j=0}$

H_1: Y_t does not cause X_t to grow, if $\sum_{j=1}^{i} \delta_{1j \neq 0}$

Where, the alternative hypothesis (H_1) formulated as follows:

H_0: X_t does not cause Y_t to grow, if $\sum_{j=1}^{i} \delta_{2j=0}$

H_1: X_t does not cause Y_t to grow, if $\sum_{j=1}^{i} \delta_{2j \neq 0}$

The causality between Y_t *and* X_t can be called bidirectional, unidirectional or no causality. Bidirectional relation occurs when the null hypotheses of equations (3.10) and (3.11) are rejected. Unidirectional existence occurs when the null hypotheses of equation (3.10) and (3.11) are not rejected. Thus, no causality occurs when neither the null hypothesis of equation (3.10) nor (3.11) is rejected.

3.6.7 Model diagnostic test

3.6.7.1 Normality test

To assess the normality of residuals, the study utilized the widely recognized Jarque-Bera test to detect if the residuals from the estimated ARDL model exhibit a normal distribution (Gujarati,

2004). This normality test assesses both kurtosis and skewness. The null and alternative hypotheses are specified as follows:

H_0: A normal distribution in residuals exist.

H_1: A normal distribution in residuals doesn't exist.

Based on the hypotheses, a normal distribution occurs in residuals when the P-values of Jarque-Bera statistics are greater than or equal to a 5% level of significance, in such cases, H_0 will be accepted. On the other hand, non-normal distribution exists if P-values are lower than or equal to 5%, leading to the rejection of H_0. The Jarque-Bera statistics test involves two degrees of freedom, where the residuals of an estimated model follow the chi-square distribution (Jarque & Bera, 1980). The Jarque-Bera statistics test is presented as follows:

$$JB = n\left(\frac{s^2}{6} + \frac{\mathrm{K}-3^2}{24}\right) \quad (3.12)$$

Where, K is the kurtosis, S is the skewness and *n* are the degree of freedom.

3.6.7.2 Serial correlation test

Serial correlation describes the link over time between two variables and their delayed version. When a variable's current level influences its potential future level, repeating patterns frequently display serial correlation. The estimations of the parameter's values and standard errors are impacted by the disturbance term's serial correlation. Particularly, the parameter estimations using OLS are statistically unbiased when the residuals are serially correlated. Lagrangian multiplier (LM) and Durbin-Watson (DW) tests were utilized to examine the serial correlation. This research employs the LM test.

3.6.7.3 Heteroskedasticity test

Heteroskedasticity exists when the variance of error terms is not constant. The research utilized the Breusch-Pagan test to detect the existence of heteroskedasticity. If the p-value is lower than 5%, the null hypothesis of homoscedasticity is rejected, revealing the presence of

heteroskedasticity in the regression model. Hence, the null hypothesis against the alternative is formulated as follows:

$H_{0:}\ q_1 = \cdots = qr = 0$ (Homoscedastic)

$H_{1:} = q_1 \neq \cdots \neq q_r = 0$ (Heteroskedastic)

3.6.8 The stability test

The study employed the most well-known stability tests, such as CUSUM and CUSUMSQ suggested by Brown et al. (1975). The CUSUM identified systematic changes in regression coefficients, while CUSUMSQ detected sudden changes in regression coefficients. However, if the plots of CUSUM and CUSUMSQ stay inside critical boundaries at 5%, the null hypothesis could not be rejected. Therefore, there is the existence of a stability coefficient in the short and long terms during the study period.

3.6.9 Conclusion

Chapter Three presents the methodology and relies on data from the UN COMTRADE database for the period 1980-2014. The chapter introduces the new trade model to investigate the short-term and long-term correlation among variables of interest. The purpose of this approach is to provide answers to research questions.

CHAPTER FOUR: EMPIRICAL ANALYSIS

4.1 Introduction

The empirical results on the determining factors of export diversification in Rwanda from 1980 to 2014 are presented in this chapter. The rest of this section is arranged in three sections. The first section discusses the description of variables and the empirical findings of the unit root test employing ADF and PP tests. Co-integration test results using the ARDL model suggested by Pesaran, et al. (2001) to estimate short-term and long-term coefficients are presented in the second section, while the third section determines causality among dependent and explanatory variables using the causality test developed by Toda & Yamamoto (1995).

4.2 Econometric analysis

4.2.1 Descriptive statistics

In this research, statistical description aims to demonstrate that all variables employed in this work are statistically significant, and the individual behavior of each variable is included in the model. To achieve this, Table 2 shows that the Theil index (TI) had an average value of -3.367% and a median of -3.400% for the study period (1980 to 2014).

Table 2: Descriptive statistics

Variables	LTI	LGDPPC	LHC	LTOT	LTOP	LFDI	LTEL
Mean	-3.367	5.796	2.667	6.051	-1.480	-0.679	-1.738
Median	-3.401	5.664	2.755	5.840	-1.495	-0.206	-1.740
Maximum	-0.495	6.611	3.707	7.833	-0.948	1.338	-0.804
Minimum	-4.843	4.844	0.705	4.718	-2.062	-8.927	-2.769
Std. dev.	0.616	0.401	0.630	0.790	0.295	1.796	0.579
Skewness	2.465	0.586	-0.836	0.903	0.136	-2.779	-0.128
Kurtosis	15.569	3.157	4.557	3.132	2.342	13.777	1.979

Jarque-Bera	265.840	2.039	7.609	4.781	0.739	214.388	1.614
Probability	0.000	0.361	0.022	0.092	0.691	0.000	0.446
Sum	-117.849	202.856	93.334	211.802	-51.809	-23.787	-60.843
Sum sq. dev	12.906	5.479	13.503	21.244	2.956	109.635	-11.4031
Observation	35	35	35	35	35	35	35

Source: Author's construction.

The maximum value of TI is -0.495%, while the minimum value is -4.843%, with a standard deviation of 0.616%. Based on the results of TI, it is expedient that Rwanda attempts to diversify its exports. However, GDP per Capita (GDPPC) had an average value of 5.796 units and a median of 5.664%, whereas its maximum and minimum values are about 6.611 and 4.844 units, respectively, with a standard deviation of 0.401 units. This demonstrates that there is no income inequality in Rwanda.

Also, Human Capital (HC), with a standard deviation of 0.630 units, has an average value of 2.667% and a median of 2.754%, with maximum and minimum values of 3.707 and 0.705 units, respectively. Similarly, the terms of trade (TOT) had an average value of 6.051%, corresponding with the lowest value of 4.718 units and the peak value of terms of trade being 7.833 units.

Trade openness (TOP) for the period studied has an average value of -1.480. The maximum value of trade openness was -0.948, and the minimum value was -2.062, with a median of -1.495. Also, foreign direct investment (FDI) and infrastructure (TEL) negatively averaged about 0.679 and 1.738 percent, respectively.

The Jarque-Bera statistical test results, which measure normality, revealed that the Theil index, FDI, and human capital are not normally distributed, as the p-values are less than 5%. In contrast, GDP per capita, terms of trade, trade openness, and infrastructure are normally distributed, as the H_0 was not rejected at five percent level of significance. Lastly, kurtosis shows the closeness of time series data to a normal distribution. Hence, only three variables, namely human capital,

foreign direct investment, and infrastructure, have kurtosis values close to three. The statistics indicate that all variables are positively skewed except for human capital and infrastructure.

In addition, the correlation among the studied variables is presented in Table 3.

Table 3: Correlation results

	LTI	LGDPPC	LHC	LTOT	LTOP	LFDI	LTEL
LTI	1.000	-0.052	-0.011	-0.023	-0.102	- 0.108	0.303
LGDPPC	-0.052	1.000	0.873	0.949	0.469	0.720	0.585
LHC	-0.011	0.873	1.000	0.848	0.305	0.803	0.442
LTOT	-0.023	0.949	0.848	1.000	0.629	0.661	0.569
LTOP	-0.102	0.469	0.305	0.629	1.000	0.217	0.119
LFDI	-0.108	0.720	0.803	0.661	0.217	1.000	0.103
LTEL	0.303	0.585	0.442	0.569	0.119	0.103	1.000

Source: Author's construction.

Table 3 above displays the highest correlation between TOT and GDPPC, while the smallest correlation exists between TI and HC. However, there is a weak negative correlation between TI and FDI during the research period.

4.2.2 Unit root test

In this study, the assessment of stationarity for the underlying variables and the variability of regression was carried out using a unit root test. Additionally, the ADF test was employed to verify

the order of integration and stationarity for the underlying variables, both in their levels and first differences. Consequently, Table 4 displays the results of the ADF test, incorporating constants and trends in the model.

Table 4: Augmented Dickey-Fuller (ADF) coefficients

Variables	Levels		1st Difference		
	Intercept	Intercept& Trend	Intercept	Intercept & Trend	Order of Integration
LTI	-4.79(0.0005) **	-5.11(0.0011) **	-9.44(0.0000) **	-9.29(0.0000) **	I (0
LGDPPC	-1.38(0.58) **	-1.75(0.7057) **	-6.31(0.0000) **	-6.32(0.0000) **	I (1)
LHC	0.76(0.9916) **	-1.17(0.9016) **	-7.91(0.0000) **	-8.41(0.0000) **	I (1)
LTOT	-1.9(0.5723) **	-1.65(0.6077) **	-6.03(0.0000) **	-5.23(0.0000) **	I (1)
LTOP	-1.60(0.4733) **	-1.75(0.7078) **	-7.03(0.0000) **	-7.23(0.0000) **	I (1)
LFDI	-2.17(0.2212) **	-2.34(0.4004) **	-6.71(0.0000) **	-6.84(0.0000) **	I (1)
LTEL	-1.04(0.7274) **	-3.36(0.0733) **	-6.64(0.0000) **	-6.548(0.0000) **	I (1)

Note: ** denote a five percent level of significance.

Source: Author's construction.

It is indicated that all variables of interest are not stationary at levels, except for the Theil index, they are stationary at the first difference. However, the ADF test results affirm that underlying

variables of interest are (I (1)), except the dummy for Theil index, which is integrated order zero (I (0)). The ADF test also confirmed that there is no variable with integration order two (I (2)).

The null hypothesis of the series is non-stationary against the alternative hypothesis. However, the probability values for all selected variables are lower than 5%, given the standard level of significance at first difference. Thus, the null hypothesis is accepted, indicating that variables of interest are stationary at the first difference, except for the Theil index. Consequently, (AIC) was employed to determine the lag length when testing the stationarity of all variables in the series.

As displayed in table 5, The unit root findings indicate that all variables of interest were non-stationary at levels, except for LTI and LFDI. The probability values (P-values) from the Phillips-Perron (PP) tests are statistically significant at five percent. Conversely, other variables employed in this research are not stationary at levels since P-values of the PP test are not statistically significant at 5 %. However, after differencing all variables in the model become stationary at five percent as the null hypothesis is rejected.

Table 5 : Phillips-Perron (PP) coefficients

Variables	**Levels**		**1st Difference**		
	Intercept	Intercept& Trend	Intercept	Intercept & Trend	Order of Integration
LTI	-4.79(0.0005) **	-5.10(0.0012) **	-25.82(0.0001) **	-27.12(0.0000) **	I (0
LGDPPC	-0.73(0.82267) **	-1.75(0.7077) **	-7.69(0.0000) **	-7.80(0.0000) **	I (1)
LHC	-1.36(0.5909) **	-1.75(0.7057) **	-6.35(0.0000) **	-6.43(0.0000) **	I (1)
LTOT	-3.21(0.3876) **	-1.16(0.9027) **	-7.69(0.0000) **	-8.68(0.0000) **	I (1)

LTOP	-1.68(0.4284) **	-1.69(0.7323) **	-6.910(0.0000) **	-7.39(0.0000) **	I (1)
LFDI	-3.77(0.0072) **	-3.77(0.0311) **	-11.78(0.0000) **	-16.85(0.0000) **	I (1)
LTEL	-0.87(0.7857) **	-3.41(0.0673) **	-7.65(0.0000) **	-7.56(0.0000) **	I (1)

Note: ** denote a five percent level of significance.

Source: Author's construction.

Table 5 above displays that all variables are not stationary except for LTI and LFDI. The outcome affirm that the variables are integrated of order zero and one, with no integration of order two. Therefore, as discussed in the study methodology, the co-integration test helps us to determine whether a combination of a series of non-stationary variables can become stationary. This is important if there is a correlation between underlying variables. For this reason, we need to proceed with the co-integration test.

4.2.3 The optimal lag length and model selection criteria

As addressed in the methodology section, the VAR model was utilized to determine the optimal lag in the ARDL model based on AIC, as presented in Table 6. The results confirmed that the optimal lag length on the AIC was one, and the best-fitting model from the top 20 selected ARDL models was ARDL (1, 1, 0, 1, 0, 1, 1).

Table 6 : Lag order

Lag	LOGL	LR	FPE	AIC	SC	HQ
0	-74.702	NA	$3.34e^{-07}$	4.952	5.269	5.058
1	76.283	228.765*	$7.39e^{-10e*}$	-1.229*	1.310*	-0.375*

2	118.296	45.833	$1.74e^{-09}$	-0.806	3.956	0.796

Note: * denoted lag order

Source: Author's construction.

4.2.4 Co-integration Test

After determining the stationarity properties of all variables, a bound test for cointegration was conducted to assess the existence of a long-run correlation among underlying variables, utilizing an estimation of the ARDL bound test with the appropriate decision criteria for lag length. As suggested by Pesaran, Shin & Smith (2001), it is advisable to select a maximum number of lag lengths for time series data. In this research there is a small sample size, it is recommended to use only one lag length. This is because as the lag length increases, the observations may not adequately demonstrate a proper long-run correlation among variables, and it is essential to ensure that the number of observations is at least higher than 30. The cointegration test in this study was selected using the bounds test approach, as indicated in the table below.

Table 7: ARDL bound test for co-integration

F-statistic	Significance	Lower bound I (0)	Upper bound I (0)
8.106**	10%	2.12	3.23
	5 %	2.45	3.61
	2.5%	2.75	3.99
	1%	3.15	4.43

**denote 5% level of significance

Source: Author's construction.

As reported in the above Table 7, the F-statistic (8.106) exceeds both the upper (3.23) and lower (2.12) bounds of critical values at the 5% level of significance. This indicates that the null

hypothesis (H_0) is rejected at 5%. These results are like the co-integration technique used by Iyoboyi (2019) in Nigeria. This reveals that there is cointegration of long run associations between variables. The findings also confirm there was a long-term relationship among Rwanda's export diversification and its determinants.

4.2.5 The long run estimates of the ARDL

After detecting the presence of co-integration among variables, it is necessary to employ an ARDL model as the best method to estimate long-run coefficients. Table 8 below shows that all coefficients of variables used in the regression have their expected signs except for terms of trade (TOT). As mentioned in the empirical literature section, trade openness (TOP), foreign direct investment (FDI), infrastructure (TEL), and human capital (HC) have a positive influence on Rwanda's export diversification in the long term. In contrast, GDPPC and TOT have a negative effect, while terms of trade (TOT) exhibit a negative relationship and insignificant influence on export diversification in the long term.

Table 8 : The long run estimates

Variables	Coefficients	St. Error	T-Statistics	Probability
LGDPPC	-2.260	1.127	-2.005	0.057
LHC	0.159	0.448	0.354	0.726
LTOT	-0.424	1.054	-0.403	0.691
LTOP	1.224	1.045	1.171	0.254
LFDI	0.356	0.180	1.976	0.061
LTEL	1.402	0.349	4.013	0.001

Source: Author's construction.

The Table 8 exhibits the results of long run estimation, coefficients of GDPPC was having a negative and insignificant effects on Rwanda's export diversification in the long term. This implies that assuming other variables are constant, one percent increment in GDPPC leads export

diversification to enhance (or reduce export concentration) approximately by 2.26 % at 5% level of significance. This reveals that there is insignificant negative correlation between GDPPC and Theil index (TI). This result concurs with the previous empirical investigation such as Imbs & Wacziarg (2003), Parteka & Tamberi (2008), Elhiraika & Mbate (2014).

Moreover, human capital was having insignificant positive influence on export diversification. This indicates that assuming other variables constant, a one percent rise in human capital rises export diversification by approximately 0.16 % at 5%. This result implies that Rwanda has a lower level of secondary education rate in the labour force such as a lower rate which causes the country to increase in income due to negative terms of trade (TOT) that reduce diversification. This corresponds the findings of Agosin, et al. (2012).

Furthermore, as discussed in the empirical literature section, the negative coefficient of terms of trade (TOT) indicates that there are significant negative impacts on export diversification, these results suggested that Rwanda's TOT have significant negative influence on export diversification. This reveals that assuming other variables constant, one percentage increment in TOT will tend to decrease diversification by approximately 0.42 % at a 5% level of significance in the long- run. From the analysis, favourable terms of trade have been influenced by the exchange rate due to the increase in currency value. This has a negative effect on Rwanda's import prices but not directly on the price of export commodities. The results confirm the discoveries of Agosin et al. (2012), and Carbaugh (2013), who discovered that there exists a negative relationship when terms of trade are compared with export diversification.

Again, Trade openness (TOP) was insignificant positive impacts on Rwanda's diversification in the long run with a P-value of 0.2542. These results indicate that, assuming other variables constant, a rise in trade openness by 1% decreases export diversification by approximately 1.22 % at a 5% level of significance. This is explained earlier in economic theory that the more a country opens its economy, it will increase export diversification through the international market. The

result opposes the findings of Kamuganga (2012) that TOP was having a significant positive influence on export diversification.

As Table 8 also indicates, the coefficient for foreign direct investment (FDI) was found to have a positive and insignificant impact on Rwanda's diversification at the five percent level of significance. The long -run coefficient of FDI demonstrates that, assuming other variables remain constant, a 1% increase in FDI leads to a reduction in export diversification by approximately 0.37%. Overall, as discussed earlier in economic theory, a positive sign indicates that FDI inflow in Rwanda decreases the likelihood of East African countries exporting new commodities and entering new market margins. Hence, the results are similarly to the discovery of Alemu (2009) and Iwamoto & Nabeshima (2012) where their found a negative correlation among foreign direct investment (FDI) and Theil index (TI).

Finally, Telephone line (TEL) was found positive and strong impact on Rwanda's export diversification at five percent level of significance. The long run coefficient of telephone lines reveals that, holding other variables constant, a rise in telephone lines by one percent enhances export diversification by approximately 1.40 %. Hence, infrastructure development in Rwanda reduces production costs, increases productivity, and maximizes profitability. The outcome obtained support the results of Kamuganga (2012), and Obeng (2018).

4.2.6 Short-run estimates from ECM

After assessing the long-run nexus among underlying variables, the next stage is to find out the short-run coefficients within an ARDL estimation model. Considering Table 9 below, it is observed that there are four variables, namely GDP per capita (GDPPC), infrastructure (TEL), foreign direct investment (FDI), and trade openness (TOP) are the only short run determining factor of export diversification in Rwanda.

Table 9 : Coefficient of ECM

Variables	coefficients	St. Errors	t-statistics	P-values
C	19.036	2.242	8.492	0.000
D(LGDPPC)	-0.499	0.702	-0.712	0.484
D(LTOP)	-0.452	0.528	-0.856	0.401
D(LFDI)	0.039	0.072	0.543	0.592
D(LTEL)	0.652	0.468	1.392	0.178
cointEq (-1)	-1.161	0.137	-8.498	0.000

Source: Author's construction.

The ECM reveals that GDP per capita (GDPPC), and trade openness (TOP) reduces export concentration (increases diversification) in the short run as their coefficients has negative sign. In contrast, infrastructure (TEL) and FDI increase export concentration in the short run during the study period. However, only four variables namely GDPPC, TOP, FDI, and TEL were found as determinants and statistically insignificant to affect export diversification at 5% in the short run. As the ECM results are displayed in Table 9 a negative coefficient of trade openness (TOP) indicates that Rwanda's total imports exceed total exports, and the exchange rate also has experienced depreciation which caused a negative trade balance over the study period.

However, foreign direct investment (FDI) can be painful to the Rwandan economy and the results show that assuming other variables constant, an increase in FDI by one percent leads to enhance export diversification by 0.04 % in the short term. This suggested that FDI was correlated with export diversification. The study by Swathi & Sridharan (2022) delivered the same findings. Also, ECM estimation shows that trade openness (TOP) is having a negative influence on export diversification in the short- run at a five percent level of significance. This phenomenon suggested that TOP is not correlated with diversification in the short run which implies that TOP has an indirect impact on Rwanda's export diversification. This reveals that rise of 1% in TOP by holding other variables constant leads to enhance export diversification by 0.04% in the short run, whereas telephone line has a positive coefficient which is indicates that, assuming other things constant an increase of 1% in TEL raises export diversification about 0.65%.

The estimated coefficient of short-term in error correction term (ECT) is statistically significant as was expected at 5% with -1.161. The ECT indicates how quickly the speed of adjustment from the short-term to achieving the long-term equilibrium after a random shock. Furthermore, the coefficient of the co-integrating equation cointEq (-1) implies that the deviation from the long-term equilibrium level of diversification index (TI), which measures export diversification in the current year, was approximately 116 % of disequilibrium from the current period's shock, returns backs to the equilibrium in the same period. As cointEq (-1) is highly statistically significant which proves that there is an existence of long-run relationship among variables. Hence, it takes half of the year to restore the long-run equilibrium. These results agree with the findings of Banerjee et al. (2003).

4.2.7 Granger causality test

The Granger causality test employs the TY causality test (Modified WALD test) to detect the causal interaction among variables in the estimated model. Hence, the VAR model was increased by building-up the optimal lag length (dmax) which is equal to one and was further enlarged by the order of integration (q) which is equal to three.

Table 10: TY causality test results (Modified Wald test)

Null hypothesis	Chi-sq.	df	P-value	Causality interaction results
There is no Granger causation from LGDPPC to LTI	5.383	3	0.146	No causality
There is no Granger causation from LTI to LGDPPC	6.808	3	0.078	
There is no Granger causation from LHC to LTI	4.148	3	0.246	Unidirectional causality (LTI ↔LHC)

There is no Granger causation from LTI to LHC	10.722	3	0.013	
There is no Granger causation from LTOT to LTI	3.743	3	0.290	No causality
There is no Granger causation from LTI to LTOT	5.194	3	0.158	
There is no Granger causation from LTOP to LTI	1.563	3	0.667	No causality
There is no Granger causation from LTI to TOP	6.689	3	0.168	
There is no Granger causation from LFDI to LTI	2.605	3	0.457	Unidirectional causality (LTI↔ LFDI)
There is no Granger causation from LTI to LFDI	16.479	3	0.009	
There is no Granger causation from LTEL to LTI	3.135	3	0.371	No causality
There is no Granger causation from LTI to LTEL	4.795	3	0.187	

Note: ** denote significance level at 5%.

Source: Author's construction.

Toda Yamamato causality test reveals that comparing gross domestic products per capita (GDPPC) and export diversification (TI) shows a unidirectional relationship. This also confirms the feedback hypothesis. Also, no causality was detected in both directions between the following variables: Terms of trade (TOT) and export diversification (TI), Trade openness (TOP) and export diversification (TI), Infrastructure (TEL) and export diversification (TI), since their P-values is higher than 5% which means the null hypothesis was not rejected.

4.2.8 Diagnostic test

The diagnostic tests are employed to verify if the estimated model is reliable or not reliable. In this study, the model diagnostic was checked in three ways. Firstly, Serial correlation (using Breusch-Godfrey LM test), Secondly, Normality (using jarque-Bera test), Lastly, Heteroskedasticity (using Breusch-Pagan Godfrey test). All diagnostic tests are performed on the selected model. To reject or accept the null hypothesis based on probability values correspond with F-statistic. Thus, in this study, the null hypothesis was rejected when the standard level of significance at 5% is higher than the calculated p-values.

4.2.8.1 Serial correlation results

As indicated in Table 11, calculated P-value of 0.871 exceeds 5 % level of significance. Hence, Serial correlation does not exist among variables as the null hypothesis was not rejected.

Table 11 : Breusch-Godfrey LM results

Null hypothesis	F-statistic	P-value	Decision
Not correlated	0.027	0.871	H_0 was not rejected

Source: Author's construction.

4.2.8.2 Normality test results

The Jarque-Bera test output is presented in Table 12. Test results found that the series is normally distributed as a p-value of 0.901, which exceeds a 5% level of significance.

Table 12: Jarque-Bera test results

Null hypothesis	Jarque-Bera	P-value	Decision
Normal distributed	0.209	0.901	H_0 was not rejected

Source: Author's construction.

4.2.8.3 Heteroskedasticity test results

The heteroskedasticity test results from Table 13 indicate that the null hypothesis was not rejected due to the calculated p-value of 0.5367 which exceeds the 5% level of significance. Consequently, the estimated model has homoscedasticity variances.

Table 13 : Breusch-Pagan-Godfrey test results

Null hypothesis	F-statistic	P-value	Decision
Homoscedasticity	0.923	0.537	H_0 was not rejected

Source: Author's construction.

4.2.9 Model stability test

The appropriateness and stability test for the long terms together with short terms relationship dynamics was detected by employing CUSUM and CUSUMSQ tests. According to Pesaran (1997), the stability of the estimation model shows whether coefficients of regression are changing over time. Accordingly, the graph of the estimated ARDL model for the CUSUM and CUSUMSQ are graphed against the critical bounds at 5%. If the plots of CUSUM and CUSUMSQ stay within parallel lines (red links) at 5% the null hypothesis cannot be rejected, then all parameters are stable both in the short and long terms relationships. However, if the parallel lines and blue lines are closed, at 5%, H_0 cannot be rejected. Then, the parameter instability exists in short term and long-term relationships.

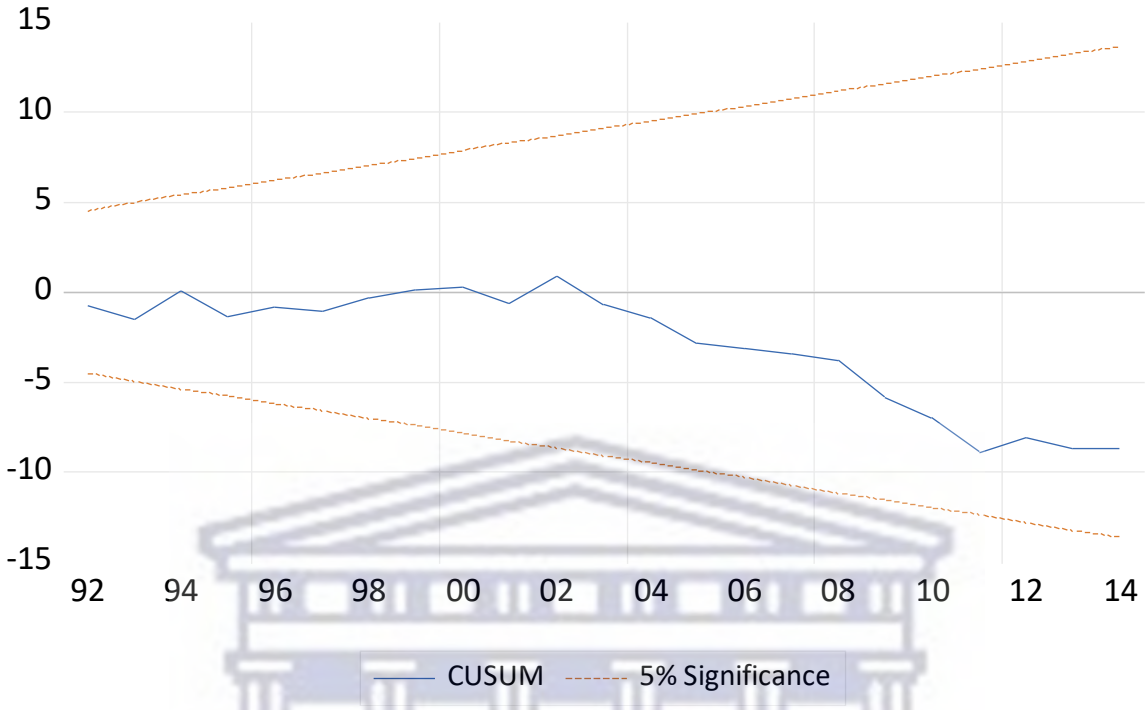

Figure 1: Plot of CUSUM

Source: Author's construction.

As indicated in Figure 2, plot of CUSUM on the estimated model stays within red links (lower and upper bounds) at 5 percent level of significance. Then, author confirm that all parameters are stable.

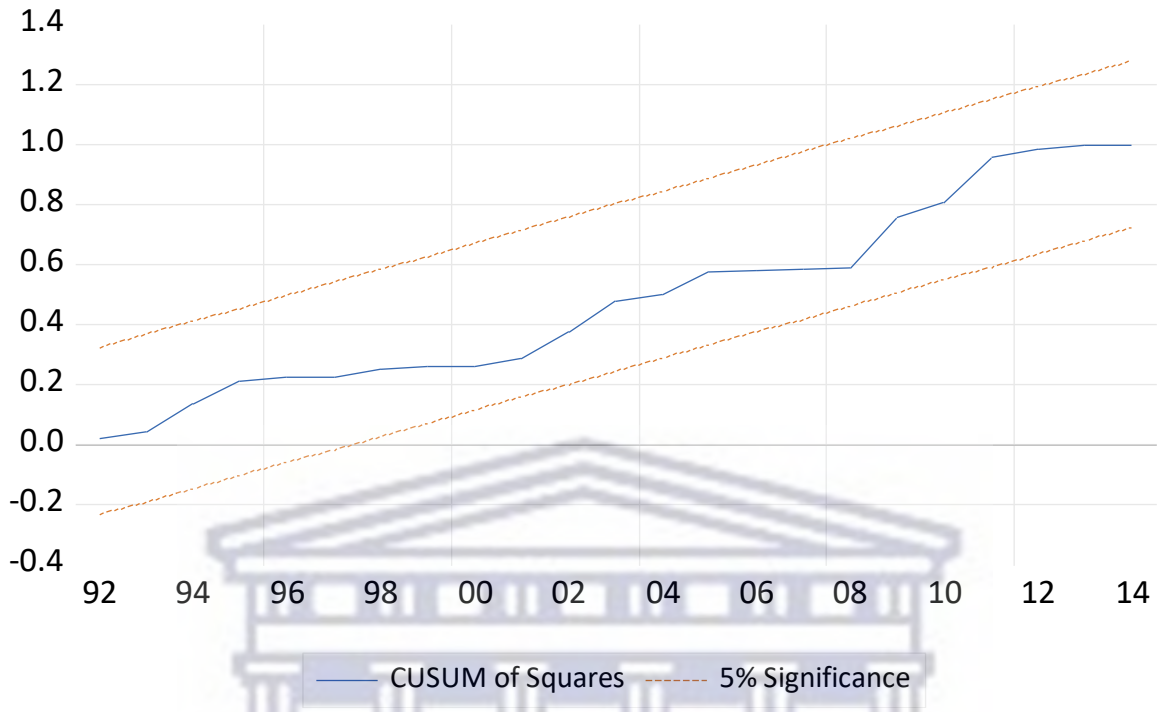

Figure 2 : Plot of CUSUMSQ

Source: Author's construction.

Also, as displayed in Figure 3, plot of CUSUMSQ on the estimated model suggests that parameters are well specified, and the stability exists as CUSUMSQ stays between the two critical bounds (red links) at 5 percent level of significance.

4.3 Conclusion

The purpose of this study was to examine the determinants of export diversification in Rwanda between 1980 and 2014. The study employed the ARDL technique to determine the short-and long-term relationship among underlying variables. The Theil index was utilized as the best estimator in diversifying export. The independent variables employed in this research were GDPPC, FDI, HC, TOT, TOP, and TEL. Before estimating the model, the stationarity properties in time series data were tested employing the ADF and PP tests. The outcomes of the unit roots test to exhibit that all parameters were integrated in order zero and one, but none was integrated in order two. The ARDL bound test for co-integration confirmed that there is an existence of long- and short-term relationships between variables. Hence, the results obtained from ARDL estimation indicated that GDP per capita, foreign direct investment, human capital, terms of trade, trade openness, and infrastructure were found as Rwanda's long term export diversification.

Specifically, the outcomes proved that GDPPC, FDI, HC, TOT, TOP, and TEL proxied by telephone line hypothesized signs which demonstrate the increase of export diversification. Thus, TEL was found to have a significant positive effect on Rwanda's export diversification compared to other selected variables in the long run. However, from ECM estimation indicated that GDPPC, TOP, FDI, and TEL was only short run determinants in Rwanda. The coefficient of ECT (116%) was highly statistically at 5% which confirms that there is co-integration among variables.

The model diagnostic and stability tests results revealed that there is no existence of serial correlation. Meanwhile, the estimated model is homoscedasticity, plots of the estimated model for CUSMSQ and CUSUM tests revealed that all parameters was stable over the specified period since the estimated model was situated in the middle of red link. These results confirmed that there is relationship among export diversification and its determinants as referred to by Narayan (2005).

CHAPTER FIVE: CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

The objective of this chapter is to deliver a summary, conclusion, and recommendation concerning the findings of the study. The chapter opens with section 5.2, in this section, the study presents a summary of findings and how those findings were made while section 5.3, deals with a conclusion. Section 5.4 constitutes recommendations based on the outcomes of the paper. Finally, in section 5.5, the study presents areas for future studies.

5.2 Summary

Objective of this paper was to investigate the relationship among export diversification and its determinants. To achieve this, the study employed ARDL model (Pesaran & Shin, 2001) and TY developed by Toda & Yamamoto (1995). The study revealed an upward trend in TI, HC, GDPPC, TOT, TOP, FDI and TEL during the study period. The stationarity variables were assessed utilising unit root test. The outcomes of PP and ADF tests confirmed that all underlying variables became stationary after differencing, except for the Theil index, and none were integrated in order two (I (2)). The bound test for co-integration indicated long run correlation between selected variables under investigation.

Moreover, the short-run dynamics for the estimated model indicated that only trade TOP, FDI, and TEL had a short-term impact on Rwanda's export diversification in the period from 1980 to 2014. Notably, telephone lines had a significant positive effect on the country's export diversification, while foreign direct investment and trade openness had an insignificant impact in the short run. The study found that the coefficient of ECT was -1.16, suggesting that the adjustment from long-term disequilibrium to equilibrium was extremely fast, with Rwanda's economy correcting itself by 116% from the previous year's disequilibrium. However, foreign direct investment and trade openness had an insignificant effect on Rwanda's export diversification, both in the short and long term, while telephone lines had a significant effect.

The examination of the causal relationship among variables using the Toda and Yamamoto test revealed unidirectional causality from export diversification to its determinants in Rwanda. Furthermore, diagnostic and stability tests were conducted to assess the variability of the estimated model. These included serial correlation, normality, functional form, and heteroskedasticity tests. The results indicated that there was no serial correlation, no evidence of normal distribution, the functional form was incorrectly specified, and the estimated model exhibited homoscedasticity. Moreover, the CUSUMSQ and CUSUM tests for the estimated model showed that all parameters remained stable throughout the research span, as the model was situated within the middle of the upper and lower bounds at a 5 percent critical value.

5.3 Conclusion

In examining the empirical results with specific study objectives, the author concludes that there is existence of short and long-term relationship between export diversification (TI) and its determinants (GDPPC, HC, TOT, TOP, FDI, and TEL). Furthermore, the results demonstrated that in in the long-run, GDP per capita insignificantly impacts export diversification negatively, while human capital has an insignificantly positive effect on export diversification. This suggests that improving the level of education is essential for increasing export diversification.

Meanwhile, terms of trade significantly affect export diversification, signifying that higher terms of trade associated with lower export diversification. Additionally, TOP has a positive effect, but it is statistically insignificant regarding export diversification, implying that higher trade liberalization enhances export diversification. Consequently, FDI has a positive impact but is statistically insignificant regarding Rwandan export diversification, indicating that higher foreign direct investment is associated with greater export diversification. Finally, infrastructure significantly influences export diversification, with a higher level of infrastructure associated with increased export diversification.

Furthermore, only four variables, namely FDI, TOP, TEL and GDPPC have been found to have positive and insignificant effects on Rwanda's export diversification in the short run. Moreover, the causality test reveals that there is presence of unidirectional causality between FDI, HC, and export diversification, while there is no causal link among TOP, GDPPC,TOT, and the diversification index (TI).

5.4 Recommendations

Considering the results of the study, the following policy recommendations are suggested:

- **Trade Promotion:** The Rwandan government should Support Rwandan businesses in marketing their products abroad where the Government agencies can help in trade promotion activities, such as participating in trade fairs and trade missions.
- **Infrastructure Development:** Rwanda should invest in infrastructure, including transportation and logistics, to reduce the cost of exporting. Efficient logistics can streamline businesses' access to international markets.
- **Quality Standards and Certification:** The government should ensure that Rwandan products meet international quality standards and obtain necessary certifications. This can enhance the competitiveness of Rwandan exports.
- **Diversification Incentives:** The government should Implement policies and incentives to motivate businesses to diversify their export products. This may include tax incentives, grants, or subsidies for businesses exploring new export markets.
- **Access to Finance:** The government must ensure that businesses have access to affordable financing options to support their export endeavors. This can involve export credit guarantees and trade finance programs.
- **Risk Mitigation:** Develop strategies to mitigate risks associated with diversification, such as currency exchange rate fluctuations and market volatility. This could entail creating risk-sharing mechanisms or insurance programs.

- **Cluster Development:** Encourage the formation of industry clusters where related businesses can collaborate and share resources, expertise, and knowledge to foster diversification.
- **Promote Sustainable Practices:** Embrace sustainable and environmentally friendly practices in export-oriented industries. This can enhance the marketability of Rwandan products in environmentally conscious markets.
- **Internationalization of Education:** Promote education and training programs that align with global market demands, ensuring that the workforce is equipped with the necessary skills and knowledge for diversified export sectors.
- **Monitoring and Evaluation:** Establish a system for monitoring the progress of export diversification efforts and make necessary adjustments based on feedback and data.

It is crucial for the Rwandan government, in partnership with the private sector, to develop a comprehensive export diversification strategy that takes these factors into account and adapts continuously to changing global market conditions. Additionally, fostering an entrepreneurial culture and promoting awareness of international trade can significantly influence to the success of export diversification efforts.

5.5 Limitations

Due to the lack of data, the study utilized a small sample size of 35 observations in the post-independence era in Rwanda using data from 1980 to 2014, to investigate variables affecting export diversification. Therefore, the research employed the ARDL bound test for co-integration and TY Granger causality tests to yield relevant results. This indicates that future studies may explore alternative econometric techniques and could potentially yield different results from this study.

5.6 Areas for further studies

The research identified the primary determinants of export diversification in Rwanda but did not encompass all determinants, including governance factors, institutions, exchange rates, geographical location, investments, and population. Further studies could evaluate these variables on both intensive and extensive levels.

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APPENDICES

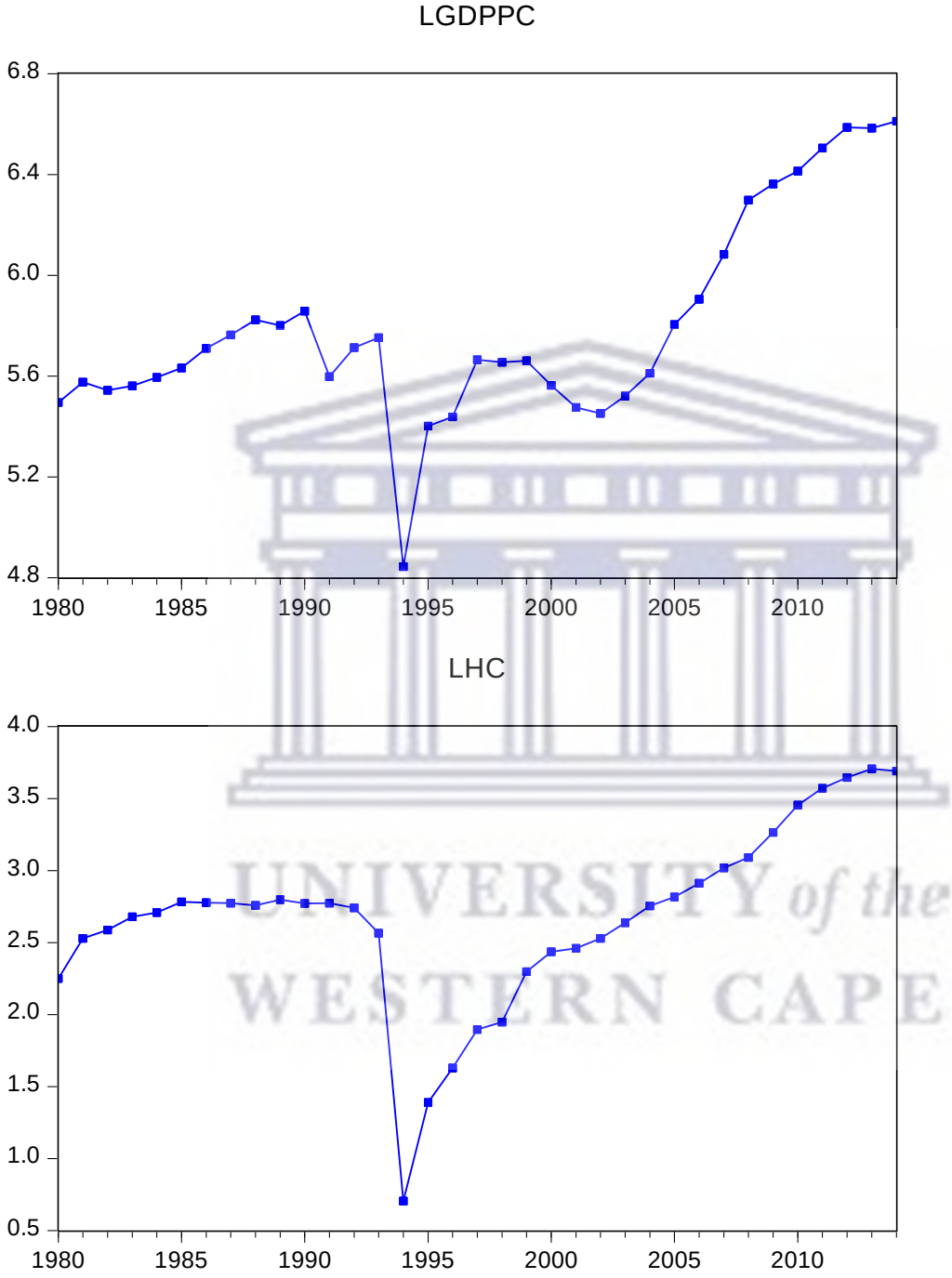
APPENDIX 1

YEAR	TI	GDPPC	HC	TOT	TOP	FDI	TEL
1980	0.031	243.487	9.471	124.307	0.251	1.309	0.064
1981	0.029	264.026	12.533	352.224	0.259	1.281	0.063
1982	0.012	255.637	13.281	327.355	0.269	1.471	0.073
1983	0.034	260.005	14.565	351.850	0.270	0.751	0.082
1984	0.033	268.923	14.998	407.628	0.267	0.949	0.083
1985	0.032	279.1059	16.150	392.274	0.250	0.852	0.084
1986	0.034	301.798	16.075	525.771	0.277	0.904	0.084
1987	0.032	318.206	16.000	383.139	0.216	0.813	0.097
1988	0.030	337.955	15.762	381.942	0.199	0.879	0.115
1989	0.029	330.497	16.412	338.936	0.175	0.646	0.127
1990	0.008	349.873	15.993	343.782	0.156	0.3004	0.142
1991	0.019	269.850	16.014	322.315	0.209	0.239	0.159
1992	0.033	302.739	15.505	261.238	0.175	0.271	0.175
1993	0.032	314.751	13.000	282.100	0.202	0.296	0.176
1994	0.033	126.955	2.023	111.983	0.367	0.000	0.168
1995	0.0383	221.629	4.012	209.382	0.224	0.155	0.118
1996	0.031	229.887	5.099	234.509	0.230	0.160	0.170
1997	0.038	288.409	6.660	303.366	0.208	0.139	0.181
1998	0.0327	285.710	7.004	247.089	0.173	0.357	0.155
1999	0.023	287.374	9.953	232.717	0.145	0.081	0.169

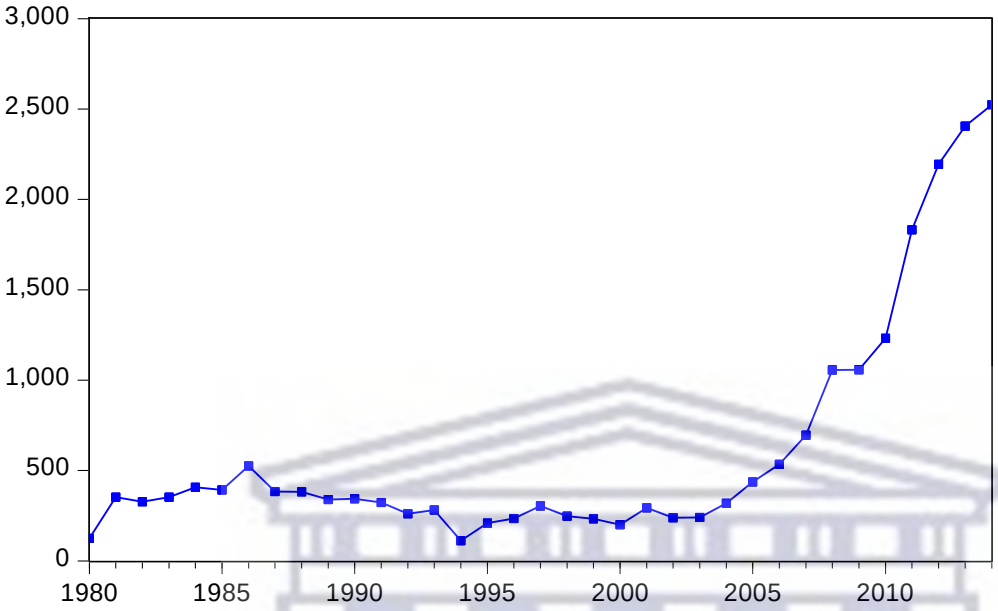
2000	0.034	260.601	11.414	200	0.127	0.392	0.221
2001	0.036	238.781	11.704	294.057	0.187	0.941	0.261
2002	0.609	233.1512	12.531	238.957	0.159	0.076	0.298
2003	0.037	249.743	13.967	240.343	0.151	0.219	0.299
2004	0.047	273.634	15.714	318.282	0.161	0.324	0.267
2005	0.034	331.690	16.725	436.982	0.203	0.271	0.267
2006	0.045	366.894	18.381	534.973	0.222	0.923	0.258
2007	0.047	438.664	20.440	694.962	0.233	2.022	0.249
2008	0.046	543.545	21.973	1055.65	0.278	1.976	0.176
2009	0.045	579.727	26.149	1057.089	0.272	2.092	0.342
2010	0.053	609.723	31.618	1232.089	0.282	3.532	0.395
2011	0.037	668.495	35.587	1832.217	0.364	1.629	0.378
2012	0.024	725.169	38.308	2193.294	0.378	3.524	0.420
2013	0.033	722.894	40.718	2405.902	0.384	2.991	0.419
2014	0.026	743.559	40.091	2522.692	0.387	3.810	0.448

Source: World Development indicator database.

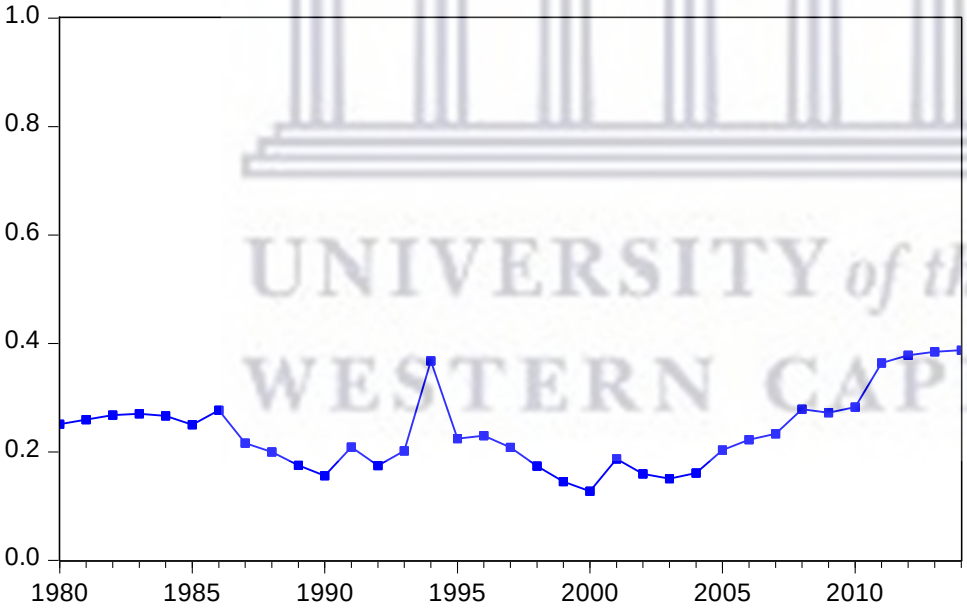
APPENDIX 2: Trend of variables



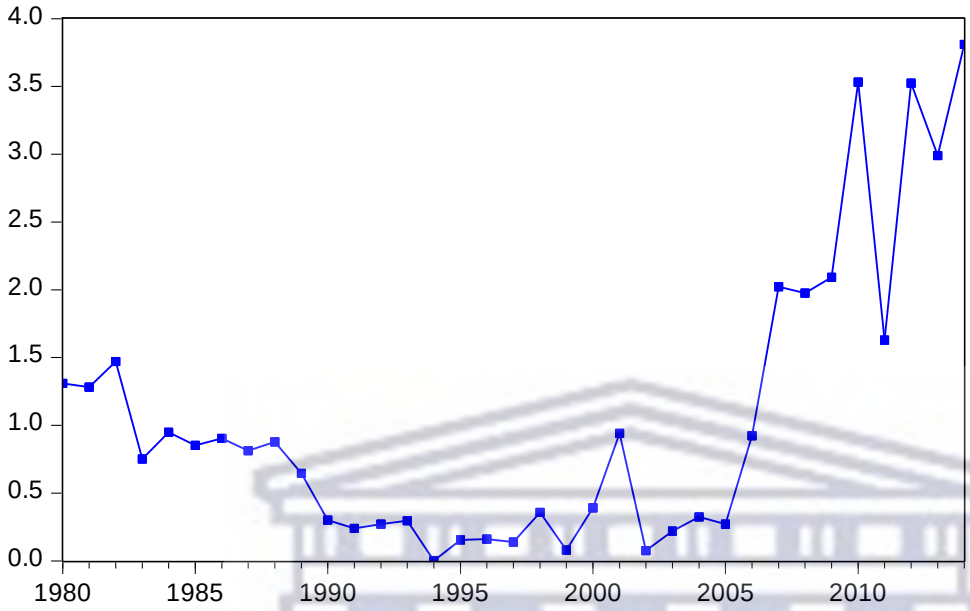
TOT



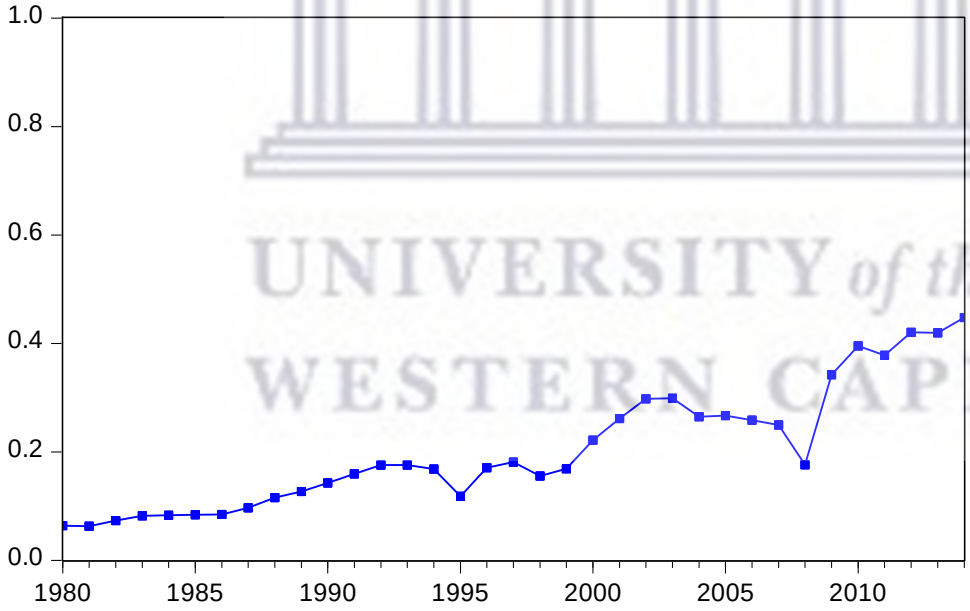
TOP



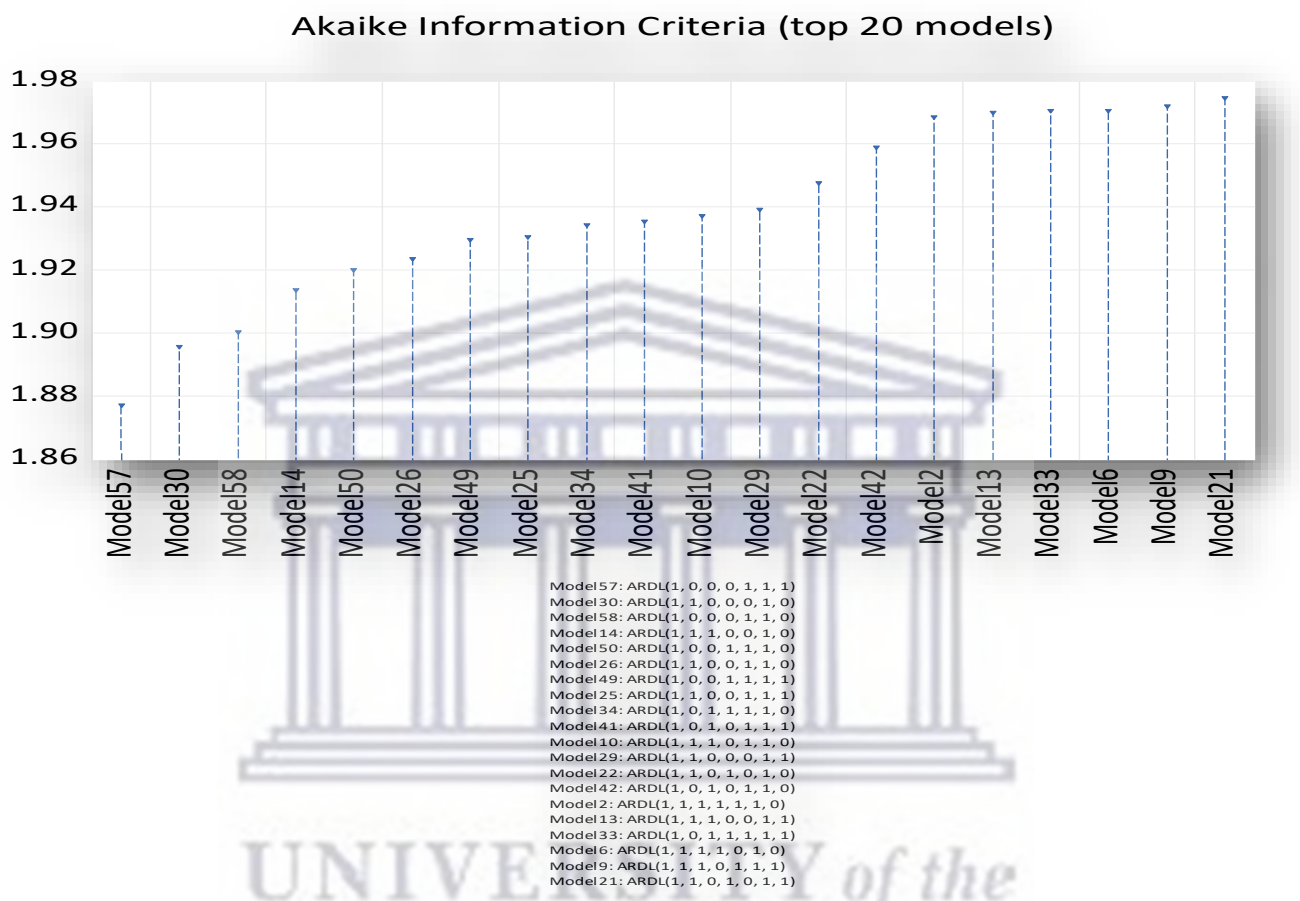
FDI



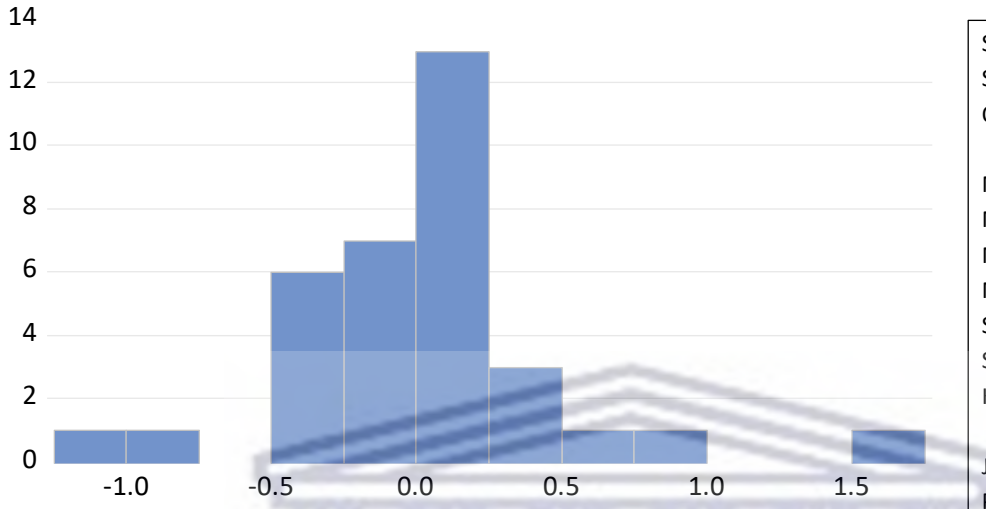
TEL



APPENDIX 3: AIC



APPENDIX 4: Normality test



Series: Residuals	
Sample 1981 2014	
Observations 34	
Mean	1.25e-15
Median	0.016449
Maximum	1.539180
Minimum	-1.023295
Std. Dev.	0.454249
Skewness	0.805929
Kurtosis	5.941284
Jarque-Bera	15.93642
Probability	0.000346