COMPETITIVENESS OF THE SOUTH AFRICAN CITRUS FRUIT INDUSTRY RELATIVE TO ITS SOUTHERN HEMISPHERE COUNTERPARTS FROM 1989 TO 2019

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COMPETITIVENESS OF THE SOUTH AFRICAN CITRUS FRUIT INDUSTRY RELATIVE TO ITS SOUTHERN HEMISPHERE COUNTERPARTS FROM 1989 TO 2019

BY

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[redacted]

MINI DISSERTATION

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ABSTRACT

The citrus fruit industry holds a significant position within South Africa's agricultural sector due to its labour-intensive and export-oriented practices. However, this industry faces growing competition not only on a global scale but particularly from citrus fruit producers in the Southern Hemisphere. The Southern Hemisphere counterparts benefit from similar climatic conditions and have access to the same export markets. Thus, the objective of this study was to compare and analyse the competitiveness of South Africa's citrus fruit industry with its counterparts in the Southern Hemisphere from 1989 to 2019. To conduct this analysis, annual time series data was collected from reputable sources such as the Food and Agricultural Organisation of the United Nations and the International Trade Centre (ITC). The data was analysed using Microsoft Excel spreadsheet and Eviews 12 software. The Balassa Revealed Comparative Advantage (RCA) index and the Net Export index (NXI) were employed as measures to assess the competitive performance of South African citrus fruit in comparison to its Southern Hemisphere counterparts. The competitiveness of different South African citrus fruits in major markets was analysed using the Constant Market Share (CMS) model. Additionally, the Armington model was utilized to examine the macroeconomic factors that impact the competitiveness of the South African citrus industry. The findings from the Balassa Revealed Comparative Advantage (RCA) index indicated that the South African citrus industry demonstrates a stronger and relatively higher competitive advantage in the production and exportation of most citrus fruit product categories compared to its Southern Hemisphere counterparts. The results from the Net Export index align with the RCA findings, showing that South Africa is a net exporter of citrus fruits. Moreover, the CMS results shed light on the specific markets where different citrus fruits exhibit competitiveness. Lastly, this study identified various macroeconomic factors, both in the short and long run, that influence the competitiveness of the South African citrus industry at different levels of significance. For the industry to be sustainable and to enhance its competitiveness, several recommendations and strategies are suggested at the end of this study which includes exploring potential strategic markets like the Russian and the Asian market, reducing reliance on the EU and producing and exporting more lemons and limes; and soft citrus.

Keywords: Citrus fruit industry, Constant Market Share, Revealed comparative advantage, Net Export index, Armington model

DECLARATION 1

I, Lefa Given Mokonyane, hereby declare that:

i. The research reported in this mini dissertation, except where otherwise indicated, is my own original work.

ii. This mini dissertation has not been submitted in partial or entirety for degree purposes to any other university.

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As the candidate 's supervisors, we agree to the submission of this thesis.

Signed: _____ Date: 02/04/2024

Dr M.A. Nkoana (Supervisor)

Signed: _____ Date: 02/04/2024

Dr L.S. Gidi (Co-supervisor)

DECLARATION 2

The following publication will form part of the research presented in this full dissertation.

Publication 1- Chapter Five of this mini dissertation

Lefa G Mokonyane, Mmaphuti A Nkoana and Lungile Gidi. Determinants of the South African citrus industry. MDPI has identified the paper for publication.

The abovementioned paper won 1st place in the School of Agriculture and Environmental science category on the 13th Faculty of Science and Agriculture research day presentations held on the 20th to the 22nd September 2023.

DEDICATION

I dedicate this mini dissertation to my late grandparents, my sweet grandmother, my parents (Mr MJ Mokonyane and Mrs PJ Mokonyane); my younger sister and my community as a token of appreciation for making me the person that I am today.

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ACDASA: Agricultural Chemical Distribution Association of South Africa

ADF: Augmented Dickey Fuller

AGOA: African Growth and Opportunity Act

ARC: Agricultural Research Council

ARCH: Autoregressive conditional heteroskedasticity

BRICS: Brazil, Russia, India, China and South Africa

CGA: Citrus Growers Association

DAFF: Department of Agriculture, Forestry and Fisheries

DALRRD: Department of Agriculture, Land Reform and Rural Development

DRC: Domestic Resource Cost

DTIC: Department of Trade, Industry and Competition

DW: Durbin Watson

ECM: Error Correction Model

EViews: Econometric Views

FAO: Food and Agriculture Organisation

FAO: Food and Agriculture Organisation

FAOSTAT: Food and Agriculture of the United Nations

ITC: International Trade Center

NAMC: National Agricultural Marketing Council

NDP: National Development Plan

NXI: Net Export Index

RCA: Revealed Comparative Advantage

RTA: Relative Revealed Comparative Trade Advantage

SA: South Africa

SACNA: South African Citrus Nurserymen’s Association

WTO: World Trade Organisation

CHAPTER 1: INTRODUCTION

1.1. Background of the study

Agriculture is one of the most prominent sectors, since it employs over 1 billion people and accounts for approximately 3% of the global gross domestic product (Food and Agriculture Organisation (FAO), 2016). According to the Foreign Agricultural Service (2018), the South African (SA) agricultural sector contributes almost one-tenth of the total export earnings. This is because the sector not only produces low-cost outputs, but because it comprises of a lot of activities ranging from crop farming, food processing, non-food processing, livestock, and fisheries (Garnett and Godfray, 2012).

Citrus is grown in more than 140 countries worldwide (FAO, 2021). Oranges, lemons and limes, mandarins, and grapefruits are amongst the most cultivated citrus types and are consumed as fresh fruit, juice and or concentrate (FAO, 2021; Sinngu, 2014). In a country with high unemployment rates, citrus farming is seen as a remedy because it is a labour-intensive economic activity with high growth potential. Hence, citrus fruits are one of the most important SA horticultural crops (Sinngu, 2014). More than 2 million tonnes of fresh citrus are harvested annually in South Africa and 70 % is traded in foreign markets, 24 % is consumed domestically and 6% is used for processing (Dlikilili, 2018). Consequently, this sector contributes roughly R6.8 billion to the aggregate fruit export value and it employs 74000 permanent employees (CGA, 2016; Uys, 2016).

South Africa like most developing countries, demands that exceptional treatment and support should be given to the agricultural sector due to their political realities (Seleka and Obi, 2018; Dlikilili, 2018). Various structural and policy changes took place in South Africa after the apartheid system was dismantled. Thus, the South African agricultural sector was deregulated in 1997. This was because the agricultural sector was highly controlled by marketing boards and producers had no autonomy to promote and advertise their produce in export markets (Mtshiselwa, 2020; Dlikilili, 2018). The citrus industry was not exempt from that since it had the Citrus Control Board (Dlikilili, 2018).

Fruit exports are an integral stakeholder in ensuring South Africa’s export growth in world markets. According to Potelwa, Lubinga and Ntshangase (2016) SA fruits accounted for a share of 33.5% in 2015. This is due to the South African citrus industry and the ability of the agricultural sector to extend their markets beyond the EU, extending to African and Asian

markets. Consequently, the South African trade value increased by approximately 13% from $2.4 billion in 2001 to over $8.7 billion in 2015.

South Africa has traditionally been known as a world exporter of citrus fruits especially oranges (Sinngu, 2014). After the demolition of marketing boards and the lifting of economic sanctions, competition in the fruit export industry from the South African citrus industry increased as marketing agents and marketers entered the sector (Abu-atab and Romstad, 2014). So, there is a need to sustain the citrus sector despite the South African citrus industry being able to increase its trade. The focus of the study was based on the competitiveness of the South African citrus industry relative to its Southern Hemisphere counterparts (Chile, Peru, Uruguay, Argentina, and Australia). This is because SA's Southern Hemisphere counterparts experience opposite growing seasons compared to Northern Hemisphere citrus-producing regions. This allows them to supply citrus fruits during periods when Northern Hemisphere production is low, making them direct competitors with South Africa in global citrus markets. Therefore, it was imperative to better understand the market positioning of the South African citrus industry. Furthermore, this study helped to expand knowledge on the determinants of export competitiveness especially for a developing country like South Africa.

1.2. Problem statement

Exports of citrus fruits due to globalization, have earned valuable foreign currency for many decades; thus, the opportunity to expand exports is limitless because they are one of the key determinants of economic growth (Bulagi, 2014). Although that may be the case, globalization has played an enormous role towards inflicting a range of new challenges in the citrus industry; hence, there is a need for the South African citrus industry to stay viable. This is because the citrus industry needs not only to compete in its domestic markets but to also compete in new and foreign markets. Also, the South African citrus industry is exposed to the same climatic conditions as its Southern Hemisphere counterparts and there is a necessity to create strategies that will encourage new customers in new markets to purchase citrus fruits and attract investment (Kirsten, 1999; Bureau for Food and Agricultural Policy, 2016)).

The deregulation of the agricultural sector in 1997 had a significant impact on South African citrus producers, as it exposed them to the forces of the real market and the effects of globalization. As a result, one of the greatest challenges faced by citrus producers was adapting to meet the global quality standards set by importers to maintain financial viability in exporting citrus fruits and promote economic growth (O'Rourke, 2017). Additionally, it is

important to acknowledge that the competition faced by South African citrus producers is not on a level playing field, as competitors have access to varying levels of natural resources and labour pools with differing qualities, skills, and costs. Moreover, the combination of liberalization, technological advancements, and stricter labour laws brought about by economic transformation has exposed the agricultural sector, including the citrus fruit industry, to the negative consequences of globalization (Esterhuizen and Van Rooyen, 2006; Chitiga *et al*., 2008). Therefore, it is crucial to analyse and understand the issue of competitiveness in this context.

Several empirical studies conducted in South Africa and globally (Ndou and Obi, 2012; Jafta, 2014; Boonzaaier and Van Rooyen, 2017; Dlikilili, 2018; Noyakaza, 2019) have examined the competitiveness of different agricultural industries such as sugar, citrus, apple, and stone fruit. The sustainability of this competitiveness will depend on its ability to compete with similar industries in the Southern Hemisphere (Sinngu, 2014). This study addressed a gap in the existing literature by comparing the competitive performance of each citrus product over various periods, considering significant events that occurred in South Africa over a span of 30 years, including the Great Recession from 2007 to 2009.

1.3. Rationale

Export competitiveness plays a vital role in ensuring that countries manufacture superior quality products using improved production methods and that businesses have access to global markets (Smit, 2010). It goes beyond South Africa's ability to produce citrus and encompasses the distribution of citrus products in the international market. Therefore, studying export competitiveness is crucial as it is a significant aspect of market planning (Kumar and Gummagolmath, 2021). Additionally, it promotes specialization by capturing the monopoly gains of the South African citrus industry, even though other Southern Hemisphere countries also benefit from the counter-seasonal advantage when targeting developed markets (Smit, 2010; Sinngu, 2014; Kumar and Gummagolmath, 2021).

According to the International Trade Administration (2020), the agricultural sector in South Africa made up 10% of the country's total export earnings, with the citrus industry being one of the major contributors in 2017. Consequently, the production of citrus products can have several positive impacts, such as generating employment opportunities for low-skilled youth, reducing rural to urban migration, improving food supply, and alleviating poverty (Sousa, 2004). Furthermore, citrus exports foster relationships between different countries, promote

interdependence among nations, and contribute to ensuring food security (Abdullah and Sulaiman, 2013; Dlikilili, 2018).

The South African National Development Plan (NDP) of South Africa has set forth the vision for 2030, which can be realized through the success of the citrus industry. The plan aims to achieve a steady annual increase of 5.4% in South Africa's GDP and create an additional 1 million jobs in the agricultural sector (Dlikilili, 2018). However, achieving this goal will pose a significant challenge if citrus farmers do not specialize in producing what they excel at while considering the demand in the international market. Therefore, this study aims to enhance our understanding of the competitiveness of South African citrus producers and contribute to the existing knowledge on this subject.

1.4. Scope of the study

1.4.1. Aim of the study

The study aimed to compare and analyse South Africa and its Southern Hemisphere citrus fruit industry counterparts' competitiveness for the period 1989-2019.

1.4.2. Objectives of the study

i. To profile the South African citrus fruit industry.
ii. To assess the competitive performance of the South African citrus industry relative to its Southern Hemisphere counterparts from 1989 to 2019;
iii. To examine the competitiveness of South African citrus fruits in major markets from 1989 to 2019;
iv. To analyse the short and long run factors that influence the competitiveness of the South African citrus industry from 1989 to 2019.

1.4.3. Hypotheses

i. The competitive performance of the South African citrus industry did not differ from its Southern Hemisphere counterparts.

ii. South African citrus fruits were not competitive in any major markets from 1989 to 2019.

iii. The factors did not influence the competitiveness of the South African citrus industry in the short and long run.

1.5. Organisation of the study

This mini dissertation is structured into five chapters. Chapter two focuses on the existing research related to the competitiveness of different agricultural products, serving as a literature review for the study. Chapter three outlines the research methods applied in this study, detailing the approaches used for data analysis, such as the selection of the study area and the analysis of empirical models. This chapter also explains the various variables, both dependent and independent, employed in different models. Chapter four offers an in-depth discussion and presentation of the South African citrus industry's overall outlook. Chapter five provides the empirical findings and discussions surrounding the competitive performance of the South African citrus industry. This chapter also presents empirical results and discussions concerning the factors influencing the export competitiveness of this industry. Lastly, chapter six concludes and provides policy recommendations based on the empirical results of this study. It also suggests directions for future research to further advance understanding of this topic. The next chapter presents a detailed review of the national and international literature on the competitiveness of the citrus industry and other commodities.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter covers the literature review, it first discusses the definition of key concepts identified, followed by an evaluation of prior research studies conducted by scholars both nationally and internationally. This research focuses on comparing the competitiveness of the South African citrus industry with its counterparts in the Southern Hemisphere.

2.2. Definition of concepts

According to Nordin's (2008) research, the concept of competitiveness is based on the fundamental principles of having a comparative and competitive advantage, which are interconnected yet distinct concepts. However, it is common for the three names to be employed interchangeably. The elucidation of competitiveness plays a crucial role in informing the research technique (Esterhuizen, 2006). Hence, it is imperative to establish a precise and unambiguous delineation of competitiveness to facilitate the utilization of suitable metrics for assessing competitiveness.

2.2.1. Competitiveness

The body of scholarly work pertaining to competition encompasses a variety of definitions, rendering the identification of a singular meaning within economic literature challenging. Competitiveness is a subjective concept that lacks a universally agreed-upon definition or a standardized method for precise measurement (Cotis *et al*., 2010). Competitiveness refers to a country's power to deliver products and services in a specific way and within the expected timeframe, meeting or surpassing the prices offered by potential competitors. This is achieved while ensuring that the returns on resources utilized are at least equal to the opportunity cost (Jaftha, 2014; Sinngu, 2014). This suggests that competitiveness can be attributed to several entities including a particular product or service, a single company, a specific industry, a broader economic sector, a region, a country, or even global economic alliances.

According to Dlikilili (2018), competitiveness may be defined as the ability of a sector to engage in successful trading activities and effectively establish and maintain its company operations throughout time. Esterhuizen (2006) defines competitiveness as the capacity of a company or a nation to manufacture a product with an average variable cost that is less than the selling price of that product. This enables sustainable business growth in the global market and maximizes the returns on the resources employed, while minimizing opportunity costs. Valentine and Krasnik (2000) assert that competitiveness entails the limitations and prospects

arising from global competition in an era where fiscal limitations shape effective governmental intervention, and the private sector encounter significant challenges when trying to compete in both local and global markets.

A nation's ability to manufacture goods and provide services that meet international market quality standards, while also sustaining and growing the real income of its citizens over an extended period within the framework of unrestricted commerce and equitable market circumstances, is indicative of its competitiveness (Organization for Economic Cooperation and Development (OECD), 2004). The presence of rules and the existing economic structure are determining factors that indicate the potential success of a business, industry, or nation in engaging in global commodities trade (Warr, 1994; Ndou and Obi, 2012). Hence, the present study adopts a definition of competitiveness that encompasses the country's capacity to sustainably produce, trade, and exchange citrus fruit goods at prices that are competitive within the global context. This definition draws upon the works of Balassa (1989) and Sinngu (2014). According to Mensah (2010), the competitiveness of exports is determined by factors such as specialization, export growth, and position. The analysis of competitiveness will encompass the inclusion of import and export values pertaining to citrus fruit products.

2.2.2. Comparative Advantage

Serin and Civan (2008) illuminated the concept of comparative advantage, which refers to a country's propensity to export goods that it has a high level of expertise in producing, relative to the global market. This suggests that in the presence of comparative advantage, a nation can manufacture goods with a lower opportunity cost in comparison to other nations. Consequently, the nation has the ability to engage in commerce and focus on the specialized manufacture of said goods (Noyakaza, 2019).

The utilization of factors of production, such as entrepreneurship, land, capital, and labor, can enable a nation to benefit from free commerce. This concept has been explored by scholars such as Blomström and Lipsey (1993) and Du Toit (2009). For instance, the optimization of global well-being and welfare for each nation can be achieved by emphasizing the specialization of a particular nation in the production and exports of items that are manufactured by other nations at higher costs (Kannapiran and Fleming, 1999). Moreover, it enables a specific nation to engage in the exportation of commodities and services in which it possesses the least absolute disadvantages, while simultaneously importing products that exhibit the greatest absolute disadvantage. Nevertheless, it has been determined that

comparative advantage is a principle that is not well suited for making comparisons between different countries. Instead, it is most applicable when examining differences within a single country, particularly within the sector of products that are traded, whether that be comparisons within the same industry or across different industries (Kannapiran and Fleming, 2000).

2.2.3. Competitive Advantage

A company or nation gains a competitive advantage when it becomes a market leader in its industry by producing goods or providing services at a cheaper cost to the customers and a bigger profit margin than the competitors (Sinngu, 2014). Competitive advantage was defined by Van Rooyen, Esterhuizen, and Doyer (1999) as a concept that describes how trading patterns in the market are influenced by various factors, including the actual market dynamics and any factors that might affect trade, such as product quality, pricing effects, government policies, and a company's marketing strategies. Therefore, establishing a competitive advantage might start with a comparative advantage (Khemani, 1997). It shows whether, given current laws and the state of the economy, a particular company might successfully participate in the trading of a commodity on global markets. Competitive advantage is a strategic concept that highlights the potential for a business to excel by capitalising on favourable conditions arising from market pricing and policy discrepancies (Van Rooyen *et al*., 2009) thus being able to demonstrate the viability of nation, firm, industry, or sector.

2.3. Theoretical literature

2.3.1. Mercantilism

The adoption of this policy framework predominantly occurred from 1500 to 1750, by countries such as Germany, Spain, Italy, and so forth during which the primary focus was on the acquisition and exchange of minerals such as gold and silver, to enhance the economic strength of a particular region (Langdana and Murphy, 2014; Sihlobo, 2016). The methods established by mercantilists were not conducive to the promotion of free trade; rather, they advocated for policies that aimed to deter imports by implementing quotas and taxes (Ndou and Obi, 2012). Suggesting that a nation should enhance its accumulation of valuable metals through the facilitation of exports and the discouragement of imports, thereby leading to a trade deficit that may be settled through the acquisition of precious metals. The primary aim of this ideology was to establish a trade surplus, which implies that trade was viewed as a situation

where one country's success was seen as directly causing losses for another, essentially framing it as a competition in which one's gains meant the other's losses (Dlikilili, 2018).

2.3.2. Absolute advantage-theory of Adam Smith

This theory was developed in response to the limitations of the Mercantilism theory, which suggested that the policies advocated by mercantilists favored producers while being detrimental to the interests of consumers (Dean *et al*., 2020). Furthermore, Smith presented a counterargument to the prevailing notion that the measurement of a nation's wealth should be based solely on the abundance of precious metals it possesses. According to Dlikilili (2018), the concept of absolute advantage is utilized to quantify wealth based on production and the living standards of a nation's population. In addition, the idea of absolute advantage posits that commerce should not be impeded by stringent governmental rules, but rather should be driven by market forces (Atma Global Inc, 2012; Dlikilili, 2018). In a hypothetical scenario involving two nations, if one nation, referred to as X, can produce a particular commodity or deliver a service at a lower cost or with greater efficiency (or both) compared to another nation, denoted as Y, then nation X possesses an absolute advantage in the production or provision of commodity or service. Consequently, nation X should concentrate its efforts on specializing in the production or provision of that specific commodity or service. Likewise, if nation Y were to exhibit a comparative advantage in the production or provision of an additional item or service, it would be prudent for it to engage in specialization in this area as well. Specialization enables nations to achieve efficiencies through the division of labor, since it allows their workforce to acquire more skill and efficiency by focusing on certain jobs (Anderson, 2008; Dlikilili, 2018).

2.3.3. Theory of comparative advantage

According to Esterhuizen (2006), the theory of comparative advantage suggests that, even if one country is better at producing both types of goods, it is still beneficial for two countries to specialize in what they do best and engage in trade with each other. This statement presents a contradiction to the principle of absolute advantage, since it suggests that even if a country exhibits greater efficiency in producing two goods, it should still focus on specializing in the production of those goods. The lack of feasibility stems from the inherent constraint faced by nations, as they possess finite reserves of natural resources. Consequently, nations are compelled to make decisions on the allocation of resources, necessitating the consideration of opportunity costs in determining which goods and services to create. Hence, it may be argued

that a country that exhibits the lowest opportunity costs when producing a particular commodity, even in the presence of market pressures, is considered to possess a comparative advantage (Porter, 1990; Dlikilili, 2018). According to Esterhuizen (2006), the theory of comparative advantage suggests that both Country X and Country Y will experience increased outputs because of engaging in trade and specializing in their respective areas of expertise.

2.3.4. Heckscher-Ohlin theory

This theory elucidates the process by which a nation can attain a comparative advantage by the strategic focus on producing items that rely on resources that are abundantly accessible inside its borders. The primary emphasis lies on the effective allocation and utilization of a nation's factors of production, encompassing entrepreneurship, land, labor, and capital. The H-O (Heckscher-Ohlin) model is based on two key assumptions. Firstly, it assumes that production factors cannot be readily swapped between countries. Secondly, it posits that these factors are mixed in diverse combinations during the manufacture of a specific product (Atma Global Inc, 2012). Based on the model proposed by Dlikilili (2018), a nation is seen to hold a comparative advantage when producing a particular product given that it owns a surplus of production factors that are extensively utilised during the manufacturing process of such a product. The determination of a country's comparative advantage is mostly based on the availability of production elements for manufacturing a certain item. The underlying assumption is that countries with greater resources can achieve lower production costs. Therefore, a nation should participate in global trade by prioritizing the exportation of items that extensively utilize its plentiful production components, while simultaneously importing commodities that largely depend on resources that are comparatively rare within the country. This technique results in reciprocal benefits derived from trade for all nations that are engaged.

2.4 Review of national literature

The agricultural sector is a major contributor towards developing the local economy and alleviating poverty through export earnings (Mtshiselwa, 2020). Competitiveness plays a huge role in evaluating trade changes and movements in South Africa's agricultural industry. So, the competitiveness of agricultural trade holds substantial importance, as it directly impacts the overall performance and growth of the agricultural sector, even considering the prevailing global shift towards a free-market orientation in South Africa (Mosoma, 2004).

A pioneering investigation into competitiveness in South Africa was carried out by Vink, Kleynhans, and Street (1998), focuses on the international competitiveness of wheat production within the Western Cape area. The study employed producer profitability per hectare as a proxy for measuring competitiveness. According to the study, wheat products from the Western Cape region were found to lack international competitiveness. Moreover, it is worth noting that some wheat farmers in other countries achieved lower yields per hectare than South African producers, but they still managed to generate a net gross margin three times higher than the South African farmers. This study served as a foundational framework for subsequent research endeavors, as it highlighted the insufficiency of relying solely on producer profitability as a singular metric for assessing competitiveness.

Kirsten *et al*. (1998) scrutinised the competitive advantage of producing wheat for commercial purposes in South Africa. They employed a modified version of the Domestic Resource Cost (DRC) approach for their investigation. Competitiveness is a multifaceted concept, as highlighted by Porter's (1990) research. It is not solely contingent upon profitability, shaped by a variety of elements, the factors that impact a business such as factor conditions, demand conditions, the presence of related and supporting industries, a company's strategy, its organizational structure, the competitive landscape, government assistance and policies, and unpredictable chance occurrences. However, an integrated strategy was utilized to analyze the competitiveness of the South African dairy sector supply chain, focusing on cost leadership through low-cost production and value-adding through product innovation. This approach considered both local and international factors. According to Blignaut's (1999) research, the South African dairy industry is experiencing a decline in the overall competitiveness of its supply chains. The above-mentioned observation aligns with the conclusions drawn by Vink, Kleynhans, and Street (1998), Kirsten *et al*. (1998), and Venter and Horsthemke (1999), who reported a yearly decrease in the Southern African sheep meat sector's competitiveness when compared to the Australian sheep meat industry.

Many years of isolation due to the apartheid regime and unsatisfactory product quality compared to other producers are some of the major causes of the non-competitiveness and the decrease in the degree of competitiveness within the South African fruit export sector (Kalaba and Henneberry, 2001). Production and revenue earned by producers were also found to affect the degree of competitiveness of South Africa compared to countries like Canada, Argentina, Britain, Australia, Germany, United States of America, and Zimbabwe (Mashabela, 2007).

In a study conducted by Mosoma (2004), an analysis was conducted to assess the international competitiveness of South African agricultural exports that originate from Australia and Argentina. This study utilized time series data and employed the Relative Revealed Comparative Trade Advantage (RTA) index as a measure. The analysis revealed that the competitiveness of South Africa's food chains on a global scale was frequently lower in comparison to Argentina and Australia. The result of the study shows that the agricultural industry in South Africa had a very modest level of competitiveness on a global scale. When examining Argentina, Australia, and South Africa, the data reveals that South Africa has made notable progress in ascending the value chain. Mosoma (2004) proposed that South Africa should consider the potential for value addition through a thorough study, the expansion of new commodity production, and the exploration of abundant value-adding options in the three examined countries.

Mashabela and Vink (2008) utilized the Relative Revealed Comparative Trade Advantage (RTA) index which was used to assess how well South African deciduous fruit supply chains compete with those in Chile. This index helps determine which country has a stronger position in the global market for deciduous fruit based on their respective trade advantages. The research revealed that the domestic supply networks for deciduous fruit exhibit a moderate level of competitiveness in the global context, but the supply chains for Chile's deciduous fruit demonstrate a high level of competitiveness. Moreover, it might be argued that local deciduous fruit products possess a competitive disadvantage in terms of value addition when compared to those from Chile. The research findings additionally demonstrate that the domestic business possesses a comparative advantage on a global scale when it comes to the sale of deciduous fruits. Nevertheless, as one progresses up the value chain, the level of competition within the local industry diminishes. The reason for this phenomenon can be attributed to the significant rates of return that have been documented at the farm level.

According to Esterhuizen and Van Rooyen (2006), as well as Van Rooyen, Esterhuizen, and Stroebel (2011), assessed the level of competitiveness within the South African wine industry. They examined various factors that influenced this competitiveness. To measure the industry's operational trade performance, they employed the Relative Trade Advantage (RTA) approach, which allowed them to compare South African wines with their international counterparts. The success in the wine industry, and other fruit-based sectors, is greatly influenced by several crucial factors. These include the ability to create affordable yet top-notch products, the presence of efficient supporting industries, and access to local input suppliers that can compete

on a global scale. These elements play a significant role in determining the overall competitiveness of technology-driven applications in the fruit and wine sectors. In contrast, South Africa's wine industry faces a strong competition internationally from countries such as Australia, Chile, Italy, and New Zealand. A study conducted in 2006 highlighted several factors that played an important role in the competitiveness of the South African wine sector. These factors included fluctuations in exchange rates, confidence in the political support system, the competency of administrative staff in the public sector, and the size and growth potential of the South African market. These aspects were identified as key determinants that could enhance the competitiveness of the South African wine industry in the future (Esterhuizen and Van Rooyen, 2006).

Hallatt (2005) was one of the first researchers to use three indexes, the Revealed Comparative Advantage (RCA) index, the Net Export Index (NXI), and the Relative Revealed Comparative Trade Advantage (RTA) index. These indices were utilized to assess the comparative competitiveness of South Africa's oilseed industry when compared to Argentina's. The study revealed that South African groundnuts and sunflower seeds held a competitive edge in their raw or primary state, whereas processed or value-added oilseed products from South Africa faced a competitive disadvantage. In contrast, Argentina's oilseed products demonstrated a competitive advantage in the global market.

Ndou and Obi (2012) conducted a study on the competitiveness of the South African citrus industry through the utilization of the Constant Market Share approach. A reason behind this phenomenon can be attributed to the ideology of the CMS model, which posits that alterations in market share solely indicate competitive circumstances. Additionally, the authors assert that CMS is the most effective instrument for assessing competitiveness. Ndou and Obi (2012) augmented the CMS model by using the Porter's diamond model (Porter, 1990; Porter, 1998) that emphasizes the significance of ecological factors that foster competitiveness and their impact on industry performance. The author asserts that a notable benefit of employing the diamond model lies in its comprehensive evaluation of overall participants within the supply chain industry (Porter, 1990; Porter, 1998). Ndou and Obi’s conclusion suggests that the South African citrus sector is exhibiting satisfactory performance overall, notwithstanding certain factors that may have been considered. Certain citrus fruits may face less competition in certain countries. Additionally, the transportation system poses a pervasive issue for South African exporters.

The Department of Agriculture, Forestry, and Fisheries (DAFF) (2011) assessed the competitive performance of a particular group of agricultural exports to the European Union (EU) during the period from 2001 to 2009. This evaluation was carried out by applying the RCA index and the Comparative Export Performance (CEP) index methodology. Based on the findings presented in the research, it can be observed that South Africa has demonstrated competitiveness within the EU market for fish and crustaceans, fruits, vegetables, and drinks. However, it has not exhibited the same level of competitiveness for cereals, sugar, or tobacco. Furthermore, the data reveals that within the European Union market, agricultural exports from Argentina frequently exhibited a competitive advantage in comparison to agricultural exports from South Africa.

Three factors were included in the analysis to measure each nation's level of competitiveness, production efficiency, inputs and infrastructure, and financial market, and out of 29 major apple producing nations, South Africa was placed 11th in terms of apple competitiveness in 2011. Porter's model identifies several key factors that contribute to determining competitiveness, including factor conditions, demand factors, the structure of the firm, rivalry within the industry, government support and policies, and chance factors (O'Rouke, 2011).

Jafta (2014) conducted a study to evaluate the comparative advantage of the apple industry in South Africa. The author utilized three well-established indices, namely the Net Export Index (NXI), the Revealed Comparative Advantage (RCA) index, and the Relative Revealed Comparative Trade Advantage (RTA) index, to accomplish this objective. Despite South Africa being ranked as the third-largest global producer of apples, the results indicated that it was surpassed by several other countries. However, the author concluded that the apple sector in South Africa has been able to sustain a competitive advantage compared to its competitors.

Bahta (2021) analysed the competitive performance of the South African Agrifood industry using RCA index, Export Diversification Index (EDI) and regression analysis. The results demonstrated that vegetables, fruit, and coffee showed a comparative disadvantage. The study also demonstrated that South Africa does not depend on international trade from the agri-food industry. Priilaid *et al*. (2021) examined the competitiveness of emerging organic wine farmers by employing Porters model and the results demonstrated that South African wine farmers found it hard to negotiate to obtain foreign organic certification.

The competitiveness of South African carrots, onions, and tomatoes was examined using metrics such as relative trade advantage (RTA), relative comparative advantage (RCA), and

net export index (NXI) (Sanganza, 2021). The findings indicate that South African vegetables exhibited a lower comparative advantage and are not competitive within the African market. However, the NXI values are notably high, suggesting that the vegetable sector is a net exporter. On an individual basis, carrots and onions demonstrate both comparative and competitive advantages in the African market, whereas tomatoes show neither. All three vegetables exhibit high NXI values, indicating that they are net exporters. Major competitors in the African market for these vegetables include Egypt, Morocco, Belgium, and the Netherlands.

2.5 Review of international literature

2.5.1 History of international competitiveness studies

Dunmore (1986) analysed the competitiveness and the comparative advantage of agriculture in the United States when using Vollrath's extension of the Balassa Revealed Comparative Advantage (RCA) model. The study highlighted that although the agricultural competitive advantage of the United States decreased from the 1970s, it was still not operating under a comparative disadvantage. Furthermore, most developing countries experienced a decline in their competitive performance while developed countries experienced an improvement in their competitive position. This was due to a combination of factors, including domestic macroeconomic policies, domestic agricultural policies, and foreign trade policies related to agriculture.

The competitiveness of the agricultural sector was analysed prioritising individual commodities. For example, Brinkman (1987) investigated the competitive position of Canadian agriculture. It was found that Canada's competitive position was higher for wheat and pork, moderate for feed grains, oilseeds and beef but low for dairy and poultry. This was due to foreign and domestic support policies and not agricultural subsidies. Afterwards, Vollrath (1989) examined the US agricultural export competitiveness using market share, revealed competitiveness and relative export advantage. The study found that soyabeans and coarse grains were the most competitive compared to Australia, Argentina, Brazil and Canada because those commodities had the least government intervention. Thus, implying that trade openness increases global market efficiency.

2.5.2 Factors affecting competitiveness

a. Trade policy

Exporters encounter different trade regulations and policies when conducting business in their home country and international markets. It is paramount for firms and sectors to have access

to an appropriate trading environment in the form of adequate trade policies, efficient trade and customs administration systems; and good infrastructure to be competitive (Bin and Jiangyong, 2009). Henceforth, it was suggested that trade policy in Pakistan should be based upon comparative advantage (Faruqee, 1995). In contrast, Chen, Xu and Duan (2000) administered the CMS model to investigate China's agrifood export competitiveness from 1980 to 1996. It was found that trade policy reforms may lead to decreasing agricultural food export competitiveness. This differed with the findings of Kea, Li, Shahriar, and Abdullahi (2020) that the competitiveness of rice exports from Cambodia was due to a stronger trade policy. This suggested that export competitiveness could be promoted embracing the process of globalization emphasising on the gradual reduction in trade barriers (Prasad, 2006; Kea *et al*., 2020).

b. Exchange rate and competitiveness

The exchange rate stands as a critical factor with significant influence on the competitiveness of exports. Thierfelder and Robinson (2003) found that when exchange rate declines, exports go up and imports go down. This was correlated by the findings of de Pineres and Ferrantino (2018) that the weakening the exchange rate between emerging market currencies and the Euro strengthens, it results in an increase in the prices of agricultural goods. This, in turn, leads to a decrease in imports to developed nations, as demonstrated by (Pan *et al*., 2007) study., exports are more competitive (Thierfelder and Robinson, 2003; Pan *et al*., 2007). For example, when the exchange rate between an emerging market and the Euro goes down, it is often cheaper for developed countries like Germany to buy agricultural products from emerging markets. On the other hand, if the exchange rate between emerging markets and the Euro strengthens, it leads to an increase in the prices of agricultural goods. As a result, imports into developed nations tend to decrease (Pan *et al*., 2007).

Although Keror, Yego, and Bartilol (2018) utilized the Multiplicative model to investigate the factors affecting Kenyan cut flower exports to the European Union market from 2001 to 2017, they discovered that the competitiveness of these exports was significantly influenced by real interest rates, exchange rates, and foreign income. This finding aligns with Mensah's (2010) assertion that exchange rates play a crucial role in Ghana's canned tuna exports to the European Union. Additionally, Amin (1996) identified that estimated relative prices and

assessments of the degree of real exchange rate overvaluation were the primary factors contributing to the decline in Cameroon's agricultural competitiveness.

c. Price and competitiveness

The Salter–Swan theory states that variations relative factor prices are influenced by the world commodity price, and it can also affect the factor prices of agricultural goods (Thierfelder and Robinson, 2003). Xue and Revell (2009) found that the Chinese vegetable industry prioritised cost considerations, highlighting the importance of streamlined and economical logistics solutions. However, Crescimanno and Galati (2014) focused on the 2009 global financial crisis while analysing the competitiveness of Italy, Spain, and Turkey. It turned out that the agricultural food industry was resilient to the crisis. Of the countries under analysis, Turkey's competitiveness was the highest and declined very little in the wake of the crisis. This can be partially accounted for by the nation's reduced structural reliance on overseas markets. Competitive subsectors generally outperformed uncompetitive ones, with significant drawbacks.

One of the primary factors impacting the competitiveness of Italy, Spain, and Turkey is the pricing of agricultural and food products. Essentially, this means that when industries lack economies of scale, their competitiveness is negatively affected (Xue and Revell, 2009; Crescimanno and Galati, 2014). Furthermore, Majkovic and Chevassus-Lozza (2006) observed a decline in the quality and price competitiveness of Slovenian agricultural food products in the Croatian market. Additionally, Baroh *et al*. (2014) employed the Armington model to assess the international competitiveness of Indonesian coffee, using secondary data from 1990 to 2011. Their findings indicated that the competitiveness, as reflected in consumer prices, was influenced by producer prices and exchange rates against the United States dollar.

d. Export specialization

Specialization can be considered as a technique towards ensuring economic growth (Bernatonyte, 2015). According to Lall (2001), exports have a crucial role in generating foreign cash, facilitating specialization, and serving as a conduit for the acquisition of new technologies and knowledge. Therefore, the competitive performance of a particular sector is closely connected to export specialization (Carraresi and Banterle, 2015; Bernatonyte, 2015). Nevertheless, according to Saboniene's (2009) findings, the issue of export specialization holds considerable scientific importance towards export competitiveness. Therefore, the analysis conducted by Crescimanno and Galati (2014) examined the level of competition within

the Italian wine industry. The study pinpointed specialization and the quality of products as crucial elements for meeting diverse consumer needs and boosting competitiveness. Furthermore, the study conducted by Bojnec and Fertő (2014) revealed that export specialization, competitiveness, and long-term survival strategy play significant roles in the global meat markets. These factors are influenced by the diversification of meat products through the introduction of new varieties, segmentation based on quality, development of brand names, and implementation of various distribution and marketing mix activities.

e. World Trade Organization and competitiveness

Guo, Feng, and Tan (2011) conducted a study on measuring the competitiveness using the Constant Market Share model, wherein they differentiated between the short-term and long-term effects. The implementation of the Common Agricultural Policy (CAP) reform in Germany in 1999 and China's entry to the World Trade Organisation (WTO) in 2001 had adverse immediate consequences for the bilateral relationship between Germany and China. Nevertheless, these developments ultimately yielded favorable long-term effects on their agricultural and food commerce. The authors placed significant emphasis on the impact of fluctuations in exchange rates on the level of competitiveness. The financial challenges that occurred in 2008 resulted in a notable decline in China's agricultural and food exports to Germany. Furthermore, the study conducted by Rani, Reddy, Prasad, and Reddy (2014) employed the DRC and Policy Analysis matrix (PAM) to evaluate the competitiveness of rice, maize, cotton, and groundnut in India's accession to the WTO. The findings of the analysis indicated that India exhibited trade competitiveness in the cultivation of rice, maize, and cotton after its membership in the WTO. In addition, a study conducted by Matkovski, Kalaš, Zekić, and Jeremić (2019) revealed that the accession to WTO had a favorable impact on the competitiveness of European nations in the agricultural food sector.

2.5.3. Competitiveness of the agricultural sector

Chen and Duan (2001) incorporated an analysis of the Constant Market Share (CMS) to analyse the competitiveness of Canadian agricultural food exports relative to its counterparts like USA, Europe, Australia, and New Zealand. It was found that Canada was the second most competitive agrifood exporter compared to Asia, and China. In contrast, the rising demand at home for beef was a major factor in this (and stagnant domestic supply). Therefore, despite

significant shifts in Hungarian agriculture during the 1990s, consequently, Ferto and Hubbard (2003) discovered RCA in several agricultural food products in the country.

Abbas and Waheed (2017) conducted a study using Balassa's RCA index to examine the competitiveness of various agricultural industries in Pakistan. The findings revealed that Pakistan has a significant advantage in producing raw cotton, raw leather, cereals, and fruits. Similarly, Gupta and Kumar (2017) utilized the Balassa revealed comparative advantage index (BRCAI) measure to analyse Rwanda's trading patterns. The results indicated that intense competition from other exporting countries hindered the competitiveness of Rwandan exports, and a decline in export product lines was attributed to supply-side pressures. The export competitiveness of Rwanda's agricultural sector was positively influenced by factors such as export volume, irrigated land area, and the exchange rate against the US dollar. On the other hand, domestic consumption demand and labour costs were found to undermine export competitiveness. In comparison to Brazil and India, South Africa performed poorly in terms of export competitiveness (Gupta and Kumar, 2017).

Qineti, Rajcaniova, and Matejkova (2009), investigated the competitive positions of the Slovak Republic and the EU-27 in their trade of agricultural products with Russia and Ukraine. The primary aim of their research was to analyse how the dynamics of agricultural food trade had evolved for these countries in the period following their EU accession. In contrast, Bhattacharyya's (2012) findings reveal that India held a comparative advantage in the EU market for vegetable and fruit products, but faced a comparative disadvantage when it came to the flower sector. Additionally, Kea *et al*. (2020) analysed Cambodia's rice exports using the country's Revealed Export Competitiveness (REC) measure and found that they had become more competitive in recent years. Conversely, Jambor and Hubbard (2012) found that the Hungarian food industry's revealed that comparative advantage had declined since accession, with most products exhibiting a comparative disadvantage since 2004. The finding revealed a huge impact on the lifespan of the agricultural food industry.

2.5.4. Competitiveness of the international citrus industry

Brazil is one of the biggest producers of oranges, which are the most consumed form of citrus fruits (Jambor and Czirkl, 2022). This is due to the tropical weather conditions in Brazil, but Brazil’s primary focus is processing citrus instead of exporting primary goods (Talon, Caruso, and Gmitter, 2020; Jambor and Czirkl, 2022). Hence Vargas-Canales *et al*. (2020) indicated that the key exporters of citrus were Spain, Mexico, Turkey, Argentina and South Africa with

export values of US$798 Million(M), $508 M, $336 M, $327 M, $312 M respectively. The export value of Argentina was constituted by the competitiveness of the exportation of lemons. It was emphasised by the findings of Gonzalez, Hallak, Scattolo, and Tacsir (2022) that lemons had the highest competitiveness compared to the exportation and production of pork and dairy.

According to Kidane and Gunawardana (1997), Australia contributes approximately 12% to the global production and export of citrus. Despite having a market, the majority of Australia's citrus production, over 80%, is sold within the country. Additionally, a significant portion of Australian citrus exports, around 57%, is distributed and sold in various Asian countries. The study found that increased transportation and labour costs have reduced the competitiveness of Australian citrus in global markets, even though there is untapped potential for further expansion in the Asia-Pacific market for fresh Australian citrus fruits. In another study conducted by Abu-Hatab (2016), an analysis was carried out on the Russian demand of their imported oranges from Egypt and other major suppliers. The study utilized the Rotterdam import allocation model and the RCA model to examine the period from 1996 to 2014.

The findings of Abu-Hatab (2016) were correlated by the findings of Jambor and Czirkl (2022) using the revealed comparative advantage (RCA) model. Which revealed that Spain, SA and Egypt had a gradually increasing market share and an advantage in the exportation of fresh oranges. Nonetheless, Hassanain and Gabr (2020) found that the Egyptian orange prices in international markets was much higher compared to prices offered by rival suppliers thus contributing to the competitiveness of Egyptian orange exports. This was in line with the findings of Attia, El-Saadany, Melouk and Atty Mohamed (2021) that Egypt had a price advantage in the BRICS's market compared to its counterparts like namely Morocco, Turkey, Spain, Australia, the USA and South Africa, which is a part of the BRICS.

Attia *et al*. (2021) recently conducted a study to evaluate the competitiveness of Egyptian orange and grape crops in the markets of the BRICS countries using the CMS model. The findings revealed that from 2015 to 2019, the average market share of oranges in BRICS countries were 0.1%, 63.9%, 81.1%, 13.3%, and 3.1% respectively. This indicates that Egypt had a relatively low market share in two major orange-producing countries within the BRICS. Additionally, the results showed that Egypt had a comparative advantage factor of 23.9, while South Africa and Spain had factors of 21.3 and 7.6, respectively.

2.6. Research gap

Despite the citrus industry being one of South Africa's top fruit exporting industries, there is a knowledge gap from the reviewed literature, which presents an opportunity to build and improve a hypothetical model to assess original and existing assumptions of factors that influence the competitiveness of the country's citrus industry. Furthermore, most models that examine both the competitiveness and factors influencing the competitiveness of a particular industry in a certain nation or region fail to include diagnostic tests that would effectively verify the validity of the model and the stationarity of the data. Finally, research on the international variables influencing South African exporters is scarce. This study aims to close this gap in the literature and offer an empirical addition to the macroeconomic factors that influence citrus fruit export competitiveness.

2.7. Chapter summary

This chapter has offered valuable insights pertaining to the citrus sector and its export competitiveness. The initial section of the chapter delineated fundamental concepts and furnished comprehensive insights into the idea of competitiveness and comparative advantage. The chapter explored the ideas of international trade, including Mercantilism, Absolute advantage, Comparative advantage, and the Heckscher Ohlin hypothesis. In addition, the chapter elucidated the mechanisms through which public investment contributes to the advancement of agricultural growth. An additional segment of this study was dedicated to examining many factors that exert an influence on the level of export competitiveness. Ultimately, the chapter presented an abundance of research about both domestic and global circumstances. Most of the research employed the Revealed Comparative Advantage (RCA) index as a tool for analyzing competitiveness. The next chapter presents the methods and analytical procedures that were employed in this study to achieve the objectives.

CHAPTER 3: METHODOLOGY AND ANALYTICAL PROCEDURES

3.1. Introduction

This chapter underscored and depicted the necessary data specifications, protocols for managing data, analytical methods, and data origins employed to gauge the various approaches for achieving the study's goals. Additionally, it outlined the steps taken to convert raw data variables and address any non-stationarity issues, given the study's reliance on secondary data.

3.2. Study area

The primary focus of the study was South Africa, chosen due to its status as a citrus export-oriented nation. South Africa, known for its agricultural diversity, is geographically divided into various agricultural regions (Goldblatt, 2009). Situated in the southernmost part of Africa, it comprises nine provinces covering a total area of 122 million hectares (Goldblatt, 2009; Walker and Dubb, 2013). The study compared South Africa with its top five counterparts from the Southern Hemisphere: Peru, Chile, Argentina, Uruguay, and Australia (Sinngu, 2014). This selection was made to gain insights into the competitiveness of South Africa's citrus industry relative to its regional competitors. This will enable them to make informed decisions aimed at enhancing competitiveness.

Figure 3.1: Southern hemisphere countries

Source: Alamy (2024)

3.3. Data collection

A quantitative research approach was employed in this study, including the use of secondary annual time series data which was sourced from Food and Agriculture Organization Statistics (FAOSTAT), World bank, and international trade centre (ITC) from 1989 to 2019 and was analysed using Excel 2016, and E-views software (Ndou and Obi, 2012; Sinngu, 2014; Noyakaza, 2019). This information was integral in the analysis the competitiveness of South African exports with its Southern Hemisphere counterparts.

3.4. Analytical techniques

The RCA index, NXI index, Armington model and CMS model were adopted to analyse the competitiveness of the citrus fruit industry focusing on the following citrus fruit categories namely, oranges, grapefruit, lemons, and limes as well as soft citrus. Various cultivars within each category were ignored. Furthermore, the citrus fruit juices were not considered for the analysis of the competitiveness of the industry.

3.4.1. Revealed Comparative Advantage (RCA) index.

This study made use of Vollrath (1991) revealed comparative advantage index (RCA) to indicate the level of competitiveness through specialization of the SA citrus industry. This is one of the most widely used and effective measures of sectoral competitive performance (Galetto, 2003). This is due to the RCA's index's ability to determine a given country's strength in producing a certain product in a specific sector compared to another product; thus, differentiating a given country's weak and strong sectors.

Moreover, the changes in the RCA index can indicate the change in trade policies (Sinngu, 2014). However, the index has some measurement issues due to its inability to observe autarkic pricing relationships (Batha & Jooste, 2004). In addition, this index is based on the idea that trade statistics only capture post-trade conditions, and that post-trade data reveals the underlying pattern of competitive advantage. Consequently, the government's actions may skew actual trade patterns, misrepresenting underlying competitive advantage (Bender & Li, 2002; Sinngu, 2014). Thus, it is a concern that, to some extent, RCA indexes may be distorted by import quotas, export subsidies, and other protectionist government policies.

Therefore, the formula for calculating RCA is specified as follows:

$$\mathrm{RCA} = \frac{\left\{\frac{x_{pk}}{(\sum_p x_{pk}) - x_{pk}}\right\}}{\left\{\frac{(\sum_k x_{pk}) - x_{pk}}{(\sum_k \sum_p x_{pk}) - ((\sum_p x_{pk}) - x_{pk})}\right\}} \quad \text{..... (equation 3.1)}$$

Where x_{pk} represents the amount of exported goods from the sector "p" of country "k"; $\sum_i x_{pk}$ is the overall exports of country "k"; $\sum_k x_{pk}$ represents the global exports of the sector "p", and $\sum_k \sum_p x_{pk}$ are total world exports.

Therefore, when the RCA index exceeds 1 it shows that country p has a comparative advantage in exporting product k, thus, it will reveal competitiveness and an RCA index which is less than 1 will show that country p has a comparative disadvantage in exporting that citrus product.

3.4.2. Net Export Index

The study employed the net export index to measure competitiveness by analysing the position of a product on the market through its market share (Ndou and Obi, 2012). This was because the RCA index received extensive criticism due to its incapacity to include imports especially when net trade effects are supposed to be considered when analysing competitiveness (Sinngu, 2014; Noyakaza, 2018). For instance, a nation that is largely self-reliant, possessing a minimal surplus for export and no imports, would register an index of 100, thus seemingly highly competitive despite its limited trade activity. Consequently, Galetto (2003), as referenced by Sinngu (2014), suggested the combined use of both RCA and NXI to assess the competitiveness of a particular industry or commodity accurately.

The NXI is a great tool because it can capture the fluctuations in market share over different periods, in addition to showing how a given country that exports goods to a specific market can increase or sustain its export share compared to its counterparts (Mensah, 2010; Ndou and Obi, 2012). Therefore, this study made use the NXI and RCA indexes to analyse the competitiveness of South African citrus fruit industry relative to its competitors in the Southern Hemisphere region.

Thus, the index was be measured using the following formula:

$$NXI_{ki} = \frac{X_{ki} - M_{ki}}{X_{ki} + M_{ki}} \times 100 \quad \text{..... (Equation 3.2)}$$

Whereby X_{ki} represents the overall amount of good k that exported to the target market by country i and M_{ki} represents the total amount of imported product k by country i. An index that is greater than 100 indicates that there are no imports, and an index that is less than negative 100 indicates that there are no exports.

3.4.3 Constant Market Share Model

This model was employed in the study to analyse competitiveness through changes in exports. It is a useful and descriptive tool that can be used to determine the factors that cause differences in a country's export share over a given period. The Constant Market Share model is an eloquent model that permits the examination of trade between one or more countries that export to different markets (Ahmadi-Esfahani, 2006; Mensah, 2010).

Furthermore, the CMS model was fit for this study because it places a distinct emphasis on the market challenges even though production is geographically biased, while marketing can be channelled to any part of the world (Ndou and Obi, 2012).

Chen and Duan (2001) outline that, at the initial level, the CMS model dissects export variations into three components: changes attributable to alterations in the export market (structural effect), modifications stemming from shifts in the exporting country's competitiveness (competitive effect), and adjustments in export resulting from the combined influence of structural changes and competitiveness (second-order effect).

This research will focus solely on the first level of CMS analysis. An inherent advantage of the CMS approach is its provision of a straightforward means to scrutinize export expansion (Mensah, 2010; Ndou and Obi, 2012)

Thus, the model is defined as:

$$\Delta q = \sum_i \sum_j S_{ij}^0 \Delta Q_{ij} + \sum_i \sum_j Q_{ij}^0 \Delta S_{ij} + \sum_i \sum_j \Delta S_{ij} \Delta Q_{ij} \quad \text{..... (Equation 3.3)}$$

Where, q represents the total value of the country that exports; Sij is the market share of the country that exports product i market j whereas:

Qij is the total amount of product i that was imported by market j

Δ represents the change in the two periods,

The base year is represented by the superscript 0.

The limitation of the CMS model is that it does not provide sufficient information on the causes of the changes in market shares of market share. To remedy the shortcomings of the CMS model, it was used along the Armington model (Mensah, 2010; Ndou and Obi, 2012).

3.4.4. Armington model

The study made use of the Armington model to address the fourth objective of this study. This is because the model has been verified to be a crucial tool in analysing the factors that affect the export competitiveness due to its ability to show trade patterns (Mensah, 2010, Bazjik *et al*., 2020). The Armington model assumes that goods are imperfect substitutes in demand implying that goods will be not distinguished only by the type of product but also where the product comes from. It has been found that the model reduces multicollinearity by assuming weak separability which is related to the potential substitution among commodity groups and homotheticity of import demands, which states that the elasticities are the same (Bubula,1987). The model is easy to use, estimates less parameters and it maintains compatibility with the Hicksian demand theory (Bubula, 1987; Mensah, 2010; Ogundeji *et al*., 2010).

The Armington model assumes that products vary depending on where they originate geographically, and that consumers' preferences for a product remain largely unaffected by their purchases of other products. This assumption simplifies the analysis of export competitiveness on a worldwide level. However, empirical trade literature, as highlighted by Fagerberg (1988) and Junz and Rhomberg (1973), has identified a significant limitation of this model: it solely focuses on price competitiveness and disregards other dimensions of competitiveness that could also contribute to understanding fluctuations in export volumes.

The Armington model adopted was specified as (Mensah, 2010): $\mathrm{qi/Q} = \mathrm{bi\sigma\,(pi/P)^{-\sigma}}$

Dummy variable, trends, exchange rate and other factors that may affect export competitiveness can be illustrated using the Armington model because of its linear form the OLS (Alston *et al*., 1990). Thus, the model will be specified as:

Model specification: (Y_i) ln MS = β0 + β0 (pi/P) + β2 lnER + β3 lnRCA + β4 DUM(WTO) + ε … (equation 3.4)

Table 3.1 below portrays the description of variables that were employed in this study.

Table 3.1: Description of study variables

		Variables	**Expected sign**	**Units**
Dependent variables				

Y_i	In MS	Market share	+/--	Number
Independent variables				
X_1	pi/P	Price ratio	+	Number
X_2	ER	Exchange rate	-	Number
X_3	RCA	Level of specialization	+	Number
X_4	WTO	1= if SA is a part of the world trade Organisation, 0= otherwise	+	Dummy

Source: Own computation

Whereby MS is South Africa's market share (quantity), β0 is the constant, β1 is the coefficient of price ratio, β2 is the coefficient of the exchange rate of South Africa, β3 is the coefficient of the RCA index of oranges produced in South Africa, and β4 is the coefficient of the dummy variable to capture the effect of the WTO (The dummy variable takes the value of one (01) for the period before 1995 and 0 thereafter) and ε is the error- term.

3.4.4.1. Data analysis framework

Since this objective is addressed by incorporating time series data through the Armington model, there were some tools that were incorporated to ensure that the data is not stationary and that the model is of good fit. Tools such as the Augmented Dickey fuller test is incorporated to test for stationarity.

3.4.4.2. Augmented Dickey-Fuller test

The Dickey-Fuller test is a commonly used test for assessing stationarity in time series data. This test is particularly useful when dealing with secondary data, as non-stationarity can lead to inaccurate estimations and misleading conclusions (Bongsha, 2011). According to Bulagi (2012), a nonstationary series has a null root, which means that the classical estimation theory is not applicable due to the changing mean and variance over time. To determine stationarity, the ADF test employs three different equations. The first equation includes only a constant term ($a0$), while the second equation incorporates both an intercept term ($a0$) and a trend. Lastly, the third equation excludes both an intercept and a deterministic trend (t). In all three equations,

the disturbance term is independent and has equally distributed variance (Chamalwa & Bakari, 2016).

Thus, the equations are defined below:

$\Delta Yt = \beta 1 + ZYt{-}1 + ai + \varepsilon t$ (Constant only) … ... (Equation 3.5)

$\Delta Yt = \beta 1 + \beta 2 + ZYt{-}1 + ai + \varepsilon t$ (Constant and trend) … … (Equation 3.6)

$\Delta Yt = ZYt{-}1 + ai + \varepsilon t$ (No constant, no trend) … ... (Equation 3.7)

Where Yt represents the variable of interest, t denotes a time trend, $\beta 1$ is the constant, $t - 1$ shows a lag length while Z is the coefficient of the lagged variable and εt is the disturbance term. The ADF test is used to determine if a variable has unit root or not.

The rule of thumb is that if the t stat is greater than ADF's critical value at 95 percent confidence interval, then the hypothesis of stationarity is rejected, and the conclusion is that the series has a unit root or is non-stationary. Therefore, for a series to be stationary it is transformed into first difference or sometimes into the second difference. Thus, the stationarity test using ADF for all identified variables is adopted for the Armington model.

3.4.4.3. Granger Casuality test

The concept of causality refers to the ability of one variable to predict or influence another. Granger (1969) introduced this concept, now commonly known as the "Granger causality test," to determine whether a variable has a causal relationship with another. For instance, in the context of export competitiveness, the exchange rate is considered to Granger cause it if past and present information on exchange rates can be used to predict the average market share.

Obedenji (2010) applied the Granger causality test to examine the causality of various variables within the Armington model, specifically for the case of two stationary variables, Zt and Yt, in the context of models incorporating time series data. The models are represented by the following equations:

$Zt = a1 + \sum iYt{-}i + \sum jZt{-}j + e1t$ … … (Equation 3.8)

$Yt = a2 + \sum iYt{-}i + \sum jZt{-}j + e2t$ … … (Equation 3.9)

where it is assumed that both Zt and Yt error terms are uncorrelated and white noise such that the following would be the expected cases:

i. The lagged Y terms in Equation 3.8 may be statistically different from zero as a group, while the lagged Z terms in Equation 3.9 are not statistically different from zero. In this case, Yt causes Zt.

ii. The lagged Z terms in Equation 3.9 may be statistically different from zero as a group, while the lagged Y terms in Equation 3.8 may not be statistically different from zero. In this case, Zt causes Yt.

iii. Both sets of Y and Z terms are statistically distinct from zero in both Equation 3.8 and Equation 3.9, indicating bidirectional causality.

iv. Both sets of Y and Z terms are not statistically distinct from zero in both equations, indicating that Yt is independent of Zt.

3.4.4.4. Johnsen cointegration test

Johansen cointegration is a technique for identifying and characterizing the long-term relationships among non-stationary time series variables. The key idea is to test for cointegration, which indicates the existence of stable, long-term relationships, and to determine the number of cointegration vectors that describe these relationships (Johansen, 1988). Johansen proposes two different likelihood ratio tests which are named the trace test and the maximum eigenvalue test.

$Jtrace = -T \sum \ln(1 - \lambda i)\ n\ i=r+1$ ... ... (Equation 3.10)

$zJmax = -T \ln(1 - \lambda r+1)$ ... ... (Equation 3.11)

Where T is the sample size, λi is the largest canonical correlation and r is the number of cointegrating vectors.

3.4.4.5 Diagnostic tests

In this study, various diagnostic tests were employed to assess the validity of the model-building process. These tests included autocorrelation, CUSUM, heteroscedasticity, and

normality tests, which were used to evaluate efficiency and unbiasedness, structural changes in time series data, variability of errors, and validity of statistical inference respectively. It proves whether the residuals of the series met the required criteria. Diagnostic tests play a crucial role in determining the goodness of fit for a time series model, as highlighted by Milanzi (2021). They provide valuable insights into whether the model is appropriate or needs further refinement.

3.5. Chapter summary

This chapter outlined the methodology used to achieve the aim of the current study, which was to compare and analyse South Africa and its Southern Hemisphere citrus fruit industry counterparts' competitiveness while analysing the factors affecting South African citrus fruit industry competitiveness for the period 1989-2019. The study used available secondary annual time series data accessed from the Food and Agriculture Organisation statistics (FAOSTAT), ITC, covering a duration of 30 years from 1989 to 2019. RCA index, NXI, CMS model and Armington model were used to address the objectives of this study. The next chapter presents an overview of the South African citrus industry.

CHAPTER 4: OVERVIEW OF THE SA CITRUS INDUSTRY

4.1. Introduction

The primary aim of this chapter was to examine the South African citrus industry within the broader context of the Southern Hemisphere and global markets. This examination involved analysing production trends, export performance, and identifying key importers and exporters.

4.2. Global overview of the citrus industry

The section provides a broad overview of the worldwide citrus industry, covering production and trade trends spanning from 1989 to 2019. Additionally, it offers a summary of the principal importing and exporting nations on a global scale.

4.2.1. Production trends

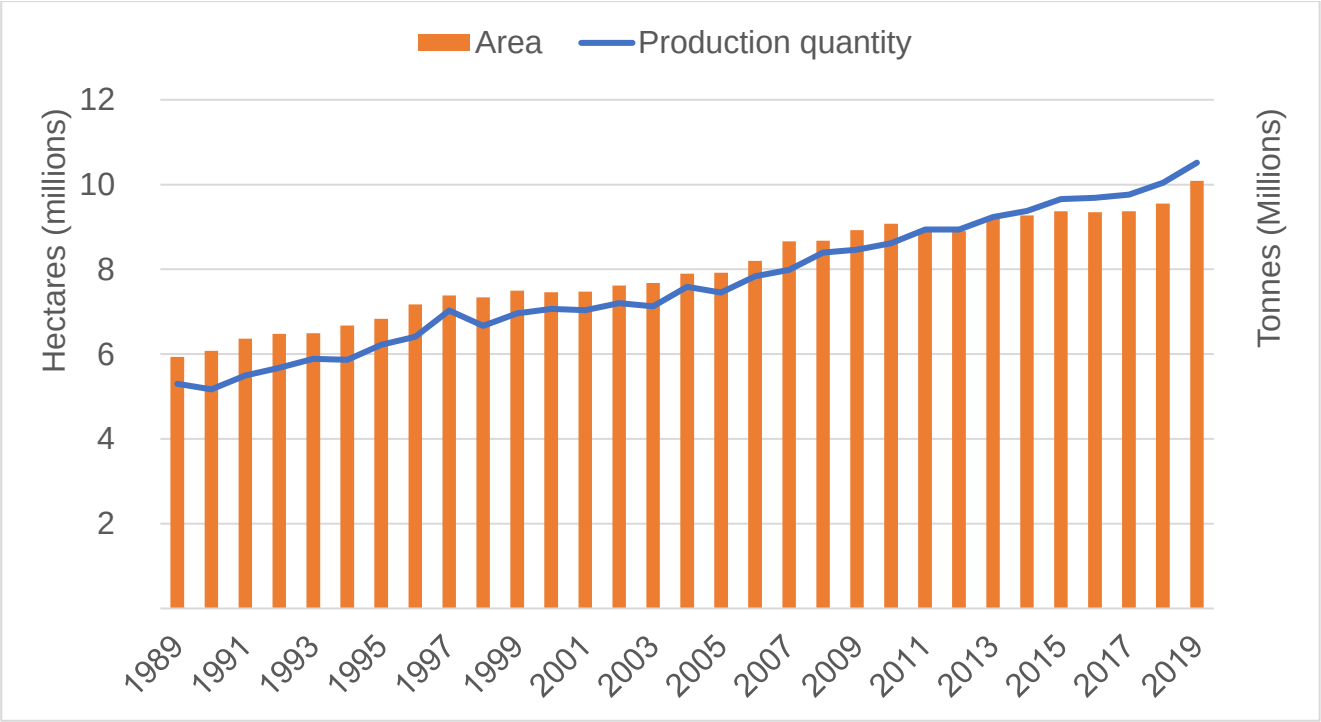

Figure 4.1: Global production area and quantity of citrus products for the period 1989 to 2019

Source: (Own calculations based on FAO data)

Figure 4.1 illustrates the area harvested and the global citrus production quantity over a period of thirty years starting from 1989 to 2019. The area harvested for citrus products has significantly increased from 5.9 million hectares in 1989 to 10 million hectares in 2019. The

increase in the area harvested has led to an incremental increase in the global production quantity of citrus fruits. Food and Agriculture Organization (FAO) (2015) found that the quantity of citrus produced during the late 1980s and early 1990s has increased with a percentage of over 50%. Thus, the quantity of citrus products produced globally has increased from 79 million tonnes in 1989 to approximately 158 million tonnes in 2019. Most citrus fruits are produced in tropical and subtropical areas therefore the major producers of citrus products are China, USA, and Brazil (Genus citrus, 2020).

4.2.2. Trade trends

Figure 4.2 demonstrates the global citrus trade trends through citrus import and export values from 1989 to 2019. It shows that the global citrus industry has a negative balance of trade because the import value exceeds the export value. The percentage increase of the export value of citrus fruits from 1989 to 2019 was 77.6%. According to Dlikilili (2018), the citrus industry has an annual export increase of 6%. Although that was the case, the value of world citrus exports amounted to 14 billion US$ which was a 5.74% decrease from 2018.

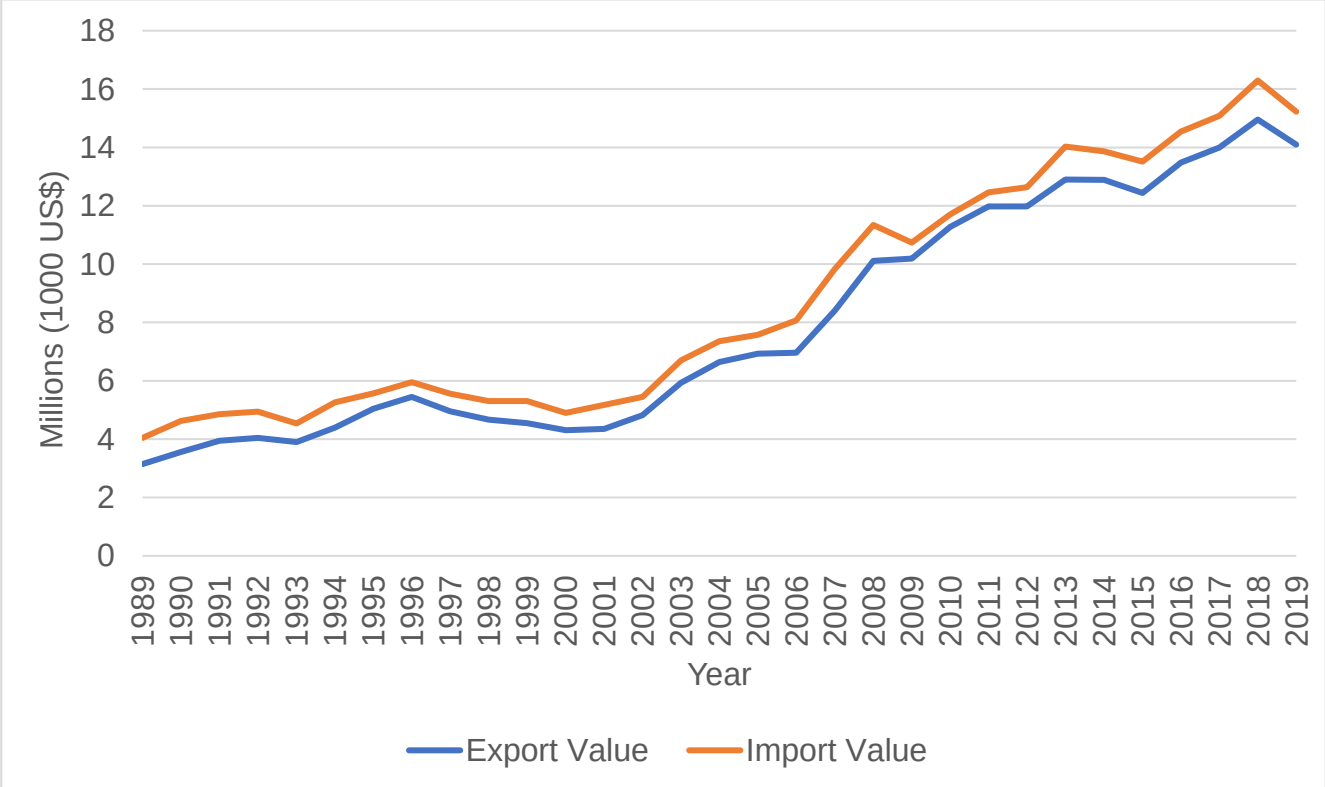

Figure 4.2: Global citrus trade trends from 1989 to 2019

Source (Own calculations based on FAO data)

4.2.3. Major trading countries

This subsection demonstrates the major trading countries by focusing on the top global citrus exporters and importers in 2019.

4.2.3.1. Top global citrus exporters

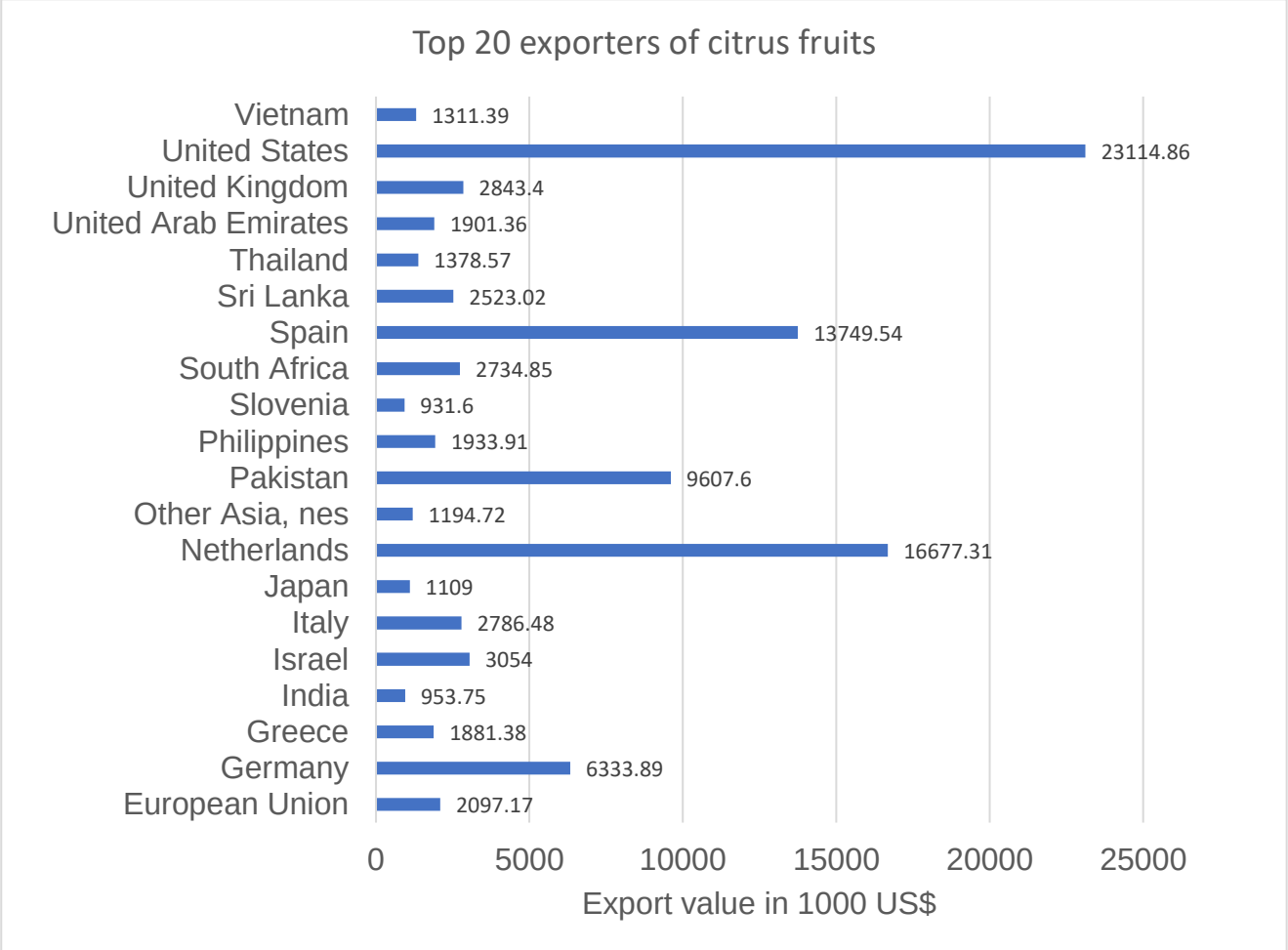

Figure 4.3: Top global citrus exporters in 2019

Source (Own calculations based on WITS data)

Figure 4.3 illustrates the top 20 global citrus exporters. The top 5 global citrus exporters in terms of value are USA, Netherlands, Spain, Pakistan, and Germany with 23,56%, 16.99%, 14.01%, 9.79% and 6.56%, respectively. Although that is the case, the top 5 exporters in terms of quantity are Spain ($4.12B), South Africa ($1.93B), China ($1.21B), Turkey ($982M), and Egypt. The global export value share of South Africa was 10.1% in 2014 (Dlikilili, 2018). The global export of South Africa has decreased to 2.78% in 2019. The citrus fruit export market is highly concentrated, with the top ten exporters accounting for approximately 79 percent with other countries like Ukraine taking the remaining share.

4.3.2. Top global citrus importers

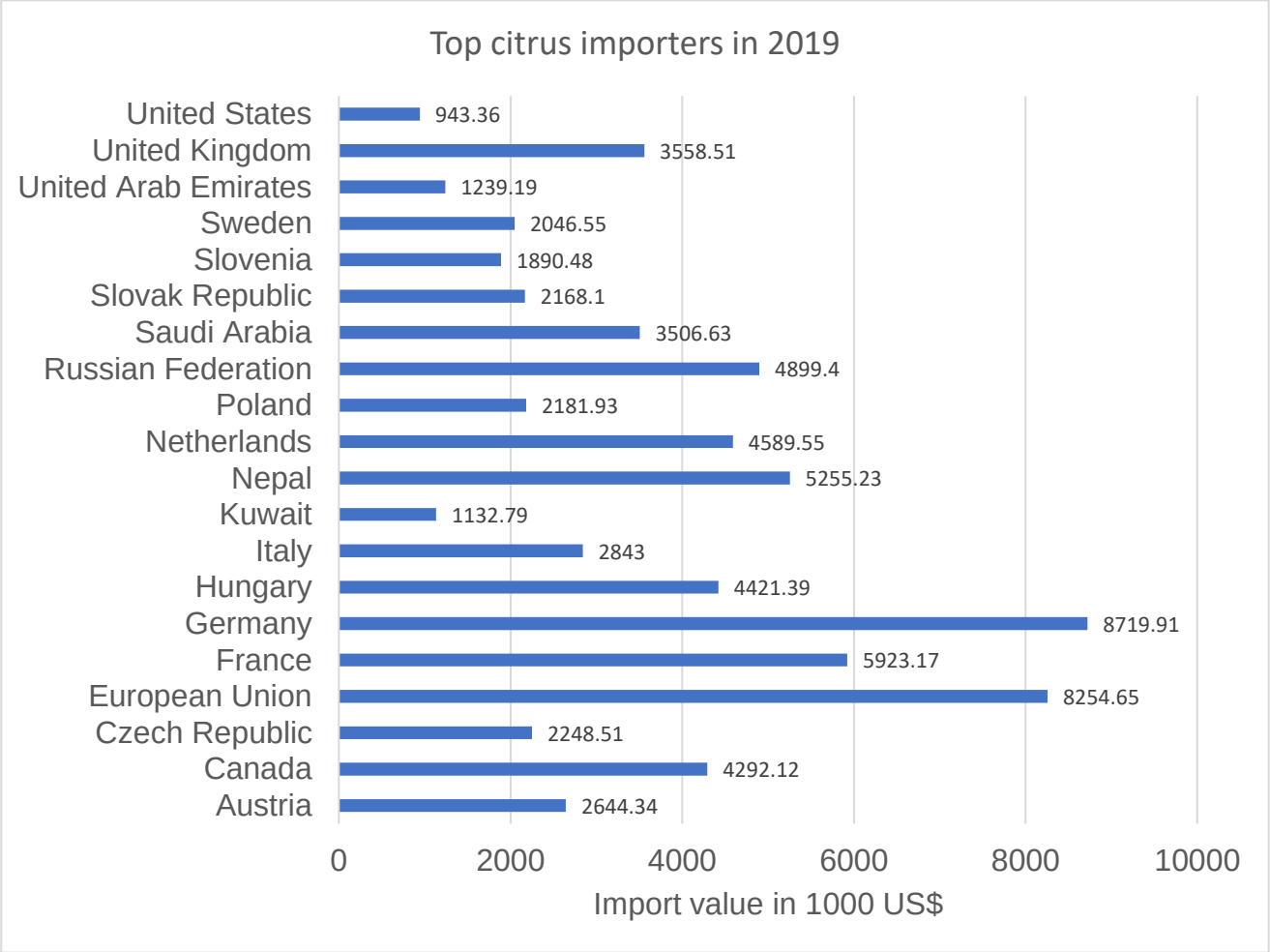

Figure 4.4: Top global citrus importers in 2019

Source (Own calculations based on WITS data)

The leading citrus importers worldwide in terms of value include Germany, the European Union, France, Nepal, and the Russian Federation, representing 11.98%, 11.35%, 8.14%, 7.22%, and 6.33% respectively. This indicates that the demand for citrus fruits on the global market is relatively distributed, with the top ten major importers collectively responsible for approximately 58 percent of total global imports.

4.3. Overview of the Southern Hemisphere citrus industry

4.3.1. Production trends

Figure 4.5 demonstrates the Southern Hemisphere citrus production trends through from 1989 to 2019. In 2019, Argentina was the biggest Southern Hemisphere citrus fruit producer since it yielded over 3.4 million tonnes. However, Argentina peaked production in 2011 yielding over

3.6 million tonnes. From 1989 to 1994 Australia was the second biggest producer of citrus fruits in the Southern Hemisphere producing oranges. In 1995 Peru and Australia produced the same quantity of citrus fruits and Peru surpassed Australia and became the second biggest producer of Citrus fruits in the Southern Hemisphere region. Peru yielded over 1.38 million tonnes in 2019 while Uruguay yielded approximately 242 thousand tonnes making it the smallest producer in the Southern Hemisphere.

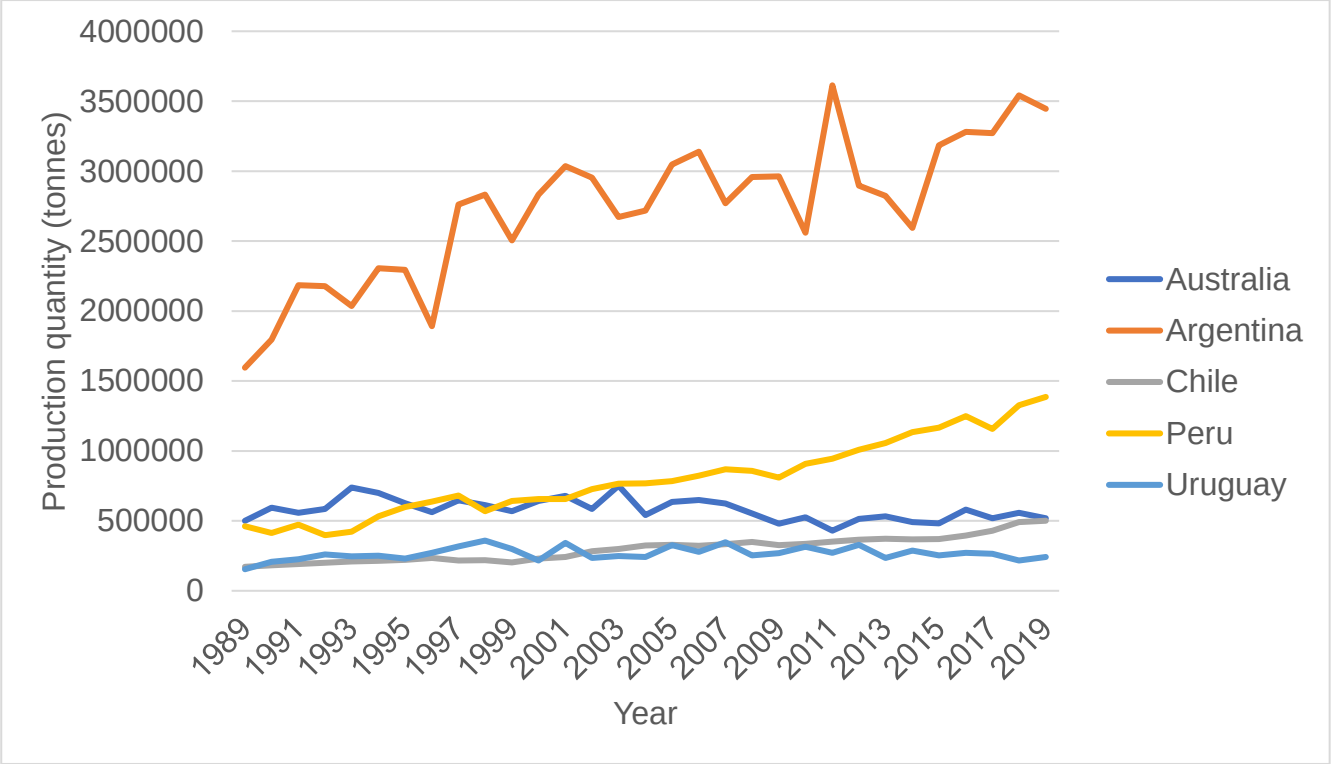

Figure 4.5: Southern Hemisphere citrus production trends from 1989 to 2019

Source (Own calculations based on FAO data)

4.3.2. Trade trends

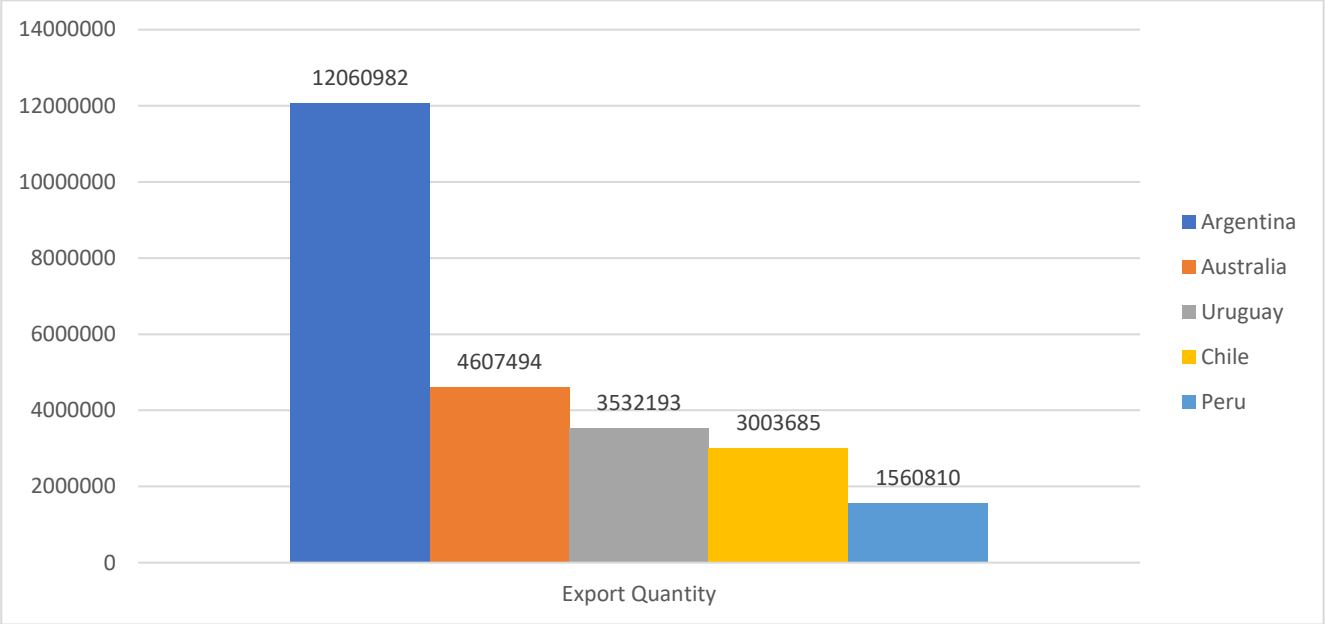

Figure 4.6: Southern Hemisphere citrus export quantity trends

Source (Own calculations based on FAO data)

Figure 4.6 depicts the trading patterns of competitors in the Southern Hemisphere's citrus fruit industry over the thirty-year span from 1989 to 2019. Argentina emerges as the dominant exporter among these nations, primarily shipping lemons (fresh or dried) to the Netherlands, the Russian Federation, Spain, and Italy. Following Argentina is Australia, which primarily exports oranges to Japan, Hong Kong, China, and the USA. Despite being the second-largest citrus fruit producer, Peru ranks as the smallest exporter of citrus fruit.

4.3.3. Tariffs applied to Southern Hemisphere Citrus products

Table 4.1: Tariffs applied to South Africa and its Southern Hemisphere counterparts by major markets

	Oranges					**Lemons and limes**					**Grapefruit**				**Mandarins (including tangerines and satsumas)**			
Countries	EU	UK	Middle East		USA	Middle East		EU	UK	Russia	EU	UK	Russia	South-East Asia	EU	UK	Russia	USA
			UAE	SA		UAE	SA											
Argentina	22,4%	10,5%	0%	0%	0%	0%	0%	12%	10%	5%	1,5%	0%	5%	5%	16%	16%	5%	0%
Australia	22,4%	10,5%	0%	0%	0%	0%	0%	4,94%	0%	5%	1,5%	0%	5%	0%	16%	16%	5%	1,3%
Chile	6,4%	0%	0%	0%	0%	0%	0%	4,94%	0%	5%	0%	0%	5%	0%	0%	0%	5%	0%
Peru	6,4%	0%	0%	0%	0%	0%	0%	4,94%	0%	0%	0%	0%	5%	5%	0%	0%	5%	0%
South Africa	22,0%	7,5%	0%	0%	0%	0%	0%	10,42 %	2%	5%	0%	0%	5%	5%	0%	0%	5%	0%
Uruguay	22,4%	10,5%	0%	0%	1,7%	0%	0%	12,3%	10%	5%	1,5%	0%	5%	5%	16%	16%	5%	1,3%
EU= European Union. UK=United Kingdom. USA= United States of America. UAE= United Arab Emirates																		

Table 4.1: Tariffs applied to South Africa and its Southern Hemisphere counterparts by major markets in 2019

Source: Market access (2022)

Previously, oranges from South Africa enjoyed privileged access to the EU market, exempt from customs fees or stringent phytosanitary requirements. However, the current scenario mandates a tariff of 21.95% for South African oranges. Nevertheless, they can still penetrate the EU market through the Economic Partnership Agreement within the SADC-EU EPA agreement, succeeding the former Trade Development and Cooperation Agreement with the EU. This agreement presents lucrative prospects for South African exporters, particularly citrus fruit exporters, as their products encounter minimal or no tariffs. Consequently, competitors from the Southern Hemisphere, such as Argentina, Australia, and Uruguay, face a higher tariff of 22.42% per ton when entering this market, giving South African oranges a significant advantage. The primary threat arises from Chilean and Peruvian oranges, subject to a 6.42% tariff in the EU market. However, exports from these countries collectively represent only 1.4% of international exports.

The Middle East, particularly Saudi Arabia and the United Arab Emirates, stands out as a significant market for South African citrus fruits due to their exemption from tariffs. Moreover, the African Growth and Opportunity Act (AGOA) trade agreement facilitates favourable tariffs, enabling South African oranges to access the American market. Lemons and limes rank as the second highest taxed citrus fruits in the EU market, facing a tariff of 10.42% per ton. However, they lack preferential access to this market, meaning they were not included in products granted free or discounted tariffs under the EPA agreement. The Russian Federation imposes a 5% tariff on all citrus fruit imported from South Africa. In most of its markets, South African soft citrus enjoys a tariff advantage over its competitors.

4.4. Overview of the South African citrus industry

4.4.1. Production areas

Although citrus production spans approximately 87,000 hectares in South Africa, the majority of this production occurs in the Limpopo Province, which dedicates the largest area to citrus cultivation. Limpopo contributes 42% of the total citrus cultivation area in South Africa, followed by the Eastern Cape Province with a 27% share. Mpumalanga and Western Cape Provinces account for 8% and 17% respectively. Both KZN and Northern Cape contribute 2% each to the total cultivated land for citrus production. Grapefruit and Valencia oranges are typically grown in Limpopo, KZN, and Mpumalanga due to their warm climatic conditions. Conversely, navel oranges, lemons, and soft citrus fruits are cultivated in the Western Cape and Eastern Cape provinces owing to their cooler weather conditions.

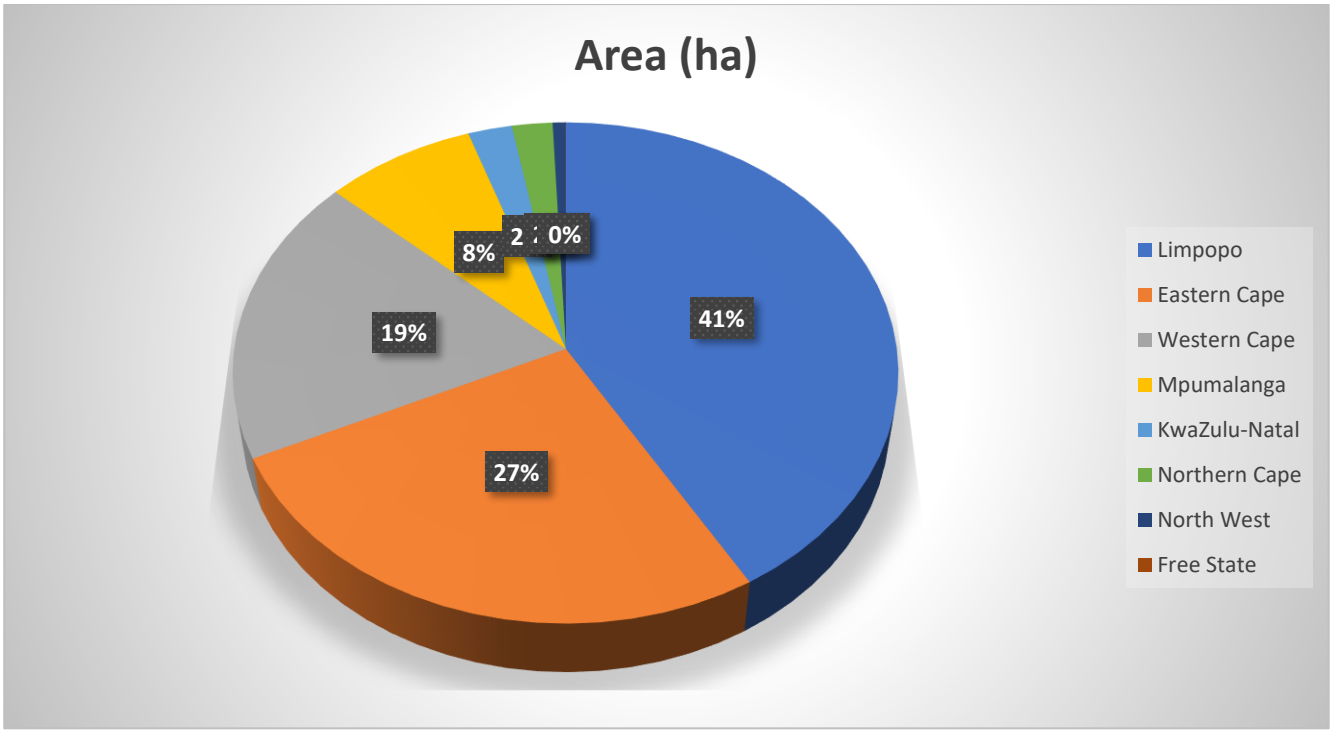

Figure 4.7: Area used for citrus fruit cultivation in South Africa in 2019

Source: Own compilation based on the Department of Agriculture, Land reform and Rural development (DALRRD)

4.4.2. Production trends

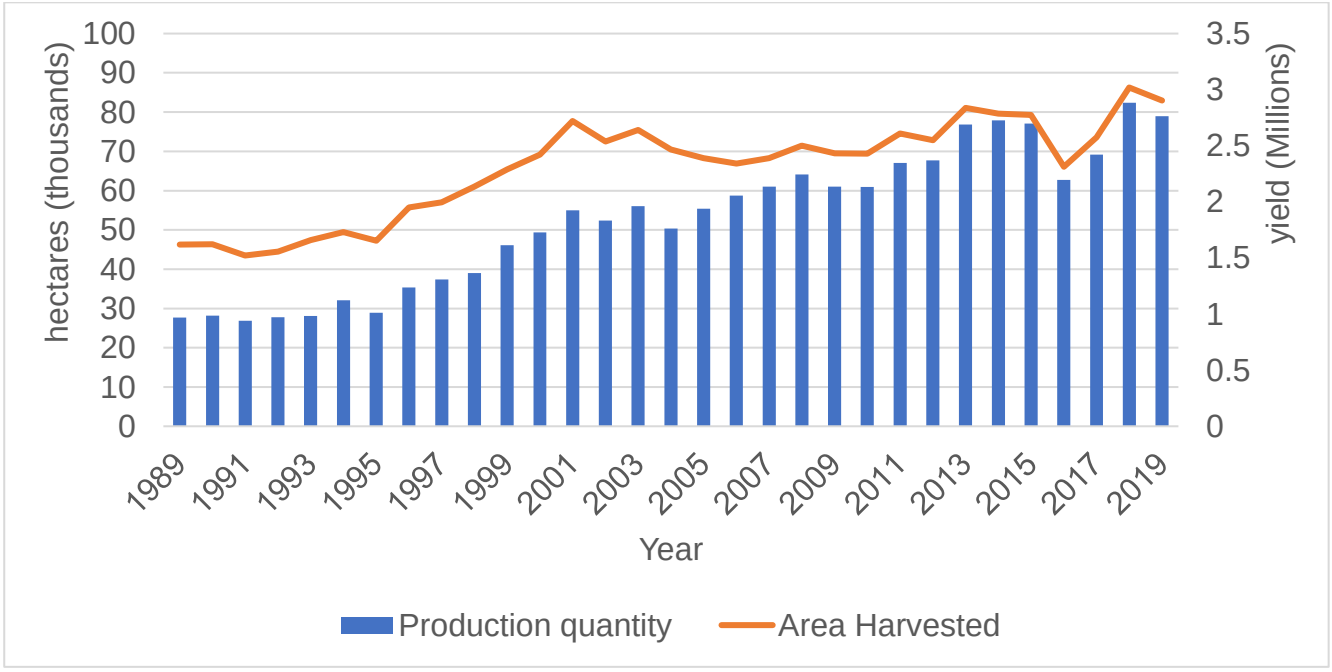

Figure 4.8: South African production vs quantity harvested from 1989 to 2019 [N=30]

Source: Own compilation based on FAOSTAT data

The top four categories in the citrus industry include oranges, lemons and limes, grapefruits and pomelos; and lastly tangerines, mandarins, and clementine. Sinngu (2014) outlined that in South Africa, the citrus industry exhibits a diverse range of growers, ranging from large, lucrative producers to smaller-scale ones who primarily distribute their goods in local markets. The leading categories collectively amounted to a total production yield of approximately 969 thousand tonnes over 46 thousand hectares in 1989.

In 2019 the production quantity was approximately 2.8 million tonnes over a total area of 82.9 thousand hectares which was a 4.16% decline from 2018. The major portion of citrus production in South Africa is intended for the export market, since approximately two thirds of production (65 percent) was exported. Twenty nine percent of the citrus fruits produced in 2019 was used for value addition and processing and the remaining 6% of the citrus fruits produced in 2019 were consumed locally (CGA, 2020)

4.4.3. Trade trends

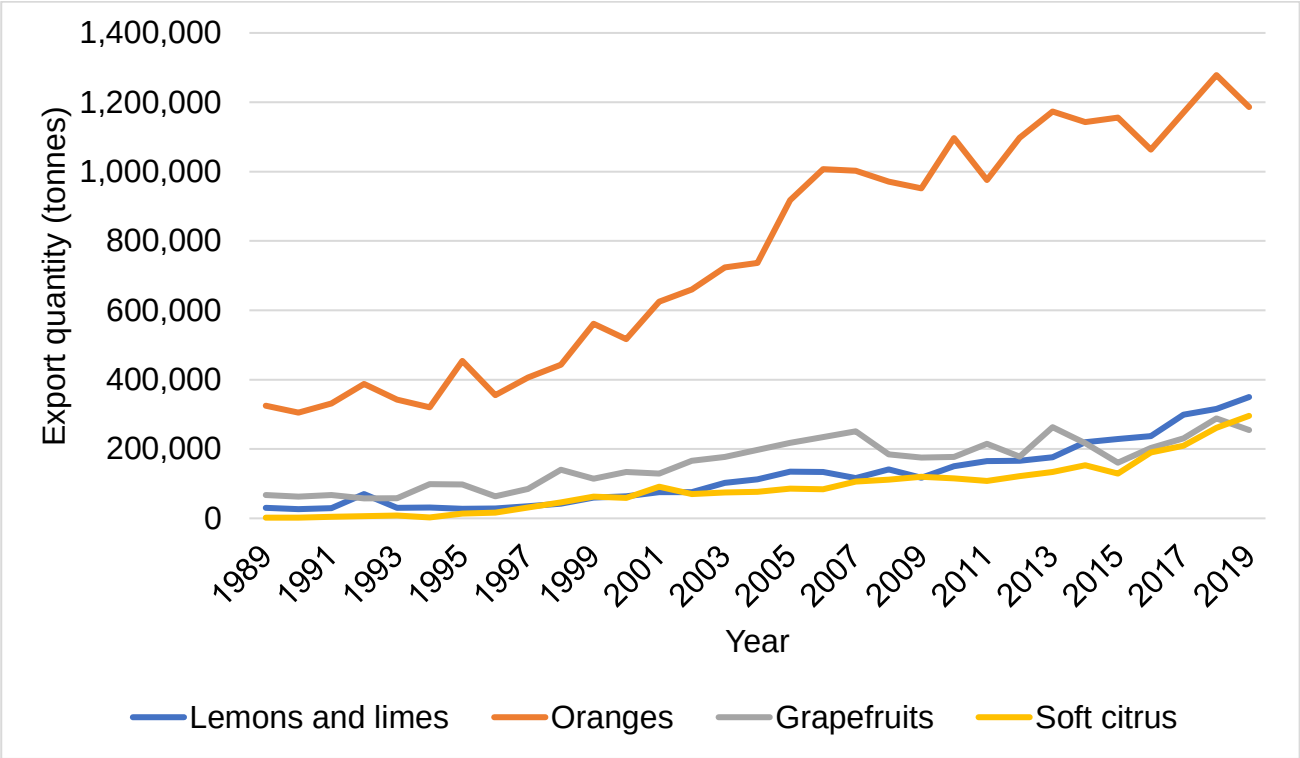

Figure 4.8: Graph representing the export quantity of South Africa citrus fruits [N=30]

Source: Own calculations based on FAOSTAT data

The export market accounts for the bulk of SA citrus production. This is because the South African citrus industry relies heavily on exports. Despite shifts in both local and international markets, the South African citrus industry has gained recognition as one of the most dependable suppliers of citrus fruits worldwide. Additionally, oranges constitute to most citrus exports. Figure 4.8 indicates that South Africa exported approximately 325 000 tonnes of oranges in 1989 and despite fluctuations in the market, the quantity of oranges exported have been increasing on an annual basis. The total amount of oranges exported in 2019 was approximately 1.19 million tonnes. Which was a 7.56% decline from 2018 which implied that the profitability of exporters is coming under pressure Sinngu (2012). Despite the production quantity declining in 2019, the total exported quantity of lemons and limes and of soft citrus increased by 9.89% and 11,73%, respectively. The export quantity of lemons and limes, grapefruit and soft citrus ranged between 250 000 tonnes and 350 000 tonnes in 2019 and lemons and limes were the second highest exported citrus fruit, followed by soft citrus then grapefruits that had a 13.26% decline from 2018.

4.4.4. Distribution trends

The European Union (EU) stands as a pivotal market for a significant portion of South African citrus fruits, accounting for a substantial 32% share of all citrus varieties consumed. Particularly crucial for orange exports, as it absorbs over 30% of them, this market's demand stems from South Africa's production of citrus and the EU's preference for high-quality counter-seasonal navel and Valencia oranges. Despite its importance, South African citrus exports face stringent phytosanitary regulations from the EU to combat citrus black spot (CBS). These regulations, as highlighted by Sishuba (2016), allow entry of CBS-infected citrus into the EU only for processing purposes. According to Dlikilililli (2018), the revised regulations are anticipated to confer a relatively stronger position on the South African citrus industry compared to Uruguayan citrus, which faces similar phytosanitary constraints. Nonetheless, the EU continues to import significant quantities of other citrus varieties from South Africa, including 26% of soft citrus, 41% of grapefruit, and 27% of lemons and limes, as illustrated in Table 4.2

Table 4.2: Destination of South African citrus exports

	Countries						
	EU	Asia	Middle east	USA	UK	Russian federation	Others
Oranges	34%	27%	18%	6%	6%	8%	1%

Soft citrus	26%	15%	9%	11%	26%	10%	3%
Grapefruits	41%	37%	0%	5%	5%	9%	3%
Lemons and limes	27%	12%	37%	5%	7%	10%	2%

Source: Own compilation based on Citrus Growers Association data

The Middle east is the third biggest market of South African oranges. Furthermore, it is also one of the of the most important export markets since it is one of the major importers of lemon and limes. It imported 37% of the total lemons and limes in 2019 which was a 3% increase from 2015. Additionally, Argentina emerges as a key competitor across many of South Africa's export destinations, particularly in the lemon and lime markets (Dlikilili, 2018). Nonetheless, Asia is the second largest market for South African citrus fruit exports with an aggregate of 22.75%. The Russian Federation and the United Kingdom are also important markets for SA citrus fruits. The UK was of the crucial markets for soft citrus absorbing approximately 26% of total soft citrus produce.

4.4.5. South African citrus value chain and major key players

Dlikilili (2018) defines a value chain as a tool that can be used to describe a full range of events that are essential towards bringing a given product throughout different stages of production until it reaches the final consumer. Therefore, a value chain includes different activities such as the production, marketing, distribution of citrus fruits to the consumer (Dlikilili, 2018; European commission, 2011). Citrus trees are planted in orchards and inputs are mainly supplied and controlled by South African Citrus Nurserymen’s Association (SACNA) and Agricultural Chemical Distribution Association of South Africa (ACDASA). South African Citrus Nurserymen’s Association controls citrus nurseries and agrochemicals service providers are controlled by ACDASA.

Despite citrus being viewed as a long-term crop due to the orchards lasting approximately 18 to 30 years, the DALRRD assists citrus producers with infrastructure and production information in collaboration with the CGA. The two stakeholders assist citrus producers to produce high yields of quality fruit annually and do this consistently over a period. Furthermore, stakeholders like universities, industry research bodies and the Agricultural Research Council (ARC). In addition, Value chains link producers, processors, marketers and distributors (Esterheuizen, 2006). Thus, the SA citrus industry includes producers, fresh produce markets like the Joburg fresh fruit market, retailers, processors, cold storage and pack house operators,

transporters, exporters, quality control and certification agents, and terminal and port operators. The Department of Trade, Industry, and Competition (DTIC) aids South African citrus exporters by establishing a fair multilateral trading system that fosters growth and enhances trade and investment relationships with major economies. Consequently, upon arrival of citrus fruits in international markets, importing agents, distributors, market intermediaries, and retailers distribute the citrus fruits to consumers. Figure 4.9 demonstrates a full depth display of the South African value chain.

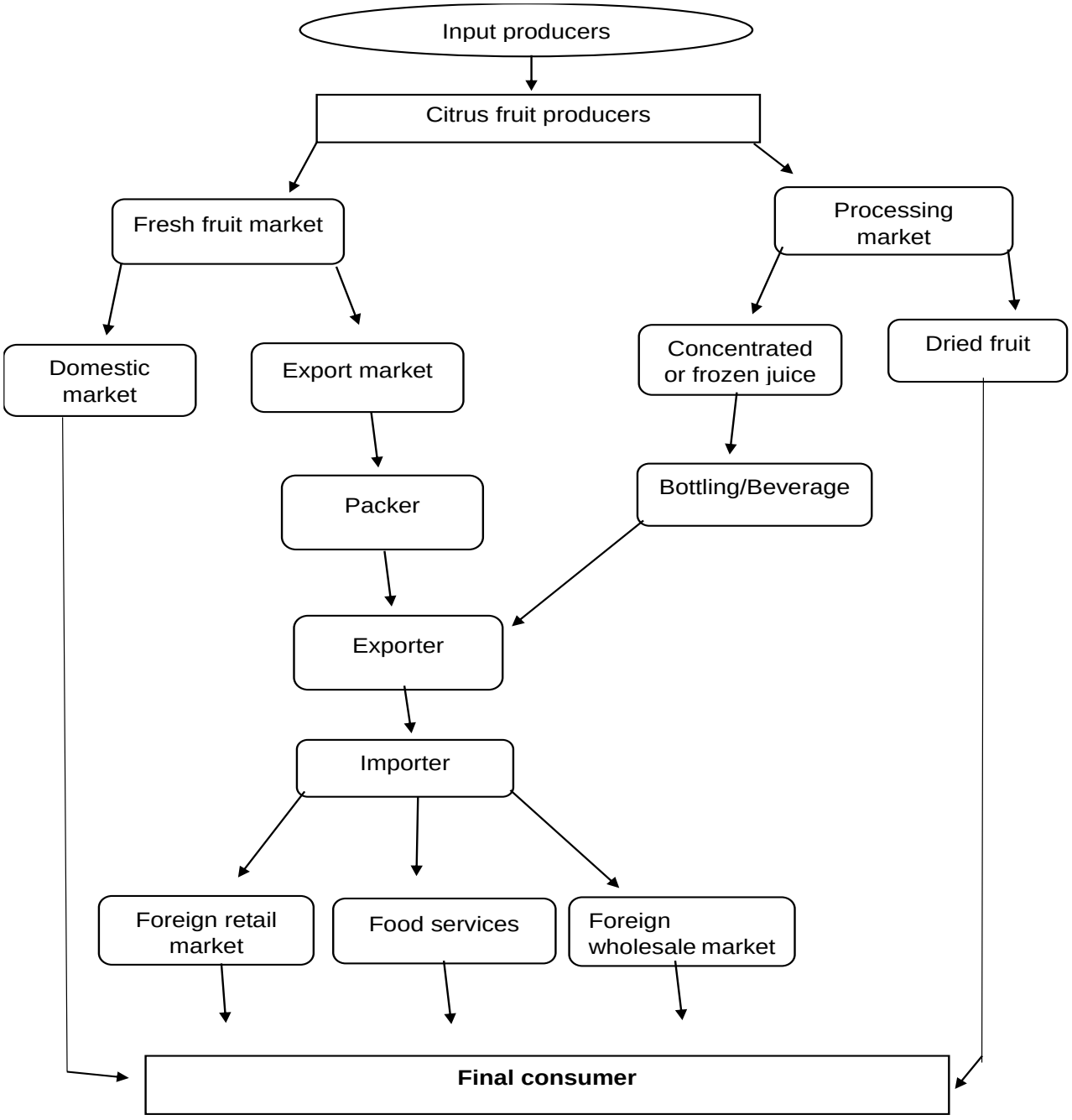

Figure 4.9: South African value chain of various citrus fruits

Source: Authors computation based on CGA data

4.4.6. Challenges facing the citrus fruit industry

The citrus industry is confronted with a plethora of challenges that are not within its power to control:

i. Oversupply of citrus fruits can lead to price fluctuations, which would ultimately cause growers and exporters to lose their profits. Excess supply of citrus in the global market,

leads to the decrease of prices, thus affecting the overall revenue of citrus producers (Wei *et al*., 2022).

ii. Mismatches in supply and demand can lead to market uncertainty. This is because citrus farmers are price takers and sudden surpluses or shortages can lead to unpredictable market conditions, making it difficult for citrus producers and exporters to plan and strategize effectively (Swinney, 2011; Dlikilili, 2018).

iii. Fluctuations of the value of the South African Rand (ZAR) can be a challenge due to citrus exporters and growers because a weaker currency can make exports more attractive because it is cheaper for importing countries, but it can also increase input costs, thus, affecting profitability.

iv. Performance of competitors' currencies so for example the Australian dollar may depreciate against the Rand and that may negatively affect SA because the country will incur higher import prices causing them to import citrus fruits at higher prices. In addition, the industry may become less competitive in international markets, potentially leading to reduced market share.

v. Competition with other fruits in different markets.

vi. Foreign government subsidies and assistance to domestic citrus industries in other countries can create an uneven playing field. These subsidies can lead to unfair competition and trade barriers, making it challenging for South African citrus exporters to access certain markets.

vii. Weather patterns and climatic conditions due to climate change such as droughts, frosts, or extreme weather events, can disrupt citrus production. This will ultimately lead to lower yields and lower-quality fruit which will not be accepted into some markets due to Sanitary and phytosanitary measures.

viii. The South African citrus industry can be subjected to unforeseen global crises like recessions, and they can reduce consumer spending if they deem citrus fruits as non-essential items. This will result in decreased demand and lower sales for the citrus industry. According to Mtshiselwa (2020) and Dlikilili (2018) the economic recession led to reduced demand for citrus fruits.

ix. Changes in consumer preferences

x. Increases in world oil prices can lead to increased transportation costs, affecting the overall cost structure of the citrus supply chain. This can result in reduced profit margins for industry players and increased cost for citrus fruit consumers.

xi. The production and packing of citrus to meet export market expectations. This can pose as a challenge to citrus producers because South Africa is located far from the global market i.e., Asia, Europe. Furthermore, the crop is grown in a wide geographic area with different climatic conditions and soil types, and that it is home to some of the most destructive pests and diseases found anywhere in the world (Ndou, 2012; Sinngu, 2014).

4.5. Chapter summary

This chapter addressed the initial objective of the study, which aimed to analyse the South African citrus industry by examining its position in the global citrus fruit market, its role in the Southern Hemisphere market, and its significance within the broader global citrus industry. It focused on production and trade trends, tariffs affecting South Africa and other Southern Hemisphere producers, as well as key importing markets for citrus fruits. The subsequent chapter will present the empirical findings derived from the study.

CHAPTER 5: RESULTS AND DISCUSSION

5.1. Introduction

This chapter presents the empirical findings of the study. The Augmented Dickey-Fuller test was employed to assess the stationarity of the time series data. Additionally, the Revealed Comparative Advantage Index and Net Export Index were utilized to determine the comparative position of South African citrus fruits relative to those of its counterparts in the Southern Hemisphere.

5.2. Revealed comparative advantage and Net export index results

5.2.1. Introduction

Section A presents and discusses the results of Revealed comparative advantage (RCA) and Net export index (NXI) for citrus fruit production in South Africa. The South African RCA and NXI is compared with other Southern Hemisphere countries to check its ranking on global production of citrus. The citrus discussed in this chapter include, oranges, lemons and limes, grapefruits and pomelos, tangerines, mandarins, and clementines (soft citrus). The results are presented in graphical visual format for better understanding of the trends. Lastly, the chapter summary will holistically conclude on the common trends and South African citrus performance compared to other countries.

5.2.2. Oranges

Figure 5.1 depicts the revealed comparative advantage (RCA) index for oranges of South Africa from 1989 to 2019. According to Sinngu (2014), an RCA index that is greater than 1 signifies a comparative advantage and an RCA index that is less than 1 signifies a comparative disadvantage. In addition, a strong comparative advantage is indicated by an RCA index for a specific commodity that is greater than 10 (Sinngu, 2014; Galletto,2003).

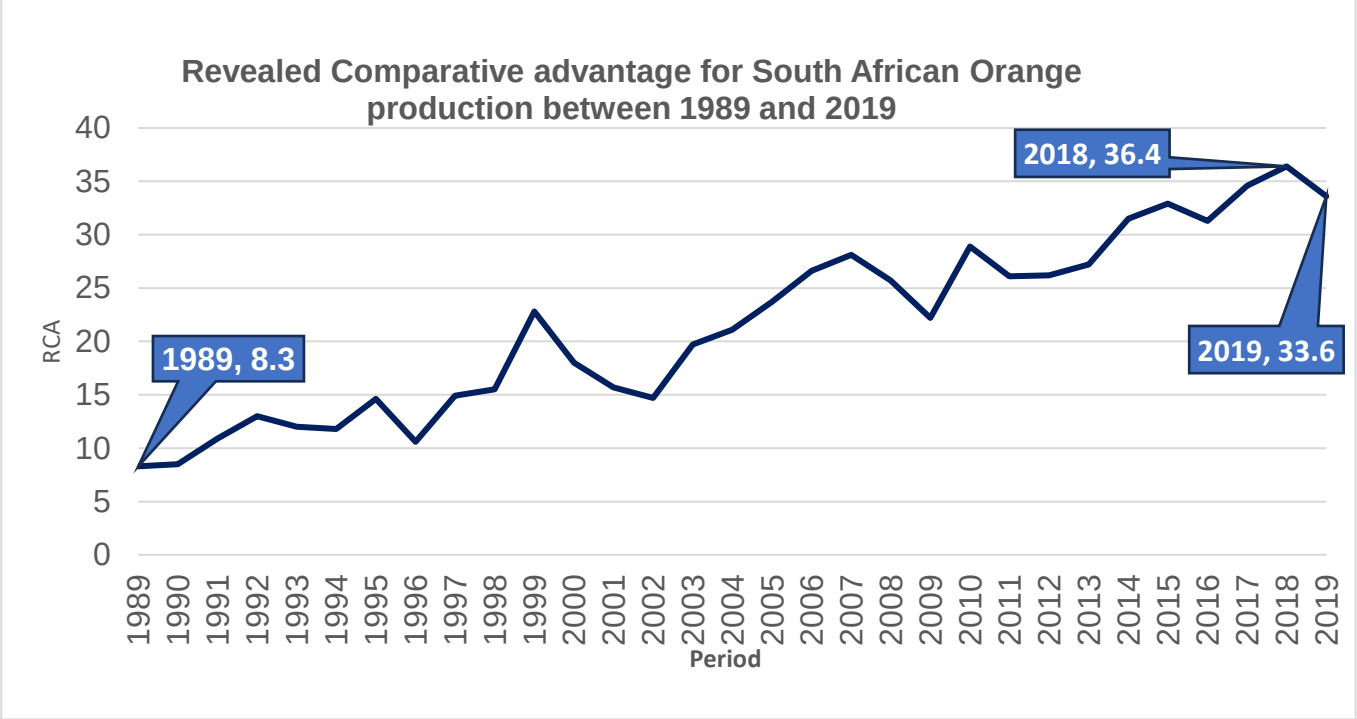

Figure 5.1: Graphical display of SA orange RCA [N=30]

Source: Own compilation

Figure 5.1 above indicates that South Africa displayed an increasing RCA trend for orange production between 1989 and 2019. This means that in all the years incorporated in the study, South Africa maintained a comparative advantage in orange production at an increasing rate. However, in 1989 South Africa had a weak comparative advantage in orange production of less than 10. It demonstrated that despite the trade sanctions imposed on the SA citrus industry the South African orange farmers were able to produce and export oranges to major markets due to increasing demand. Khuele as cited by Mshengu (2021) found that the SA market share for navel oranges exceeded 50% in the EU market from 1976 and 1993 despite trade sanctions imposed on the SA citrus industry.

Nonetheless, the results displayed that South Africa had and maintained a strong comparative advantage in the production and exportation of oranges between 1990 and 2019. This implies that it was economically viable for South Africa to domestically produce oranges rather than importing them. This corresponds with the findings of Jambor and Czirkl (2022) that SA has a comparative advantage and is a global leader in the production and exportation of oranges. Alternatively, the abovementioned results indicate a noticeable slight decline in comparative advantage between 2011 and 2012. This can be attributed by the emergence of the citrus black spot in 2018. According to Dlikilili (2018) the emergence citrus black spot in 2011 reduced the

competitiveness of the South African oranges due to phytosanitary measures. Furthermore, the study recorded another noticeable decline in the RCA index between 2018 and 2019. This is because the SA citrus industry has been migrating from the production of oranges to the production of lemons and limes and soft citrus due to the value (Chisoro-Dube and Cramer, 2019). However, the country comparative advantage remained stronger (RCA >10). Nonetheless, it is important to investigate how South Africa compares with other countries in orange production. Therefore, figure 5.2 below illustrates the comparative advantage of South Africa compared with other countries.

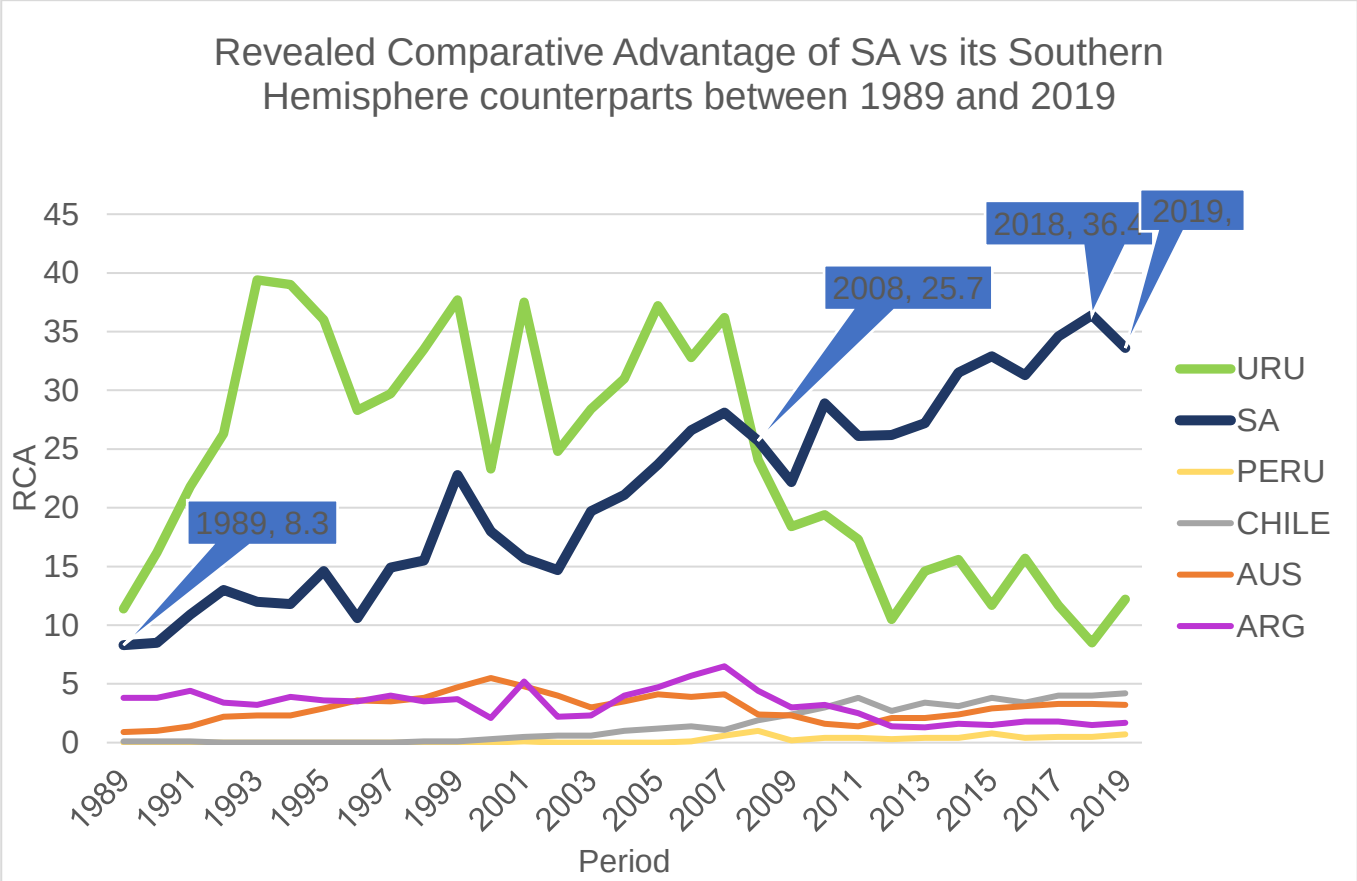

Figure 5.2: SA orange RCA vs its Southern Hemisphere counterparts between 1989 and 2019 [N=30]

Source: Own compilation

As seen in the figure above, in 2019, South Africa demonstrated a strong comparative advantage (36.4 RCA) in production of oranges compared to its Southern Hemisphere counterparts. Furthermore, South Africa had a higher comparative advantage (8.3 RCA) in orange production compared to Peru, Chile, Australia, and Argentina between 1989 and 2019. This corresponds with the findings of Luckstead and Devedoss (2021) that Australia had a

lower comparative advantage in the production and exportation of oranges due to Australian oranges susceptibility to citrus canker which leads the removal and death of orange trees.

However, between 1989 and 2008 Uruguay had higher comparative advantage than South Africa. The significant difference between South Africa and Uruguay RCA could be explained by changes in economic growth in 2008. In 2008 South Africa had a GDP of $316.13B and $388.53B in 2019, while Uruguay had $31.11B in 2008 and $62.05B in 2019 (Macrotrends, 2023). Given that South Africa is mostly comparative with Uruguay, it is important to investigate the net export index between the two countries. Figure 5.3 shows South Africa and Uruguay Orange production net export index between 1989 and 2019.

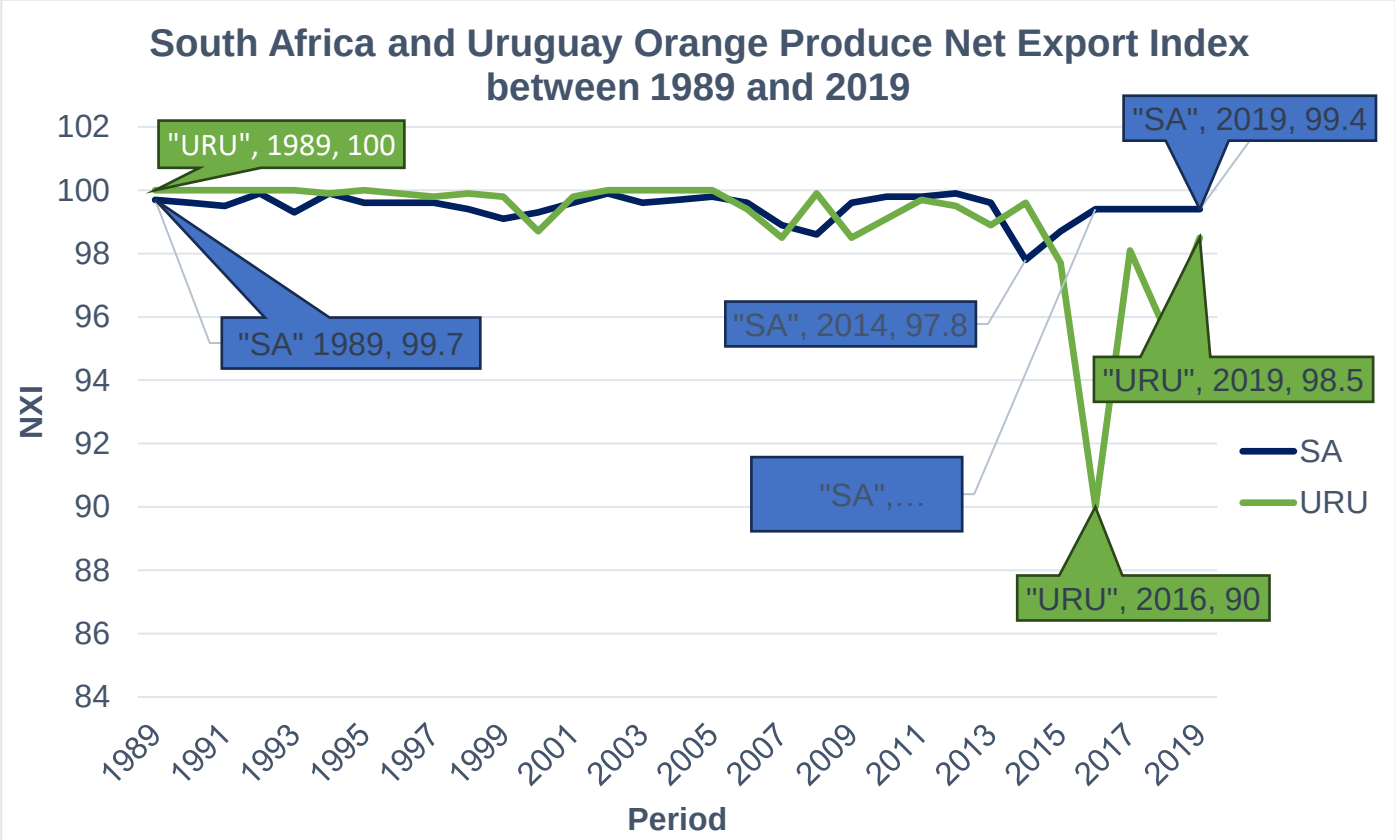

Figure 5.3: Graphical display of the net orange export index (Appendix 1) [N=30].

Source: Own compilation

As demonstrated in the figure 5.3, South Africa has maintained competitive position (between 98.5 and 99.9 NXI) in the exportation of oranges between 1989 and 2019. Furthermore, in 1992, 1994, 2002 and 2012 South Africa exported (99.9 NXI) a significant proportion of its orange production compared to its imports. Despite the high NXI in both 1989 and 2019, the NXI results indicate that South Africa had more orange produce exports in 1989 compared to

2019. This contradicts the findings of Seleka and Obi (2018) who found that SA exported more oranges in the late 2010s compared to the late 80s and early 90s.In addition, when compared with other years between 1989 and 2019, the country imported relatively more orange produce than exports in 2014. On the other hand, higher than South Africa, Uruguay had maintained a competitive position (between 98.5 and 100 NXI) between 1989 and 2019. In some years (1989-1993, 2002-2005 and in 1995), Uruguay was not engaging in any imports. Uruguay and South Africa shared a highly competitive position in net export of orange production between 1989 and 2019. However, Uruguay in comparison to South Africa, had maintained a higher competitive position from 1989-1999, 2001-2005, and in 2008 and 2014. This implies that, in these years Uruguay exported significant proportion of its orange production compared to South Africa Orange produce exports. The fluctuation of the NXI of Uruguay can be attributed by the inability of Uruguayan orange farmers to find managers with the skills needed for success in international business (Topolansky, Lestido and Triay, 2021).

5.2.3. Lemons and limes

Figure 5.4 depicts the competitive advantage for Lemons and Lime production in South Africa between 1989 and 2019.

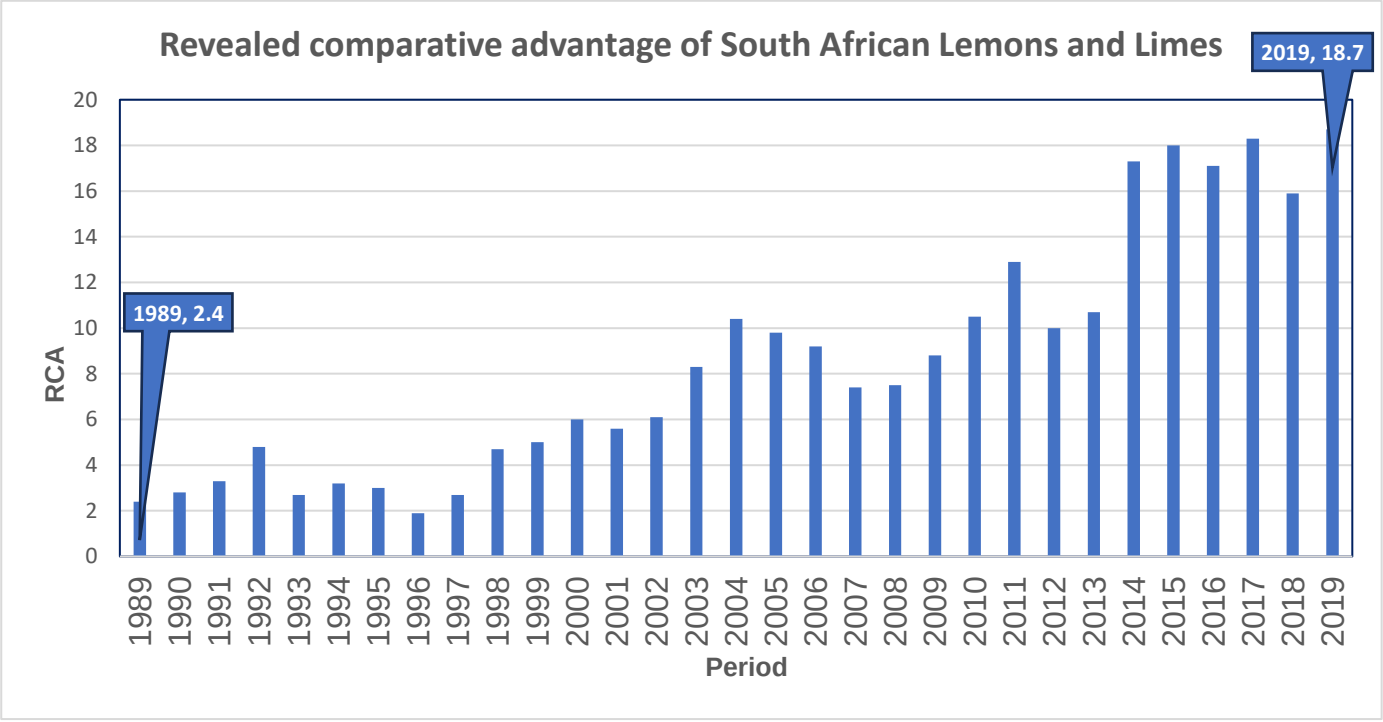

Figure 5.4: South African lemons and limes comparative advantage between 1989 to 2019 (Appendix 2) [N=30].

Source: Own compilation

Based on the figure 5.4, South Africa maintained RCA above 1 between 1989 and 2019. This means that in all the years South Africa maintained a comparative advantage in Lemon and Lime production. In addition, there is a significant improvement in the country's comparative advantage between 1989 and 2019. This is due to an increase in the amount of land used to farm lemons and limes. According to Chisoro-Dube and Cramer (2021) and Sibulali and Molefe (2021), SA has been increasing the production of lemons and limes due to the increase in demand in the global markets.

The country had 2.4 RCA in 1989, which had drastically increased to by 87.1% in 2019. In addition, South Africa started having a higher comparative advantage in 2004 with an RCA above 10. Mshengu (2021) found that the comparative advantage of SA increased due the emergence of the Trade, Development and Cooperation agreement which was introduced in 2004 and gave SA a leeway towards accessing one of the biggest markets to date. Furthermore, South Africa had a higher GDP in 2004 compared to any year from 1989 to 2003. This is in line with the findings of Gerber and Thart (2023) that GDP is an important factor in addressing the competitiveness of lemons and limes in the global market. However, it is important to investigate how South Africa compare with other countries in Lemon and Lime production. Therefore, the figure below depicts the comparative advantage of South Africa compared with other countries.

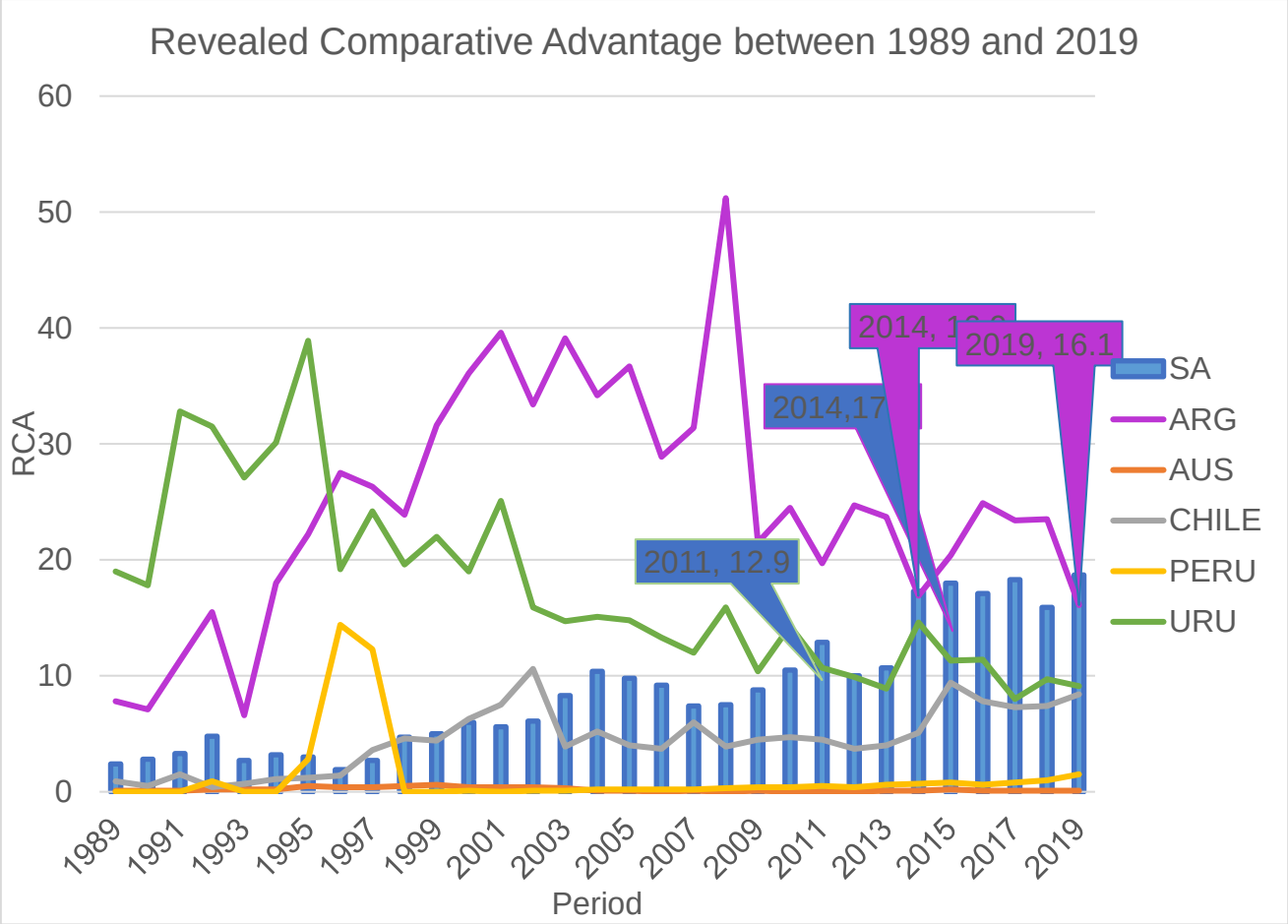

Figure 5.5: Graphical display of SA lemons and limes RCA vs its Southern Hemisphere counterparts [N=30]

Source: Own compilation

Figure 5.5 above demonstrates that South Africa had a weaker comparative advantage in Lemon and Lime production from 1989 to 2010 when compared to Uruguay. However, when compared to Argentina, the country had a weak comparative advantage from 1989 to 2013, and again from 2015 to 2018. This demonstrates that between 1989 and 2019 South Africa demonstrated a weaker comparative advantage compared to both Uruguay and Argentina. However, between 2011 and 2019 South Africa had a stronger comparative advantage compared to Uruguay. This is due to phytosanitary measures imposed on Uruguayan lemons and limes due to diseases and the inability of the Uruguayan citrus industry to control them. This corresponds with the findings of Topolansky *et al*. (2021) and Lachman, Tacsir and Pereyra (2022) that Uruguayan lemons and limes were exposed to various diseases and the inability to manage them led to reduced export competitiveness.

In addition, SA had a stronger competitive advantage in 2014 and 2019 compared to Argentina. This means that in 2014 and 2019 South Africa had a stronger comparative advantage against both Uruguay and Argentina. This contradicts the findings of Dlikilili (2018), Sinngu (2014) and Avetella *et al*., (2018) that Argentina is the most competitive in the production and exportation of lemons and limes. In most years between 1989 and 2019, South Africa had maintained a comparative advantage against Peru, Australia, and Chile. However, this contradicts the findings of Sibulali and Molefe (2021) that Chile is a net exporter of lemons and limes, and it specifically exports lemons and limes to major markets like China.

To further understand the disparities between South Africa, Argentina, and Uruguay, it is important to investigate the export and imports of Lemon and Lime produce from these countries between 1989 and 2019. Therefore, the figure below depicts lemons and limes net export index between 1989 and 2019 for South Africa, Argentina, and Uruguay.

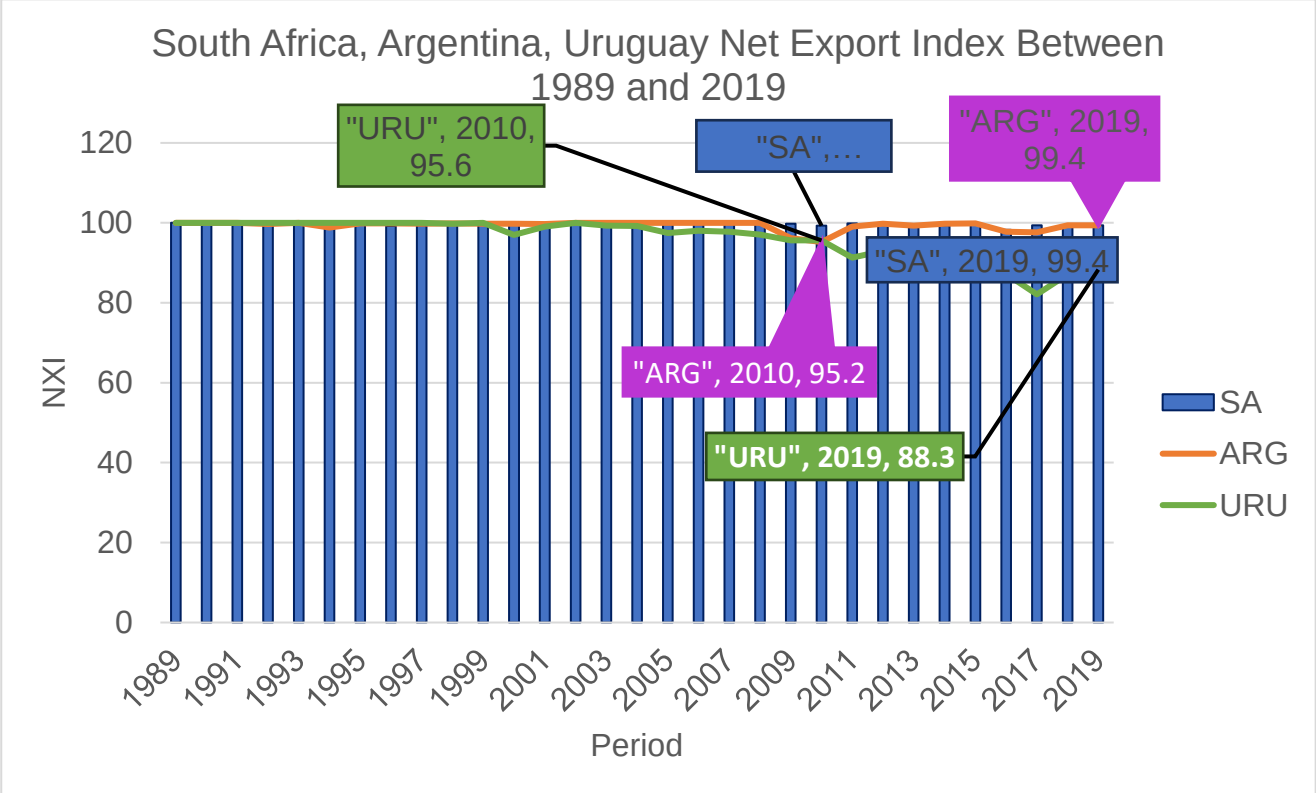

Figure 5.6: NXI graphical display between South Africa, Argentina and Uruguay between 1989 and 2019 [N=30]

Source: Own compilation

South Africa's lemon and lime NXI values consistently remained close to 100 over the entire period from 1989 to 2019. This means that South Africa has continued to have a comparative

advantage in lemon and lime production from 1989 to 2019. Evidently, South African Lemon and Lime production had a steady increase from 2000 to 2010 (Trade Probe, 2011). On the other hand, observed from Figure 5.6, South Africa, Uruguay, and Argentina all have NXI values closer to 100. This means that all three countries shared a competitive position between 1989 and 2019. In addition, the close competition was previously observed in Figure 5.6 comparing the RCA between the three countries. However, between 2009 and 2011 Uruguay and Argentina NXI values dropped, which resulted in having South Africa as the lead country in exporting Lemon and Lime produce. Nonetheless, Argentina recovered in 2011 maintaining an NXI closer to 100. The drop in the NXI values of Argentina is ascribed by the lack of funding opportunities in the breeding of lemons and limes varieties that are in line with global market requirements (Avella *et al*., 2018).

5.2.4. Grapefruits and pomelos

The figure below depicts the competitive advantage for Grapes and Pomelos production in South Africa between 1989 and 2019.

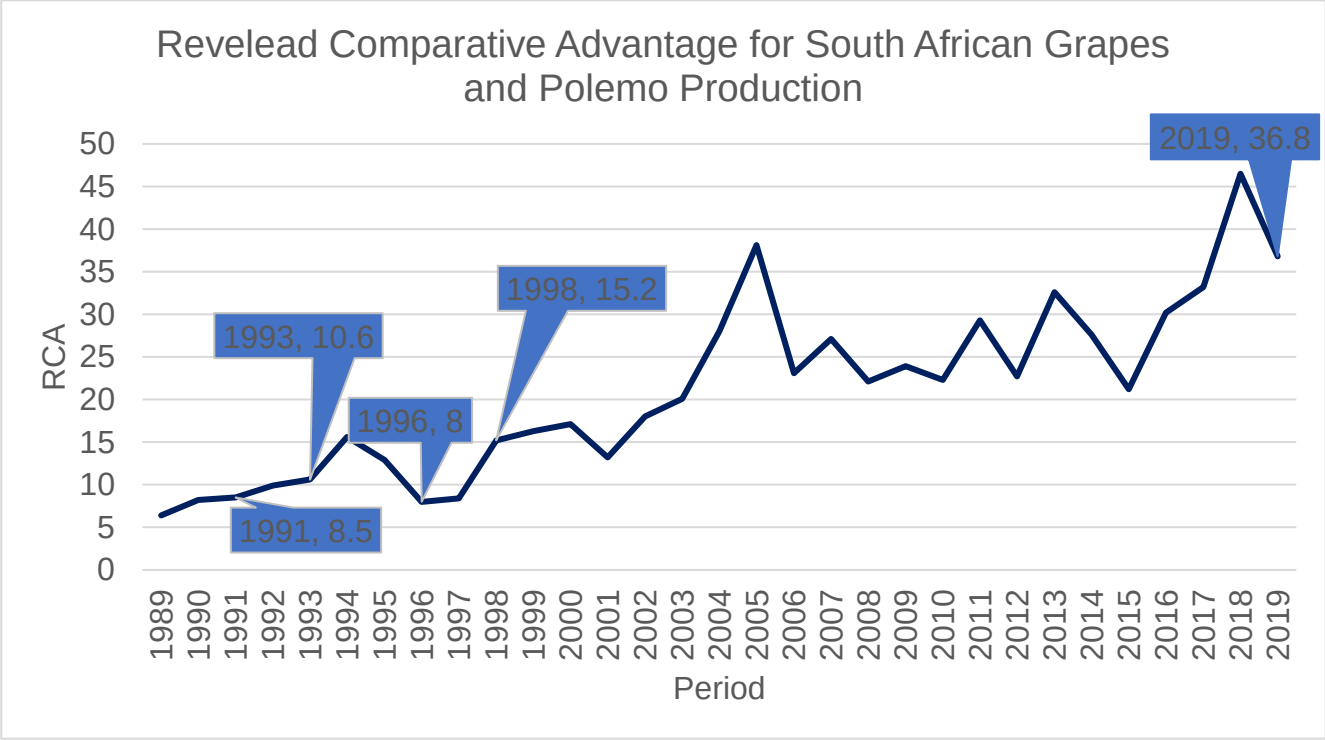

Figure 5.7: Graphical display of SA grapefruits and pomelos RCA between 1989 to 2019 [N=30]

Source: Own compilation

South Africa demonstrated an increasing trend in the production and exportation of Grapefruits and Pomelos. This indicates that South Africa had an appreciating comparative advantage in the production of Grapefruits and Pomelos (RCA>1). However, South Africa had a weaker comparative advantage from 1989 to 1991, with RCA values below 10. Similarly, the country experienced the same trend was experienced in 1996 and 1997. Nonetheless, from 1993 South Africa had a continuous RCA value above 10. This means that from 1993 the country had a strong comparative advantage in Grapefruit and Pomelos production. In addition, from 2004 to 2019 the country had strong RCA values above 10. This suggests that South Africa has successfully positioned itself as a major player in the global market. However, this opposes the find the findings of Kau, Mmbengwa and Swanepoel (2023) that South African grapefruits are not competitive because grapefruit producers are unable to adjust to price changes due to price volatility. As a result, it is important to investigate South African Grapefruit and Pomelos production with other countries. Therefore, figure 5.8 depicts South African RCA values compared with its Southern Hemisphere counterparts RCA values.

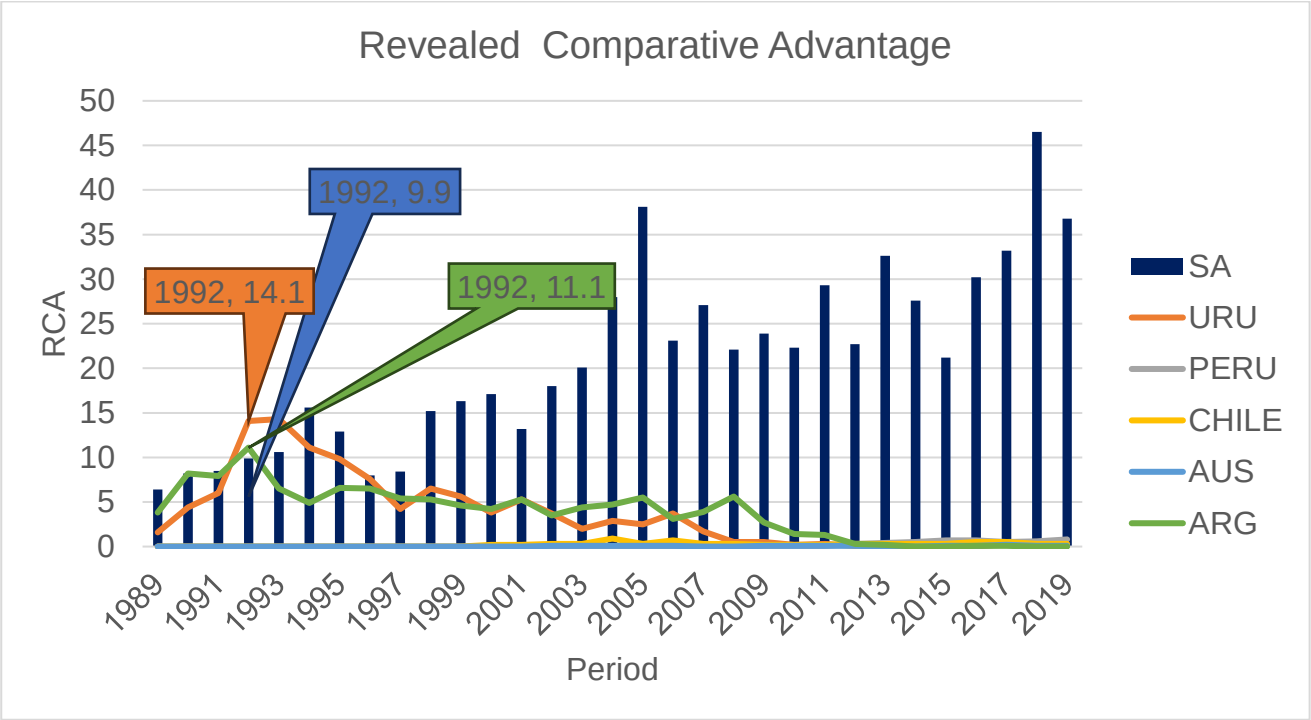

Figure 5.8: Graphical display of RCA between South Africa compared to its Southern Hemisphere counterparts [N=30]

Source: Own compilation

In comparison with South Africa, countries such as Peru, Chile, Australia generally had lower RCA values. This is because the abovementioned countries do not have access to adequate

subsidies. According to der Merwe (2022) Chile has a comparative disadvantage due to inadequate subsidies in the agricultural sector compared to other countries. However, South Africa had a weaker RCA in 1992 compared to Uruguay and Argentina. In addition, the results contradict the findings of Luckstead and Devedross (2021) and Chen and House (2021) that Peru has a strong comparative advantage in the exportation and production of grapefruits and pomelos especially to the United States of America. Additionally, South Africa had a weaker comparative advantage in Grapefruit and Pomelos production in 1992 compared to Uruguay and Argentina. Therefore, although South Africa generally maintained a higher comparative advantage from 1994 and 2019 compared to all other countries, Uruguay and Argentina are the only countries which could be a close competition to South Africa on Grapefruit and Pomelos production. Therefore, understanding export disparities between South Africa, Argentina, and Uruguay is important. Therefore, figure 5.9 shows Grapes and Pomelos net export index between 1989 and 2019 for South Africa, Argentina, and Uruguay.

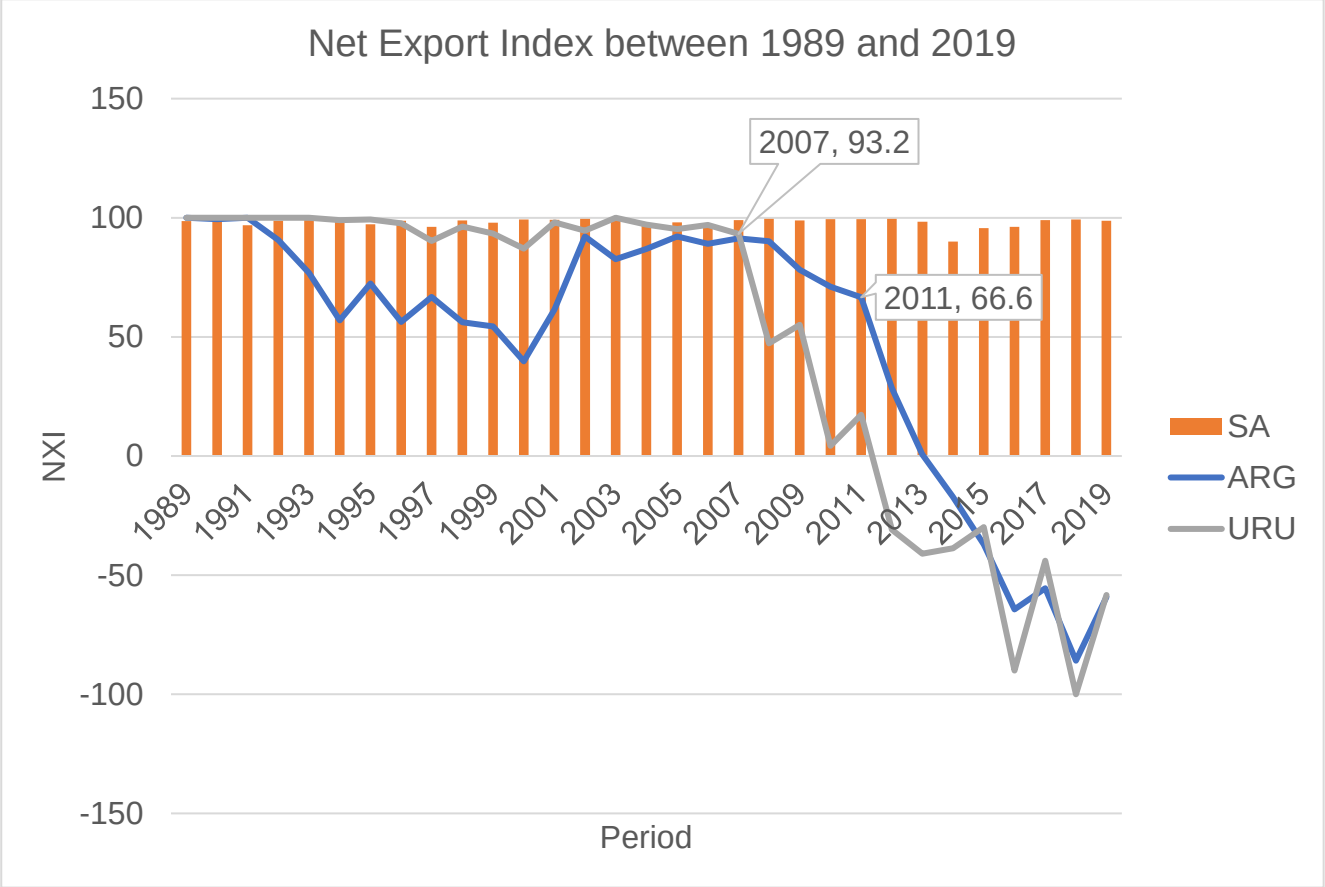

Figure 5.9: NXI graphical display for grapefruits and pomelos between SA, Uruguay and Argentina [N=30]

Source: Own compilation

South Africa had maintained steady export of Grapefruit and Pomelos produce between 1989 and 2019. However, Argentina had a fluctuating NXI values between 1989 and 2019. In 2011, Argentina, like Uruguay, experienced a steady decline in Grapes and Pomelos export and an increase in imports. Thereafter, from 2013 Argentina was no longer exporting any Grapes or Pomelos. On the other hand, Uruguay experienced a constant decline in export and increase in imports of Grapefruits and Pomelos between 2007 and 2011. Thereafter, the country was no longer exporting any Grapes or Pomelos until 2019. This contradicts with the findings of Lachman *et al*. (2022) that the grapefruit subsector in Uruguay have increased grapefruit exports due to monitoring signals from international markets to adapt to new requirements, and to exploit market opportunities. Therefore, this means that all its Grapefruits and Pomelos produce were acquired through imports. Therefore, South Africa had maintained a competitive advantage compared to Uruguay and Argentina.

5.2.5. Tangerines, mandarins and clementines (Soft citrus)

Figure 5.10 depicts the competitive advantage for Tangerines, mandarins and clementines (Soft citrus) production in South Africa between 1989 and 2019.

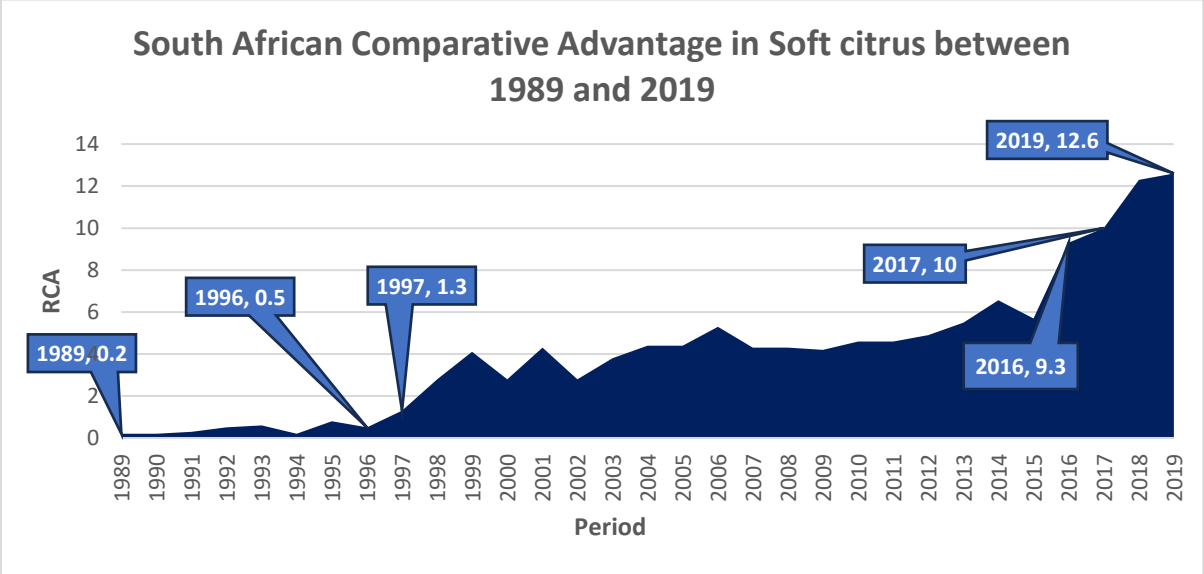

Figure 5.10: Graphical display of South African Tangerines, mandarins and clementines (Soft citrus) comparative advantage between 1989 and 2019 (Appendix 4) [N=30]

Source: Own compilation

South Africa had an increasing trend of Tangerines, mandarins and clementines (Soft citrus) production. However, from 1989 to 1996 the country had a comparative disadvantage in producing soft citrus. This can be attributed to the fact that SA was subjected to trade sanctions, less demand and the inaccessibility of land to the previously disadvantaged. This concurs with the findings of Dlikilili (2018) and Mtshiselwa (2020) that trade sanctions enabled Southern Hemisphere counterparts the opportunity to take over markets that were dominated by South Africa.

Nonetheless, between 1997 and 2016 the country had a comparative advantage in soft citrus production since the RCA index is greater than one but less than 10. In addition, it was only between 2017 and 2019 where the country had a stronger comparative advantage in soft citrus production. This can be ascribed to the increase in the price and demand of soft citrus in the export market. It corresponds to the findings of Dlikilili (2018) and Seleka and Obi (2018) that SA increased the area of soft citrus production since soft citrus fruits are considered as high value crops because soft citrus farmers get more revenue per ton compared to orange farmers.

Therefore, it was important to compare how other countries compare to South Africa between the years with weaker and between the years with stronger RCA values. The figure below illustrates the soft citrus production RCA values trend between 1989 and 2019 of South Africa compared with other countries.

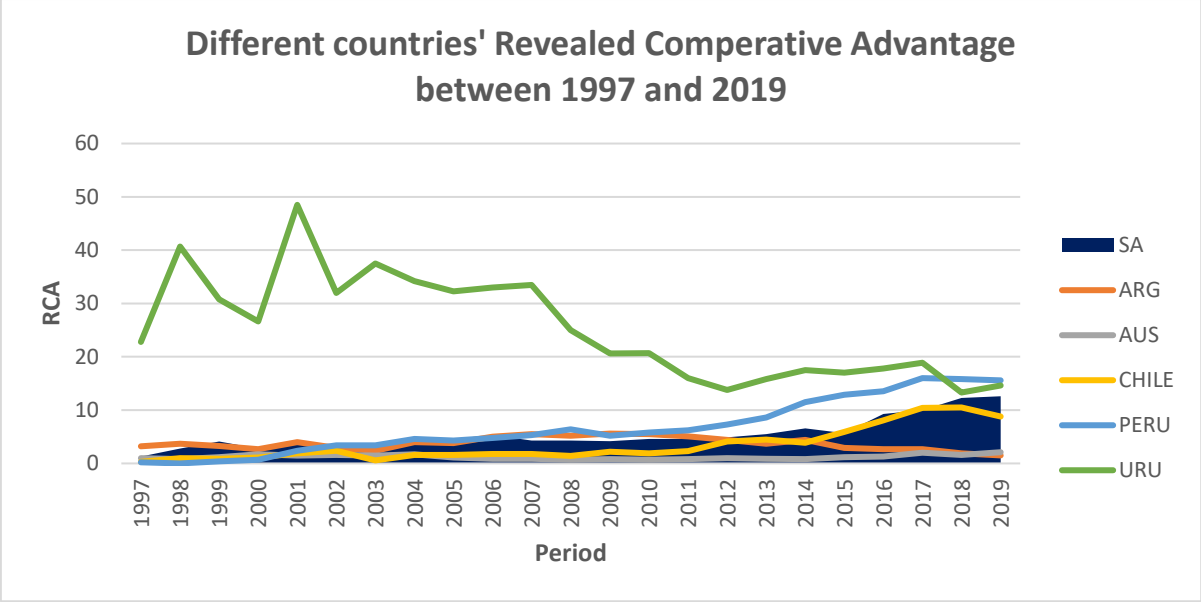

Figure 5.11: Soft citrus RCA between SA and its Southern Hemisphere counterparts between 1989 and 2019 [N=30]

Source: Own compilation

From 1997 to 2019, Uruguay consistently held a stronger comparative advantage in soft citrus production compared to South Africa, Argentina, Australia, Chile, and Peru. This indicates that throughout this period, Uruguay outperformed South Africa in soft citrus production. The findings correlate with the findings of Lachman, Tacsir and Pereyra (2022) that Uruguay is one of the major producers and exporters of Mandarins due to product quality and plant health.

Other countries that also held a higher comparative advantage included Argentina, Peru, and Chile. However, South Africa did not always lag these nations in terms of production. For instance, Argentina produced more soft citrus than South Africa only in the periods of 1997-1998 and 2007-2011. Similarly, compared to South Africa, Peru outperformed in soft citrus production and exportation from 2007 to 2019. According to the success of soft citrus production and exportation in Peru can be attributed to strong collaboration between the public and private sectors (Siekman, 2016).

Thus, Chile, on the other hand, only surpassed South Africa in soft citrus production in 2015 and 2017. As a result, it is recommended to compare the export index between South Africa and its competing countries. Therefore, the figure below depicts the net export index of soft citrus between South Africa, Argentina, Australia, Chile, Peru, and Uruguay.

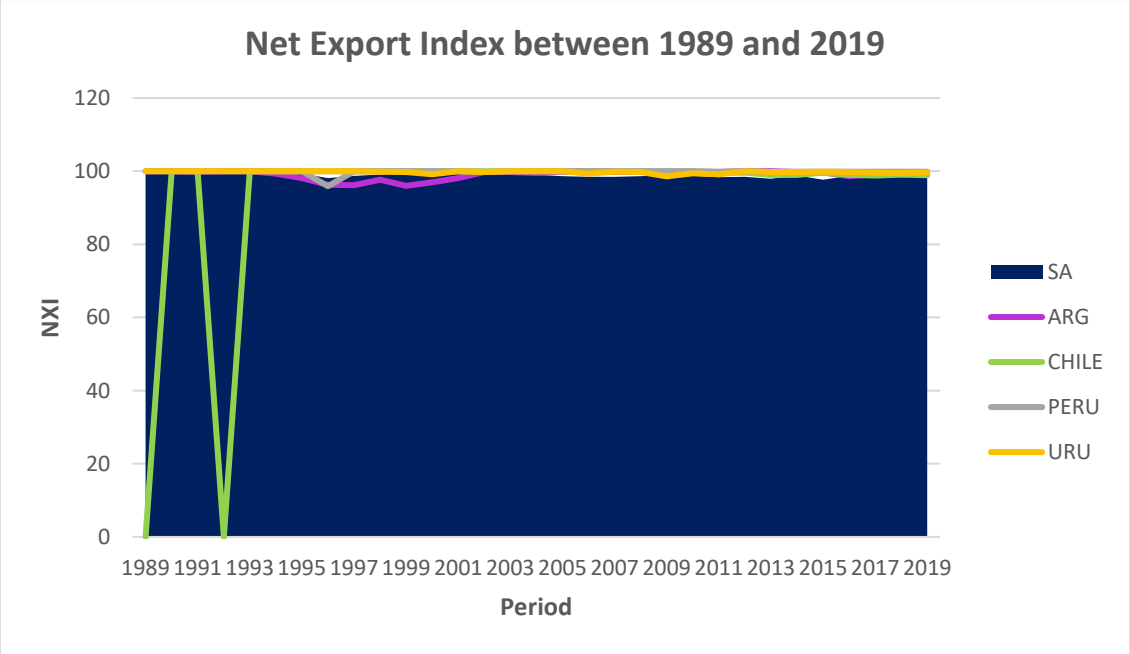

Figure 5.12: Soft citrus graphical representation between SA, Argentina, Chile, Peru Australia and Uruguay from 1989 to 2019 [N=30]

Source: Own compilation

South Africa's NXI values remain consistently high (close to 100) indicating a strong export with limited engagement in imports. Similar export trend for Tangerines, mandarins and clementines (Soft citrus) produce was observed for Argentina, Australia, Chile, Peru, and Uruguay. However, for South Africa, there are few years where its NXI was relatively weaker compared to certain other countries. In 1996, 1999 and 2009, South Africa had a relatively lower NXI values compared to Chile, Peru, and Uruguay. Moreover, in 1997, 1998 and 2019 the country had a relatively lower NXI values compared to Argentina, Chile, Peru, and Uruguay.

5.3. Constant market share results

5.3.1. Introduction

A first level constant market share decomposition was conducted to explore the sources of changes in different citrus fruits exports. The whole study period was divided into four sub-periods namely 1989-1995 (pre deregulation period), 1996-2002 (post deregulation), 2003-2009 and 2010-2019 period.

The structural effect is used as a tool to indicate the factors that impact how the export market expands contract in relation to the export growth whereas, the competitive effect indicates how change in exports occur due to the change in the exporting country’s competitiveness and lastly, the second order effect is able to indicate how the interaction of the change in an exporting country’s competitiveness and the change in the importing country’s product imports cause a change in the total citrus fruits exported (Barbaros, Akgungor and Aydogus, 2007; Ndou and Obi, 2012). The above-mentioned effects were computed for each sub -period and a summary of the computations is presented in Table 5.1, 5.2, 5. 3 and 5.4 below.

5.3.2. Oranges

Table 5.1 indicates the first level CMS decomposition of South African orange exports to 4 different markets namely the Russian Federation market, the UK market, EU market and the Asian markets. The results below indicate that the average export rose by 81.67% from the comparison between the pre deregulation period in comparison to the post deregulation period. This implied that the deregulation of the South African agricultural sector led to an increase in the export of oranges from South Africa to the global economy.

Table 5.1: CMS results for SA oranges in different markets [N=30]

		Different periods			
Country of destination	**1st level CMS decomposition**	**A**	**B**	**C**	**D**
		1989-1995	1996-2002	2003-2009	2010-2019
Average export value		22547,29	122975	268318,3	139150,7
Russian Federation	Structural effect	-987040	46208257,45	28947048,31	-65875743,31
	Competitive effect	38999161	-39909204,16	115929295,7	-92495248,71
	Secondary effect	-4059600	-32038914,69	102210558,3	20388475,44
United Kingdom	Structural effect	-76290,8	1427501	655027,6	-293874
	Competitive effect	1198465	1013468	-2472339	3321578
	Secondary effect	-28803,4	278667,1	-140302	-53569,5
Asia	Structural effect	5022633	12619507	98508986,31	86001701
	Competitive effect	3748879	8788920	-7184102,32	5800510
	Secondary effect	2105700	7361130	-15947450,27	6195476
European Union	Structural effect	9482,198	103054,7	226821	21237,87
	Competitive effect	7009,399	24686,9	6637,945	-834,954
	Secondary effect	3062,168	74626,51	13770,36	-76,1089

Source: Data from own calculations

However, SA oranges faced significant structural challenges (-987,040) in the Russian market by market in period A (1989-1996). This implied that SA orange exporters had numerous constraints to export citrus to the Russian market and it was due to trade sanctions that were

imposed on the South African orange subsector. After the orange subsector was deregulated, the abovementioned results indicate a substantial positive structural effect which demonstrated improved conditions for SA oranges in the Russian market. Despite that, the results showed that SA oranges had a negative structural and competitive effect in period D (2010 to 2019). This is ascribed to increased tariffs to export oranges in the Russian Federation market. It concurs with the findings of Matolo, Zhemin, Wen and Min (2016) that tariffs are significant in reducing the export competitiveness of South African oranges to BRICS countries but contradicts the findings of Hassanain and Gabr (2020) that SA oranges were competitive in the Russian market because its price ratio is greater than 1 implying that the price is favourable for SA exporters.

Correspondingly, the results indicate that the SA oranges faced significant structural challenges in the UK market in period A and D. Furthermore, the competitive effect was positive in all periods, indicating competitiveness in the UK market except during period C. This could be instigated by the economic recession that occurred in 2008. However, the results contradict the findings of Mshengu (2021) and DTI (2019) that orange exports competitiveness to the UK declined by approximately 24% although SA trades with the UK under the Southern customs union Mozambique and UK (SACU-M UK EPA) trade agreement.

However, SA oranges experienced substantial positive structural effects in Asia and the European Union in the period A. This implies that South African oranges were exposed to favourable conditions in both markets. Both markets continued to experience positive structural effects until period D. However, SA oranges experienced a negative competitiveness effect and second order effect in Asian market period C, and it experienced a negative competitiveness effect in the European Union market in period D. This is attributed by the inability of SA to negotiate to export more oranges specifically to China and the EU and it is in line with the results of Mshengu (2021) and Hassanain and Gabr (2020) that the growth rate of SA oranges has been lagging and growing at a slower pace compared to other periods.

5.3.3. Lemons and lime

The table below demonstrates the CMS results for South African lemons and limes in four major markets namely the European union, Asia, the Russian Federation and the United Kingdom. The results states that the South African lemons and limes exports increased in every period from period A to period D. According to Ndou and Obi (2012), a positive structural effect

implies that there is a growth in the demand of lemons and limes in that given period. Hence, the increase in the export value of SA citrus can be attained by the positive structural effect of South African lemons and limes in all the major markets. This contradicts the findings of Mariadoss (2019) that there was a negative growth in the export growth of lemons and limes in the period between 2015 and 2020.

In contrast, a positive competitiveness effect implies that South African citrus fruits are competitive in that given market (Crnokrak *et al*., 2022). Thus, it is insightful to note that; generally, South African lemons and limes have a positive competitiveness effect in most of the major importing countries. Despite that, South African lemons and limes displayed a negative competitiveness effect throughout period B in Russian federation and the United Kingdom market. Indicating that South Africa exported less lemons and limes to the RF and the UK. This contradicts the findings of Mtshishelwa (2020) and Dlikilili (2018) who found that South Africa was reclaiming its position as a top lemons and limes exporter and producer due to democracy and the lifting of economic sanctions. Additionally, the competitive effect was found to be negative in Asia during period C and this was caused by the decline of Asian countries currency that occurred between 2007 and 2013. These results are in line with the findings of Jordaan (2015) that when the Asian exchange rate depreciates there is a decrease in exports from South Africa.

Table 5.2: CMS results for lemons and limes from 1989 to 2019 in various markets [N=30]

		Different Periods			
Country Of Destination	**1st Level Cms Decomposition**	**A**	**B**	**C**	**D**
		1989-1995	1996-2002	2003-2009	2010-2019
Average Export value		4945,667	30472,83	59495	154956,2
European Union	Structural Effect	9082,286	17251,92	89639,41	113283,1
	Competitive Effect	2818,572	41376,59	24601	79047,28
	Secondary Effect	1228,455	21014,82	19410,25	36215,55

Russian Federation	Structural Effect	2326445	14710174	3102160	6273912
	Competitive Effect	1212878	-3732607	21970020	-23838161,5
	Secondary Effect	1612337	-12935619	45284382	-2784341,29
Asia	Structural Effect	1362,822	1868,148	47677,2	98968,24
	Competitive Effect	972,7743	1092,003	-2310,73	13886,4
	Secondary Effect	639,1326	467,3475	-6868,55	43748,95
United Kingdom	Structural Effect	319,5537	2931,82	742,3298	11210,21
	Competitive Effect	840,8561	-1517,34	9394,371	-5762,65
	Secondary Effect	688,753	-2522,61	9639,569	-2790,41

Source: Own compilation

5.3.4. Grapefruit and pomelos

Table 5.3: CMS for SA grapefruits and pomelos for various periods in selected markets [N=30]

		Different periods			
Country of Destination	**1st level CMS decomposition**	**A**	**B**	**C**	**D**
		1989-1995	1996-2002	2003-2009	2010-2019
Average Export value		-214,476	41381,83	28777,33	21532,5
Russian Federation	Structural Effect	-8353515,54	215691878,4	126165241,4	10519449,92

	Competitive Effect	272106089,7	-286629269,7	64123844,84	-224228126,2
	Secondary Effect	-33826603	-183511456,5	67611817,27	-9146075,066
United Kingdom	Structural Effect	-131625	80728,44	-789766	-242142
	Competitive Effect	82507,73	1379104	2425148	1551601
	Secondary Effect	-22471,6	198182,6	-414526	-37999,9
Asia	Structural Effect	1714,013	4737,304	758,5216	1714,013
	Competitive Effect	-10705,7	10118,61	-7015,04	-10705,7
	Secondary Effect	-6341,49	-23316,8	2429,966	-6341,49
European Union	Structural Effect	365,7543	48591,711889	138322,6206	-431,984395
	Competitive Effect	22768329	3011024667	10615260420	-59795990,31
	Secondary Effect	-0,93102	44812,067443	-30706,90442	-477,9011372

Sources: Own compilation

The abovementioned table demonstrates that the total value of grapefruits and pomelos exported in period A ranged between 67 thousand tonnes and 100 thousand tonnes. Despite that, the average export value of grapefruits and pomelos to the 4 markets indicated above totalled to -214,476 in period A. The negative average export value and negative secondary effect value in all markets in period A implied that South Africa was not competitive in the exportation of grapefruit and pomelos, and it was operating at a loss. This was due to the lack of demand of Grapefruits and pomelos in period A.

There was a significant negative structural effect in period A, indicating unfavourable changes in the Russian Federation market for South African grapefruits and pomelos. However, in the subsequent transitions, the structural effect became positive, suggesting improved market conditions. Nonetheless, the competitive effect fluctuated over time. It was positive in the period A and period C but turned negative in the period B and D, indicating varying levels of competitiveness in the Russian market. Contrary, the structural effect was generally negative in the UK market, indicating unfavourable changes in the market structure in all periods except in period B. However, the competitiveness effect was positive in all transitions, indicating competitiveness in the UK market for South African grapefruits and pomelos. This opposes the findings of Kupuya, Chinembiri and Kalaba (2014) that the Russian federation and the United Kingdom were strategic markets for grapefruits.

In contrast, the structural effect of SA grapefruits and pomelos in the Asian market was mostly positive in all transitions, indicating favourable structural changes in the Asian market. But the structural effect peaked in period B and declined by 83.98% in period C. The decline in the structural effect in the period C can be ascribed by the inability of South African to negotiate effective trade policy agreements for the exportation of grapefruits. Despite the positive structural effect, the competitiveness effect was negative in period A, C and D. This concurs with the findings of Matolo *et al*. (2016) and Chisoro-Dube and Cramer (2019) that SA has failed to reach an agreement regarding the exportation of citrus to China despite SA being a part of BRICS due to sanitary and phytosanitary measures therefore SA is not competitive in the Chinese market. However, the results also contradict the findings of Mariadoss (2019) that SA was competitive in the exportation of grapefruits and pomelos in the Chinese market since grapefruits and pomelos contributed 11% of the total exports to China.

Furthermore, the structural effect and competitive effect of SA grapefruits in the EU market was found to be positive in all periods excluding period D. It is important to note that the competitiveness effect was found to be negative in most markets in period D due to delayed shipments from Durban to international markets in 2019. This caused citrus producers to redirect their produce to Cape Town, and some citrus producers stored the harvested grapefruits in cold storages, and this ultimately reduced export competitiveness to those markets because it reduced its shelf life (USDA, 2021).

5.3.5. Tangerines, mandarins and clementine (Soft citrus)

Table 5.4: Constant market share model results for tangerines, mandarins and clemetines from 1989 to 2019 in various markets [N=30]

		Different Periods			
Country Of Destination	**1st Level CMS Decomposition**	**A**	**B**	**C**	**D**
		1989-1995	1996-2002	2003-2009	2010-2019
Average Export value		14794,74	28297,33	49417,83	106809,2
Russian Federation	Structural Effect	780843,8	98547368	102726768,6	4165354,356
	Competitive Effect	448459,1	168094,1	-2932343,858	-13007771,93
	Secondary Effect	1391028	4179400	-28316381,88	-3399930,048
United Kingdom	Structural Effect	153937,2	970744,7	1018495	1453220
	Competitive Effect	30602,51	73219,03	592310,2	4117537
	Secondary Effect	601579,2	326707	805773,1	2157593
Asia	Structural Effect	508,1303	2227,225	37216,92	22713,02
	Competitive Effect	229,9465	170,8359	-1182,21	3228,182
	Secondary Effect	2199,732	237,4637	-9637,23	10479,18
European Union	Structural Effect	415,3539	12177,04	25382,81	-9,48919
	Competitive Effect	96,88484	196,0077	566,1786	4671,532
	Secondary Effect	2714,844	3774,59	6738,233	-7,94177

Source: Own compilation

Table 5.4 shows that South African soft citrus have a positive structural effect in all the 4 countries for all periods except in the EU in period D. The average export value of South African soft citrus has been improving, and the improvement has been occurring mainly due to a positive structural effect. The four countries have a demand for South African soft citrus. Nonetheless, the competitiveness effect was found to be negative in the Russian federation and Asia in period C and D and period C respectively. Indicating that SA soft citrus exporters did not keep their quote on market to Russia and Asia. This contradicts with the findings of Potelwa (2017) that SA was the 3rd largest exporter of soft citrus to the Russian federation due to Russia being a net importer of soft citrus.

The CMS results indicate that there has been a 621% increase in the average export value between period A and period D. This is due to SA increasing the land allocated to citrus production by 79.47% from 1989 to 2019. Cramer and Chisoro-Dube (2019) found that SA was moving from producing more oranges to producing more soft citrus due to its high returns on investment. Furthermore, the improvement has been occurring mainly due to a positive structural effect which occurred in all periods (A to D) in all markets except the European Union in period D. The outcome is consistent with the findings of Chisoro-Dube and Roberts (2021) that South Africa's volume of soft citrus exports had grown by less than 2% due to structural changes.

Despite the positive structural effects in both the Asian and Russian federation markets, the competitiveness effect and secondary effect were found to be negative in period C. This was ascribed by the lack or underinvestment in port infrastructure which leads to congestion and delays at ports. These findings are consistent with the findings of Dlikilili (2018) and Chisoro-Dube and Cramer (2019) that deteriorating ports reduced the export competitiveness of South African soft citrus because it increases the time it takes to take the soft citrus to the given market which ultimately reduces the shelf life of soft citrus.

5.4. Armington model results

5.4.1. Augmented dicky fuller results

Table 5.5: Augmented Dickey fuller results

Variables	**Formula**	**ADF**	
		Level	**First difference**

		T stat	Critical value (5%)	T stat	Critical value (5%)
EXR	Intercept	-0.730	-2.963	4.515**	-2.567
	Trend and intercept	-2.669	-3.574	-4.430**	3.574
	None	1.632	-1.952	-3.957**	-1.952
Log (PPI)	Intercept	1.205	-1.952	-6.260**	-2.968
	Trend and intercept	-0.774	-3.580	-6.496**	-3.581
	None	-0.899	-2.964	-5.349**	-1.953
Log (RCA)	Intercept	-1.491	-2.964	-4.688**	-2.976
	Trend and intercept	-3.698**	-3.574	-4.606**	-3.588
	None	1.668	-1.952	-4.560**	-1.953
AVE MS	Intercept	-3.830**	-2.964	-2.378	-2.991
	Trend and intercept	-3.924**	-3.568	-8.918**	-3.633
	None	-3.146**	-1.952	-2.821**	-1.956
Notes: Reported values under levels and first difference are ADF t statistics Whereby * represents statistically significant at 1% level. ** statistically significant at 5% level *** statistically significant at 10% level					

Source: Own computation

Table 5.5 presents the outcomes obtained from the Augmented Dickey-Fuller test. The findings indicate that the average market share, terms of trade, and specialization were found to be stationary at various levels, including intercept, trend and intercept, or neither. However, the variables of exchange rate and price were not stationary across all equations examined. All variables exhibited stationarity at the first difference (I(1)) with a significance level of 5% in either one or all equations provided. This suggests the rejection of the null hypothesis regarding the existence of a unit root. Consequently, employing the ARDL approach, the Armington model proves to be a suitable regression model for analysing this time series data.

5.4.2. Lag length

This study implemented the usage of the information criteria approach to select the correct lag. This is due to the importance of lag selection in cointegration analysis, Granger causality test, and an impulse response analysis.

Table 5.6: Optimum Lag length

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-336.973	NA	754.620	23.653	23.936	23.752
1	-216.570	182.680	2.371	17.832	19.812*	18.453
2	-160.171	62.234*	0.827*	16.426*	20.103	17.577*
* Indicates lag order selected by the criterion (each test at 5% level) where each test represents the following: LR: sequentially modified LR test statistic FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Source: Own computation

The findings displayed in Table 5.6 indicate that lag length 2 is recommended by four criteria: LR, FPE, AIC, and HQ. The selection of lag length can impact cointegration results, making it necessary to opt for the most optimal lag order, which in this instance is 2.

5.4.3 Johansen cointegration results

Table 5.7: Johansen cointegration results

		Trace test		**Maximum eigenvalue test**	
Hypothesised no. of CE(s)	Eigenvalue	Trace statistics	0.05 critical value	Trace statistics	0.05 critical value
None*	0.991	320.660**	107.347	130.784**	43.420
At most 1*	0.968	189.876**	79.341	96.544**	37.164
At most 2*	0.812	93.332**	55.246	46.836**	30.815
At most 3*	0.648	46.496**	35.011	29.310**	24.252

Source: Own computation

Table 5.7 displays the results of the Johansen cointegration test encompassing all variables. Both the trace and maximum Eigenvalue tests reveal the presence of four cointegrating equations at a significance level of 5%. According to Ogundeji *et al*. (2010), rejection of the null hypothesis occurs when there is no cointegration among variables. Hence, in this case, the null hypothesis of no cointegrating equations is rejected at none, at most 1, 2, and 3, as the trace statistic exceeds the critical value at a 5% significance level. Consequently, based on both tests, it is inferred that there exist cointegrating equations, indicating a long-term relationship between the variables.

5.4.4 Granger causality tests

The Granger causality test provides results of the causal association between selected variables, and it provides the directional causality between two variables. It is also a tool that can assist in understanding whether an independent variable can cause a dependent variable (Milanzi, 2021)

Table 5.8: Granger casuality tests

Null hypothesis	Obs.	F-Stat.	Prob.	Decision
Dummy for WTO does not Granger cause Average MS	29	0.191	0.827	Accept
Average MS does not Granger cause Dummy for WTO		0.051	0.950	Accept
Exchange rate does not Granger cause Average MS	29	0.694	0.509	Accept
Average MS does not Granger cause Exchange rate		0.103	0.902	Accept
Price does not Granger cause Average MS	29	0.040	0.9613	Accept
Average MS does not Granger cause Price		2.295	0.123	Accept
Log (RCA) does not Granger cause Average MS	29	7.158	0.004**	Reject
Average MS does not Granger cause Log (RCA)		1.062	0.362	Accept
Notes: Granger cause if P < 0.05 * Statistically significant at 1% level ** Statistically significant at 5% level *** Statistically significant at 10% level				

Source: Own compilation

The outcomes of the Granger Causality tests reveal a single causality linking specialization to the average market share of citrus fruits. This causality is notably significant at the 1% level. The observed Granger causality suggests that specialization plays a role in influencing the

export competitiveness of the South African citrus industry. These findings align with and support the notion of a long-term relationship between specialization and competitiveness, as previously established by Ogundeji *et al*. (2010). Additionally, the results indicate that factors such as exchange rate, price, and South Africa's membership in the WTO does not Granger cause export competitiveness.

5.4.5. Estimation and interpretation of results

5.4.5.1. F bound test

Table 5.9 shows the results of the bounded F-test. This test indicates whether there is a long-run relationship between the average market share and the regressor variables. The hypothesis test for the bounded F-test is as follows:

$H_0: \delta_1 = \delta_2 = 0$ (The long-run relationship does not exist)

$H_1: \delta_1 \neq \delta_2 \neq 0$ (The long-run relationship exists)

Table 5.9: F bound test with 2 lags

Test statistic	Value	Level of significance	$I(0)$	$I(1)$
F-statistic	6.825250	5%	2.86	3.276

Source: Own compilation

According to the results in Table 5.9, it is safe to reject the null hypothesis (H_0) since the F-statistic (6.825250) is greater than the upper-bound critical value (3.276) and not lower than the lower-bound critical value (2.86) nor falls in between bound critical values. Therefore, there is a long-run relationship between the study's independent variable and its specified dependent variables.

5.4.5. Armington model results

5.4.5.1. Long run Armington results

Table 5.10 below presents the results long run Armington long run model analysis which was used to analyse the factors that influence the competitiveness of the South African citrus industry from 1989 to 2019. The analysis was obtained using Eviews 12. Four variables were included in the equation and analysed. From those independent variables that were logged in during the analysis, all of them were found to be significant. Thus, the constant term (c) was

found to be 3.65 which represents the intercept of the regression. It signifies that when all factors are kept constant the export competitiveness is equivalent to 3.65.

Table 5.10: Long run Armington (ADRL)

Regressor	Coefficient	Standard error	T-statistic	Probability
DUMMY(WTO)	-2.974382**	0.896005	-3.319603	0.0036
Exchange rate	-0.418575**	0.137095	-3.053174	0.0065
$Price\ index$	0.062132**	0.020302	3.060373	0.0064
RCA	-0.188733**	0.084725	-2.227605	0.0382
Constant	3.653126*	0.651225	5.609261	0.0000

Source: Own compilation

Note: *, ** and *** Show significance level at 1%, 5% and 10% levels, respectively.

Dummy for World Trade Organization

The DUMMY(WTO) variable represents whether a country is a member of the World Trade Organisation (WTO) or not. South Africa being a part of the WTO the highest effect on citrus export competitiveness in South Africa. The negative coefficient of (-2.974382) indicates that, when all factors are kept constant and South Africa is a WTO member, there is a 2.974% decrease in the export competitiveness in the long run. The difference is statistically significant at 5% significance level (0.0036). Thus, WTO membership appears to be associated with the decline of export competitiveness in the long run. It can be attributed to increased competition because there are over 164 member states and some of the member states (Southern Hemisphere counterparts) produce citrus during the same production period as SA and exports to the same markets. This contradicts the findings of Narayan and Bhattacharya (2019) that the accession of a given country in the WTO leads to an increase in the export competitiveness of a given commodity.

Exchange rate

The second most influential factor is the exchange rate, which exhibits statistical significance at a 5% level and demonstrates a negative correlation with the dependent variable. This finding

aligns with the anticipated negative relationship outlined in Table 5.10 and is consistent with the conclusions drawn in a study by Abbas (2022) titled "Global Warming and Export Competitiveness of Agricultural Sector: Evidence from Heterogeneous Econometric Analysis of Pakistan." Although the specific country context differs, Abbas's study emphasized that a depreciation in the exchange rate results in decreased export competitiveness. This implies that, holding other variables constant, a 1% increase in the exchange rate (indicative of domestic industry depreciation) leads to a 0.419% decline in citrus fruit export competitiveness in the long run.

Price

The coefficient of price is highly significant at 5% (Probability = 0.0064). The price elasticity of 0.06 indicates that a 1% increase in the price of citrus fruits at any given export market increases the export competitiveness of citrus by 0.06% when the effects of other variables are kept constant. This implies that citrus farmers can increase the quantity of citrus fruits that they export in the long run if the price increases. According to Ahmad *et al*. (2018), the exporters decision as to where and how much they export lies where a higher price is obtained. Thus, the findings of this given study correspond with the findings of Daulika *et al*. (2022) that price increases the export competitiveness and contradicts the findings of Khan *et al*. (2023) that price has a detrimental effect on the export competitiveness in the long run.

Specialization

A 1% increase in specialization is correlated with a 0.19% reduction in the long-term competitiveness of the citrus industry. This negative association is substantiated by the statistically significant specialization coefficient of -0.188733 at the 0.05 significance level (Probability = 0.0382). One plausible explanation is the impact of citrus black spot on South African citrus farmers, which adversely affects export quantities. Most importing countries impose strict sanitary and phytosanitary measures, and the time it takes for farmers to respond to this disease is prolonged due to the nature of citrus tree orchards. Consequently, these results deviate from the study's expected positive relationship, as outlined in Table 4.1. However, they find support in the work of Markovic, Krstic, and Radenovic (2019), which suggests that export competitiveness is tied to product differentiation and export restructuring rather than specialization. Interestingly, these results contradict the findings of Bojnek and Ferto (2015) and Bozuduman and Erkan (2019), both of which propose that specialization has a positive impact on a country's comparative advantage and competitiveness.

5.4.5.2. Short run Armington results

Table 5.11: Short run Armington results through Error Correction Representation (1, 2, 2, 1, 0)

Regressor	Coefficient	Standard error	T-statistic	Probability
DUMMY(WTO)	0.194176**	0.063323	3.066425	0.0070
Price index	-0.04745*	0.013012	3.646831	0.0017
Coint	-0.679442	0.101171	-8.531524	0.0000
R-Squared	0.732	Adjusted R-Squared		0.674
Durbin-Watson		1.633		

Note: *, ** and *** Show significance level at 1%, 5% and 10% levels, respectively.

Source: Own computation using Eviews 12

Table 5.11 demonstrates the short-run relationship results between average market share and its regressor variables from the Error Correction Model. It was found that only Dummy representing SA being a part of the World Trade Organisation and price has a short-run relationship with the Average market share of the South African citrus industry.

A 1% increase in price results in an immediate 0.05% reduction in the export competitiveness of citrus fruits in the short run, with a significance level of 1%, holding other factors constant. This phenomenon can be attributed to the short-run inelasticity of agricultural products, where farmers face constraints in responding to price fluctuations promptly, primarily due to the seasonal nature of production. These results align with the findings of Abdullahi *et al*. (2022) and Khan *et al*. (2023), which reported that price exerted a negative influence on the short-term competitiveness of Nigerian cocoa and Pakistani shrimp exports, respectively.

In contrast, South Africa being a part of the WTO led to a 0.194% increase in the citrus export competitiveness in the short run. The difference is statistically significant at 5% significance level (0.0070). This can be influenced by the fact that when SA is a part of the WTO it has access and export to WTO member countries. These findings contradict with the findings of Narayan and Bhattacharya (2019) that when India joined the WTO, it positively influenced the relative export competitiveness of rice.

According to the results in Table 5.4, the model fits data since an R-squared of 0.732 indicates that 73.2% of the variation on the explanatory variable is explained by the specified regressor variables of this study. Furthermore, the adjusted R-squared of 0.674 implies that the model fits the data that was used in this study. The Durbin Watson statistic of the value that falls between 1.5 to 2.5 is relatively normal. Therefore, the model used in this study is not autocorrelated since the test statistic is equal to 1.633.

ECM (-1) is the error correction term known as the speed of adjustment. It must be negative and between -1 and 0; otherwise, the results will not converge towards equilibrium in the long run. This might mean that the model is misspecified, autocorrelated or there are other issues with the data. Therefore, an error term of -0.679 implies that the system diverges from the long-term equilibrium at fixed rate of 67.9%.

5.4.6. Diagnostic tests on the specified Armington model in this study

This study gives an empirical analysis of factors that affect competitiveness in South Africa for policy recommendations. Hence, diagnostic tests must be carried out to identify the strengths and weaknesses of the Armington model applied in this study to ensure that better and more reliable results are reported for policy recommendations. The diagnostic test of interest in this study check for serial correlation, heteroscedasticity, residual distribution, and model stability.

5.4.6.1. Correlogram Q-Statistics

Table 5.12: Correlogram Q-statistics

	Auto Correlation	Partial Autocorrelation	Q-Statistics	Probability
1	0.121	0.121	0.4735	0.491
2	0.047	0.033	0.5484	0.760
3	-0.258	-0.272	2.8553	0.414
4	-0.242	-0.197	4.9615	0.291
5	-0.260	0.213	7.4854	0.187
6	-0.281	0.349	10.571	0.103
7	0.001	0.121	10.571	0.158

8	-0.044	0.305	10.655	0.222
9	0.337	0.034	15.747	0.072
10	0.158	0.117	16.923	0.076
11	0.139	0.159	17.889	0.084
12	0.100	0.048	18.419	0.104

Source: Own compilation

Table 5.12 presents the results of the correlogram q-statistic, a diagnostic tool for testing serial correlation in residuals. All the p-values exceed 0.05%, indicating the absence of serial correlation in the residuals. Consequently, the null hypothesis, asserting that there is no serial correlation in the residuals, is accepted.

5.4.6.2. Serial Correlation LM Test

Table 5.13: Serial correlation LM Test

Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation up to 2 lags			
F-Statistics	0.288957	Prob. F (2,117)	0.7527
Observed R-squared	0.953443	Prob. Chi-Square (2)	0.6208

Source: Own compilation

The Breusch-Godfrey serial correlation LM test is another method to test for serial correlation to affirm the results found in Table 5.6. The p-values for the f-statistic and r-squared are greater than the 0.05% level of significance, thereby accepting the null hypothesis of no serial correlation at up to 2 lags.

5.4.6.3 Heteroscedasticity test: Breusch-Pagan-Godfrey

Table 5.14: Heteroscedasticity test: Breusch-Pagan-Godfrey

Heteroscedasticity Test: Breusch-Pagan-Godfrey

Null hypothesis: Homoscedasticity			
F-statistics	0.556045	Prob. F (9,19)	0.8155
Observed R-squared	6.045883	Prob. Chi-Square (9)	0.7353
Scaled explained SS	1.815731	Prob. Chi-Square (9)	0.9941

Source: Own compilation

Table 5.14 demonstrates Breusch-Pagan-Godfrey test results for heteroscedasticity. According to the Table 5.14 results, it is safe to accept the null hypothesis of homoscedasticity since all the probability values are greater than 0.05%.

5.4.6.4 Heteroscedasticity test: ARCH

Table 5.15: ARCH heteroskedasticity test

Table 5.15 shows the results of the ARCH test as it is more powerful than the Breusch-Pagan-Godfrey to affirm the conclusion in Table 5.14. The results of the ARCH test above suggest that the null hypothesis for homoscedasticity is also accepted.

Heteroscedasticity Test: ARCH			
F-static	0.652322	Prob. F (1,26)	0.4266
Observed R-squared	0.685307	Prob. Chi-Square (1)	0.4078

Source: Authors compilation

5.4.6.5 HISTOGRAM NORMALITY TEST

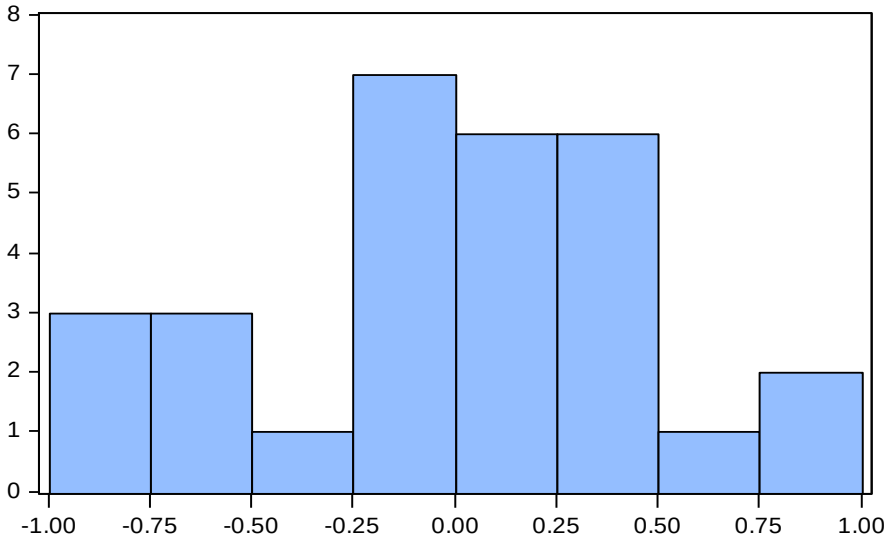

Figure 5.13: Histogram normality test

Source: Own compilation

Figure 5.13 demonstrates the empirical distribution of the data, and the anticipated pattern is a bell-shaped curve resembling a normal distribution. Upon visual examination of the graph, it is apparent that the residuals exhibit a normal distribution, meeting the requirement for a bell-shaped curve. Additionally, the confirmation of normality in the residuals is supported by the probability value of 0.7397, equivalent to 73.97%. This insignificance at the 5% critical value renders it significant at a level higher than 5%. These results are further substantiated by the Jarque-Bera statistic of 0.6029 (60.29%), exceeding the 5% critical value. Collectively, these findings validate the visual inspection of the normal distribution in the residuals of the Armington model.

5.4.6.6 CUSUM TEST and CUSUM SQUARES TEST

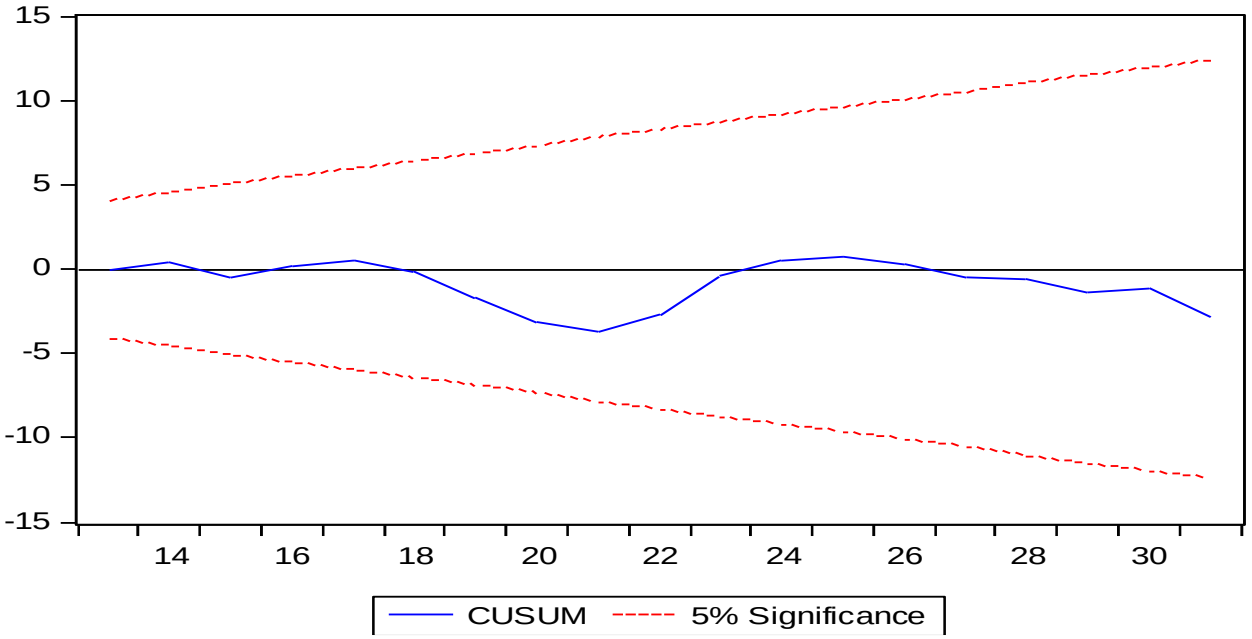

Figure 5.14: CUSUM test [N=30]

Source: Own compilation

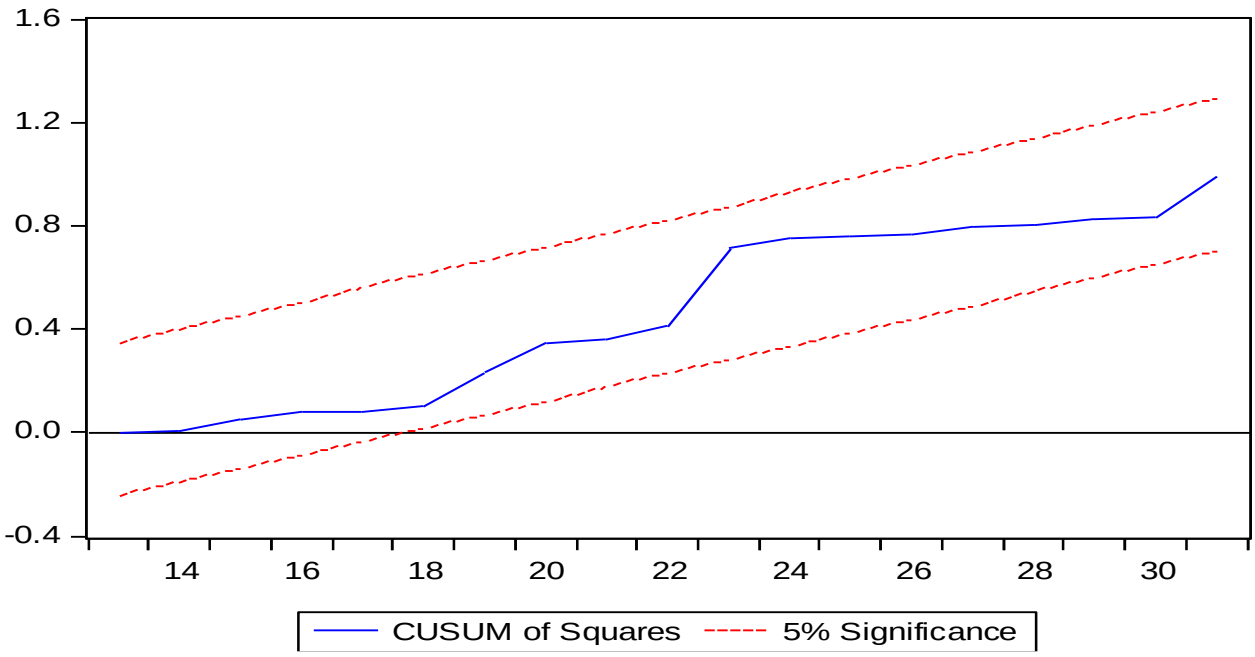

Figure 5.15: CUSUM Squares test [**N**=30]

Source: Own compilation

Figures 5.14 and 5.15 shows the CUSUM and CUSUM of squares stability tests. According to Ledwaba (2021), The abovementioned diagrams explain the patterns or of the residuals based on their stability. Hence, the objective of the tests was to verify whether the identified model is stable over time. The model was found to be stable since the residual plot fell with the 5% level of significance critical lines. The blue line representing the CUSUM and CUSUM of squares clearly indicates that that there is no instability on the cumulative sum since it has not gone outside the area between the two critical lines. This proves that the model is stable for the period sampled.

5.5 Chapter summary

The results indicated that South Africa consistently maintained an increasing Relative Comparative Advantage (RCA) in citrus production compared to its Southern Hemisphere counterparts. In addition, in most years, the Net export index (NXI) demonstrated that South Africa was a net exporter. This implied that SA was exporting more citrus fruits than it imports. In addition, the results showed that South Africa was not always leading in citrus production or in exports of citrus between 1989 and 2019. Uruguay, Argentina and Peru demonstrated a stronger comparative advantage and net export index in some countries compared to South Africa in some years in the production and exportation of oranges, lemons and limes and soft citrus.

Constant market share model results indicated that South African soft citrus had a positive structural effect in all time periods in all major markets excluding the EU in period C but however demonstrated that oranges, lemons and limes and grapefruits and pomelos demonstrated a negative structural effect in period A (1989 to 1996). This was mainly attributed to the trade sanctions that were imposed on the South African citrus industry due to the Apartheid government. Furthermore, the CMS results indicated that the competitiveness effect to some major markets were negative due to the emergence of the citrus black spot, drought and ineffectiveness of ports.

This empirical results from the Armington model through the ADRL indicated that out of the four variables (i.e., price, specialization, exchange rate and SA being a part of the WTO) all variables were significant at 5% level of significance. In the short-run, price and SA being a part WTO were significant at 5% and 1% significant level. The diagnostic tests show that the model does not suffer autocorrelation, serial correlation, or heteroscedasticity. Furthermore,

the model is normally distributed and stable. All these diagnostic results show that the model results are reliable and suitable for policy recommendations.

CHAPTER 6: RESEARCH SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

This chapter presents a recap of research objectives and methodology with an additional focus on proposing potential strategies to improve the export efficiency of the citrus industry in South Africa. It also assessed the extent to which the objectives and hypotheses set at the study's outset were addressed through the analysis. The primary goal of this concluding chapter was to present conclusions derived from the significant findings of the study and propose directions for future research.

6.2. Recap of research objectives and methodology

The primary aim of this research was to assess the competitiveness of the South African citrus industry in comparison to its counterparts in the Southern Hemisphere spanning the years 1989 to 2019. The study delineated three specific objectives: firstly, to provide an overview of the South African citrus fruit industry; secondly, to evaluate the competitive performance of the South African citrus industry compared its counterparts in the Southern Hemisphere during the specified period; and finally, to scrutinize the factors influencing the competitiveness of the South African citrus industry relative to its Southern Hemisphere counterparts between 1989 and 2019. Various analytical indices were utilized to ensure the fulfilment of these research objectives.

The Armington model, in conjunction with the three indices—RCA, NXI, and CMS—was employed to assess the trade competitiveness of various countries. This analysis aimed to identify potential markets that could be leveraged to enhance long-term exports of South African citrus fruits. Chapter 3 thoroughly elucidated all three indices, detailing their application as well as their respective strengths and weaknesses. RCA, NXI, and CMS served as instrumental tools for evaluating the competitiveness level, competitive positioning, and primary markets of the South African citrus industry. This assessment utilized time-series data sourced from reputable sources, with analysis conducted through Microsoft Excel and EViews.

6.3. Summary of findings

The findings revealed a consistent upward trend in South Africa's Relative Comparative Advantage (RCA) in citrus production compared to its counterparts in the Southern Hemisphere. Moreover, over most of the years examined, South Africa exhibited a surplus in citrus trade, indicating a propensity to export more citrus fruits than it imported. Nonetheless,

it was evident that South Africa did not consistently lead in citrus production or exports between 1989 and 2019. Uruguay, Argentina, and Peru exhibited stronger comparative advantages and net export indices in certain years for oranges, lemons, limes, and soft citrus compared to South Africa.

Analysis using the Constant Market Share (CMS) model demonstrated that South African soft citrus exerted a positive structural influence across major markets throughout the study period, except for the EU in period C. However, oranges, lemons, limes, grapefruits, and pomelos showed a negative structural effect in period A (1989 to 1996), largely due to trade sanctions imposed on the South African citrus industry during the Apartheid era. Additionally, the CMS results revealed negative competitiveness effects in certain major markets due to factors such as citrus black spot, drought, and port inefficiencies.

Empirical findings from the Armington model, analysed through the Autoregressive Distributed Lag (ADRL) approach, highlighted the significance of all four variables (price, specialization, exchange rate, and South Africa's WTO membership) at the 5% level. In the short term, both price and South Africa's WTO membership were significant at the 5% and 1% levels, respectively. Diagnostic tests confirmed the absence of autocorrelation, serial correlation, or heteroscedasticity, indicating the model's reliability and suitability for informing policy recommendations.

6.4. Conclusion

This research included three null hypotheses, which were then tested in this study and listed below.

Hypothesis one: The null hypothesis that the competitive performance of the South African citrus industry does not differ from its Southern Hemisphere counterparts was rejected because the RCA index results demonstrated that SA oranges, grapefruits and pomelos, and lemons and limes were more competitive than all the Southern Hemisphere counterparts. However, Peru and Uruguayan soft citrus were found to be more competitive than SA soft citrus. Furthermore, the Net export index proved that South Africa is a net exporter of all citrus fruits with a net export index that is greater than 90.

Hypothesis two: The null hypothesis that South African citrus fruits are not competitive in any major markets from 1989 to 2019 was rejected because the CMS model proved that all citrus fruits (oranges, lemons and limes, grapefruits and pomelos, and soft citrus) included in the study were competitive in one of the major markets in one or more periods. In addition, the

structural effect demonstrated that the major markets were keen to import South African citrus fruits at some given point and time.

Hypothesis three: The null hypothesis that factors do not have affect the competitiveness of the South African citrus industry in the short and long run. In which the hypothesis is rejected because the results of the Armington model illustrated that price, specialization, SA being a part of the WTO and exchange rate have a significant influence towards competitiveness in the long run. In addition, price and SA being a part of the WTO had a significant influence on the competitiveness of the South African citrus industry in the short run.

6.5. Policy recommendations

The recommendations stated below are made in accordance with the findings of the study:

i. The study recommends that the Department of Agriculture, Land reform and Rural Development in collaboration with the Citrus growers association (CGA) and other stakeholders invest in research that will develop new citrus varieties that are drought and black spot resistant. In addition, investment must also be dedicated towards developing citrus varieties that improve yield and optimizes production. This is due to the declining competitive performance of oranges in the European Union in period D.

ii. The study further recommends that the South African citrus industry in collaboration with the South African government should work on optimizing the supply chain by improving ports, storage facilities, roads and processing facilities to align the production yield with the market demand. This will ultimately reduce the mismatches in the supply and demand which were demonstrated by the CMS model results.

iii. For South Africa to enhance its competitive performance and sustain competitiveness relative to its Southern Hemisphere counterparts, the South African citrus industry needs to develop meaningful strategies that include improving product quality, packaging and marketing strategies.

iv. The study further recommends that the CGA in collaboration with the government through the DALRRD, and the SA citrus industry develop risk management strategies to address challenges related to unforeseen global crises, such as recessions. Furthermore, the Department of Trade, Industry and Competition (DTIC) can play a role

in assisting the citrus industry in terms of diversifying export markets for the SA citrus industry and reducing overreliance of exporting citrus fruits to the EU by negotiating better trade agreements or taking advantage of existing trade agreements. For example, SA can move towards exporting more citrus to the Russian and Asian market specifically China.

v. The South African government through the DALRRD, should continue investing and promoting the citrus industry by subsiding farmers to increase yield, provide fungicides to reduce the effects of the citrus black spot and facilitate exports to further capitalise on the competitiveness of the South African citrus industry relative to its Southern Hemisphere counterparts.

vi. The study recommends that South African citrus industry prioritises the production and exportation of soft citrus (mandarins) and lemons and limes because there is an untapped potential in the production and exportation of these fruits and the demand for the abovementioned products is increasing in major markets. This was illustrated by a lower RCA index compared to oranges and, grapefruits and pomelos. In addition, there is a higher value per ton sold for both compared to oranges.

6.6. Limitations and suggestions for future research

It is worth mentioning that this study may not have examined all the variables that influence the competitiveness of the South African citrus industry. This limitation was primarily due to constraints in data availability. As a result, future research could explore the impact of additional factors such as interest rates, policy reforms, land availability, distance, and fuel prices on the competitiveness of the South African citrus industry. Additionally, it would be beneficial to conduct a similar study using the same methodology to assess the competitiveness of the citrus industry in both the Northern and Southern Hemispheres or the competitiveness of the South African citrus industry pre and post Covid-19. Furthermore, another avenue for investigation could involve examining processed citrus fruits or exploring a different commodity or industry within the agricultural sector.

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Appendixes

Appendix 1 RCA and NXI oranges

Year	**ARG**		**AUS**		**CHILE**		**PERU**		**SA**		**URU**	
	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI
1989	3,8	100	0,9	46,3	0,1	100	0	0	8,3	99,7	11,4	100
1990	3,8	100	1,0	59,1	0,1	100	0	0	8,5	99,6	16,2	100
1991	4,4	100	1,4	92,4	0,1	99,7	0	0	10,9	99,5	21,8	100
1992	3,4	99,4	2,2	85,6	0,0	100	0	-100	13,0	99,9	26,3	100
1993	3,2	99,9	2,3	85,9	0,0	100	0	-100	12,0	99,3	39,4	100
1994	3,9	97,3	2,3	86,1	0,0	100	0	-100	11,8	99,9	39,0	99,9
1995	3,6	97,7	2,9	86,1	0,0	100	0	0	14,6	99,6	36,0	100
1996	3,5	96,0	3,6	82,6	0,0	100	0	-100	10,6	99,6	28,3	99,9

1997	4,0	95,2	3,5	84,0	0,0	73,4	0	-100	14,9	99,6	29,7	99,8
1998	3,5	88,7	3,8	83,4	0,1	0	0	-100	15,5	99,4	33,5	99,9
1999	3,7	87,2	4,7	79,3	0,1	70,2	0	-100	22,8	99,1	37,7	99,8
2000	2,1	54,5	5,5	81,7	0,3	68,4	0	17,9	18,0	99,3	23,3	98,7
2001	5,2	88,5	4,8	86,3	0,5	85,8	0,1	-10,5	15,7	99,6	37,5	99,8
2002	2,2	99,4	4,0	88,6	0,6	98,7	0	14,8	14,7	99,9	24,8	100
2003	2,3	99,2	3,0	82,1	0,6	92,5	0	-27,2	19,7	99,6	28,4	100
2004	4,0	99,0	3,5	78,5	1,0	98,7	0	35,7	21,1	99,7	31,0	100
2005	4,7	100	4,1	82,4	1,2	99,3	0	47,1	23,7	99,8	37,2	100
2006	5,7	99,3	3,9	81,8	1,4	98,9	0,1	82,6	26,6	99,6	32,8	99,4
2007	6,5	99,3	4,1	85,8	1,1	98,5	0,6	98,7	28,1	98,9	36,2	98,5
2008	4,4	97,2	2,4	74,1	1,9	97,7	1,0	99,5	25,7	98,6	24,1	99,9
2009	3,0	99,1	2,3	79,7	2,4	99,0	0,2	97,8	22,2	99,6	18,4	98,5
2010	3,2	98,8	1,6	64,8	3,0	91,7	0,4	99,1	28,9	99,8	19,4	99,1
2011	2,5	98,5	1,4	64,9	3,8	97,3	0,4	98,2	26,1	99,8	17,3	99,7
2012	1,4	100	2,1	76,1	2,7	95,9	0,3	81,0	26,2	99,9	10,5	99,5
2013	1,3	100	2,1	73,4	3,4	92,9	0,4	46,2	27,2	99,6	14,6	98,9
2014	1,6	99,8	2,4	77,4	3,1	91,5	0,4	58,8	31,5	97,8	15,6	99,6
2015	1,5	99,9	2,9	80,4	3,8	96,6	0,8	40,0	32,9	98,7	11,7	97,7
2016	1,8	87,5	3,1	83,9	3,4	94,6	0,4	52,3	31,3	99,4	15,7	90,0
2017	1,8	92,2	3,3	80,6	4,0	94,5	0,5	70,0	34,6	99,4	11,7	98,1
2018	1,5	83,1	3,3	83,0	4,0	95,4	0,5	73,9	36,4	99,4	8,5	95,6
2019	1,7	94,0	3,2	87,2	4,2	95,9	0,7	77,4	33,6	99,4	12,2	98,5

Appendix 2: RCA and NXI lemons and limes

Year	ARG		AUS		CHILE		PERU		SA		URU	
	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI
1989	7,8	100	0,1	-50,6	0,9	100	0	0	2,4	100	19,0	100
1990	7,1	100	0,1	-34,8	0,5	100	0	0	2,8	100.	17,8	100
1991	11,3	100	0,1	-15,5	1,5	100	0	0	3,3	100	32,8	100

1992	15,5	99,7	0,2	3,2	0,4	100	0,9	100	4,8	99,8	31,5	100
1993	6,6	100	0,2	12,7	0,7	100	0	0	2,7	100	27,1	100
1994	18,0	98,8	0,2	34,8	1,1	100	0	0	3,2	100	30,1	100
1995	22,2	99,9	0,5	51,4	1,2	100	2,8	100	3,0	100	38,9	100
1996	27,5	99,9	0,4	43,2	1,4	98,7	14,4	100	1,9	99,2	19,2	100
1997	26,3	99,8	0,4	21,4	3,6	97,0	12,3	100	2,7	99,4	24,2	100
1998	23,9	99,9	0,5	-2,3	4,6	99,5	0,0	-99,6	4,7	99,9	19,6	99,8
1999	31,6	99,8	0,6	30,9	4,4	94,1	0,0	100	5,0	99,9	22,0	100
2000	36,1	99,8	0,4	23,3	6,3	94,0	0,1	100	6,0	99,8	19,0	97,0
2001	39,6	99,7	0,4	22,3	7,5	97,8	0,0	-22,6	5,6	99,2	25,1	99,1
2002	33,4	100	0,4	25,6	10,6	96,5	0,1	99,0	6,1	100	15,9	100
2003	39,1	100	0,3	-10,4	3,9	98,1	0,1	100	8,3	100	14,7	99,3
2004	34,2	100	0,1	-50,3	5,2	98,7	0,2	100	10,4	100	15,1	99,2
2005	36,7	100	0,1	-72,5	4,0	97,7	0,2	100	9,8	100	14,8	97,5
2006	28,9	100	0,0	-90,6	3,7	96,9	0,2	100	9,2	100	13,3	98,0
2007	31,4	100	0,1	-71,1	6,0	97,2	0,2	100	7,4	100	12,0	97,8
2008	51,2	100	0,0	-57,6	3,9	93,2	0,3	100	7,5	99,9	15,9	97,1
2009	21,5	96,2	0,1	-61,0	4,5	93,1	0,4	100	8,8	99,8	10,4	95,6
2010	24,5	95,2	0,0	-86,5	4,7	83,8	0,4	100	10,5	99,3	14,3	95,6
2011	19,7	99,1	0,0	-88,9	4,5	67,0	0,5	100	12,9	99,9	10,7	91,3
2012	24,7	99,8	0,0	-85,2	3,7	79,6	0,4	98,5	10,0	99,9	9,9	93,0
2013	23,7	99,3	0,1	-77,2	4,0	70,9	0,6	99,1	10,7	99,6	8,9	91,5
2014	16,9	99,8	0,1	-59,8	5,1	71,3	0,7	99,3	17,3	99,4	14,6	90,9
2015	20,4	99,9	0,2	-38,3	9,4	84,2	0,8	99,4	18,0	99,7	11,3	89,7
2016	24,9	97,8	0,1	-37,5	7,8	85,8	0,6	99,2	17,1	98,3	11,4	87,2
2017	23,4	97,6	0,1	-30,8	7,3	76,7	0,8	97,0	18,3	99,4	8	82,1
2018	23,5	99,4	0,1	-8,5	7,4	77,3	1,0	100	15,9	99,2	9,7	87,1
2019	16,1	99,4	0,1	-5,4	8,4	72,2	1,5	100	18,7	99,4	9,1	88,3

Appendix 3: RCA and NXI grapefruits and pomelos

Year	ARG	AUS	CHILE	PERU	SA	URU

	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI
1989	3,8	100	0,0	-80,0	0	0	0,0	100	6,4	98,6	1,6	100
1990	8,21	99,4	0,0	-63,8	0	0	0,0	100	8,2	98,9	4,4	100
1991	7,9	100	0,0	-60,3	0	0	0	0	8,5	96,8	6,0	100
1992	11,1	90,7	0,0	-0,8	0	0	0	0	9,9	98,7	14,1	100
1993	6,5	76,9	0,0	-15,6	0	0	0	-100	10,6	99,0	14,3	100
1994	4,9	57,0	0,0	-63,1	0	0	0	0	15,6	98,6	11,1	99,0
1995	6,6	72,4	0,0	-48,9	0,0	100	0,0	100	12,9	97,2	9,8	99,3
1996	6,5	56,3	0,0	-59,7	0,0	100	0	-100	8,0	98,8	7,6	97,6
1997	5,4	66,7	0,0	-72,6	0,0	100	0	-100	8,4	96,2	4,2	90,3
1998	5,3	56,2	0,0	-53,5	0,0	1	0	-100	15,2	98,9	6,5	96,3
1999	4,6	54,4	0,0	-74,2	0,0	-62,8	0	-100	16,3	97,9	5,6	93,3
2000	4,2	39,7	0,0	-67,9	0,2	71,3	0	-100	17,1	99,3	3,8	87,1
2001	5,3	61,5	0,0	-44,9	0,2	98,6	0	-100	13,2	99,1	5,3	98,1
2002	3,5	92,2	0,1	-10,9	0,3	99,3	0	-100	18,0	99,6	3,7	94,6
2003	4,4	82,6	0,1	-26,4	0,3	100	0,0	-98,1	20,1	99,4	2,0	100
2004	4,7	86,9	0,1	-20,2	0,9	98,7	0,0	-45,2	28,0	97,5	2,9	97,1
2005	5,5	92,1	0,1	-18,2	0,3	99,7	0,0	-43,7	38,1	98,0	2,5	95,2
2006	3,1	89,0	0,1	-16,2	0,7	100	0,0	4,5	23,1	96,7	3,7	97,0
2007	3,9	91,3	0,0	-24,2	0,3	99,9	0,1	64,8	27,1	99,0	1,7	93,2
2008	5,6	90,2	0,0	-24,8	0,3	100	0,0	64,7	22,1	99,5	0,5	47,3
2009	2,7	78,2	0,1	3	0,2	100	0,1	89,9	23,9	98,9	0,5	55,1
2010	1,4	71,1	0,1	-33,0	0,2	92,1	0,1	100	22,3	99,4	0,2	4,3
2011	1,3	66,6	0,1	-48,0	0,2	87,9	0,1	100	29,3	99,4	0,3	17,3
2012	0,3	28,5	0,1	-5,1	0,3	97,1	0,3	98,8	22,7	99,5	0,1	-30,9
2013	0,2	0,6	0,0	-77,3	0,3	71,7	0,4	93,5	32,6	98,3	0,3	-41,0
2014	0,0	-17,2	0,0	-84,0	0,3	65,3	0,5	96,7	27,6	90,0	0,2	-38,7
2015	0,0	-37,1	0,1	-41,4	0,3	61,6	0,7	99,3	21,2	95,7	0,3	-29,9
2016	0,1	-64,4	0,1	-0,1	0,5	92,0	0,7	95,2	30,2	96,2	0,0	-90
2017	0,1	-55,5	0,2	3,5	0,5	77,6	0,5	96,6	33,2	99,0	0,3	-44,0
2018	0,0	-85,9	0,1	9,8	0,3	74,0	0,6	97,8	46,5	99,3	0,0	-100
2019	0,0	-59,1	0,1	14,7	0,3	81,7	0,8	98,2	36,8	98,8	0,2	-58,3

Appendix 4: RCA and NXI results for soft citrus

Year	ARG		AUS		CHILE		PERU		SA		URU	
	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI	RCA	NXI
1989	2,6	100	0,2	89,5	0	0	0,3	100	0,2	100	10,3	100
1990	2,5	100	0,2	85,0	0,0	100	0,3	100	0,2	100	11,3	100
1991	3,6	99,9	0,3	99,1	0,0	100	0,4	100	0,3	100	15,8	100
1992	3,2	100	0,3	97,9	0	0	0,5	100	0,5	100	20,8	100
1993	2,9	100	0,3	92,8	0,0	100	0,0	100	0,6	100	19,8	100
1994	2,5	99,3	0,5	88,9	0,0	100	0,3	100	0,2	100	21,2	100
1995	2,4	98,1	0,6	67,8	0,1	100	0,1	100	0,8	99,3	19,0	100
1996	3,0	96,3	0,8	86,7	0,2	100	0,3	95,9	0,5	98,1	22,1	100
1997	3,2	96,2	1,0	84,7	0,3	100	0,2	100	1,3	98,7	22,8	100
1998	3,7	97,7	0,8	87,0	1,0	100	0,0	100	2,8	99,1	40,7	99,9
1999	3,3	96,0	1,2	87,5	0,9	100	0,4	100	4,1	99,5	30,8	99,8
2000	2,7	97,0	1,7	95,6	1,1	100	0,7	100	2,8	99,3	26,6	99,2
2001	4,0	98,1	1,5	96,1	1,9	100	2,4	100	4,3	99,6	48,5	100
2002	2,9	99,8	1,6	97,3	2,4	100	3,4	99,8	2,8	99,4	32,0	99,8
2003	2,4	99,8	1,5	97,2	0,6	100	3,4	100	3,8	99,4	37,5	100
2004	4,01	99,5	1,7	91,4	1,6	100	4,6	100	4,4	99,0	34,2	100
2005	3,8	99,9	1,1	97,4	1,6	100	4,3	100	4,4	98,6	32,3	100
2006	5,0	100	0,9	87,7	1,8	100	4,8	100	5,3	98,5	33,0	99,3
2007	5,5	99,8	0,9	89,6	1,8	100	5,3	100	4,3	98,5	33,5	99,9
2008	5,2	99,9	0,7	91,0	1,4	100	6,4	100	4,3	98,6	25,0	99,8
2009	5,6	99,8	0,8	91,3	2,2	100	5,2	100	4,2	98,9	20,6	98,6
2010	5,5	99,9	0,7	86,7	1,9	99,9	5,8	100	4,6	98,7	20,7	99,4
2011	5,1	99,8	0,8	83,8	2,3	99,5	6,2	99,9	4,6	98,4	16,0	99,2

2012	4,4	100	1,0	84,8	4,1	99,6	7,3	100	4,9	98,5	13,8	100
2013	3,7	100	0,9	80,2	4,5	99,0	8,6	99,8	5,5	97,9	15,8	99,8
2014	4,4	99,8	0,8	87,7	3,9	99,0	11,5	99,9	6,56	98,8	17,5	99,8
2015	2,9	99,7	1,2	84,8	5,9	99,6	12,9	99,9	5,7	97,7	17,0	99,9
2016	2,7	98,6	1,3	89,6	8,1	99,0	13,52	99,9	9,3	98,7	17,8	99,8
2017	2,7	99,2	2,0	88,5	10,4	98,8	16,0	99,9	10,0	98,6	18,9	99,6
2018	1,9	99,1	1,6	86,9	10,5	99,1	15,8	99,9	12,3	99,1	13,3	99,5
2019	1,5	99,6	2,1	90,3	8,8	98,9	15,6	99,9	12,6	98,8	14,6	99,7

Appendix 5: Grapefruit and Pomelos CMS decomposition

Year	EV GRAPEFRUIT	AVERAGE	IMP RF	AVERAGE IMP	ms rf	av ms	change in ms	change inimp
1989	20613		0		0			
1990	22862		0		0			
1991	29128		0		0			
1992	27479		8720		0			
1993	28716		2555		2636,364			
1994	42634		46135		727,9412			
1995	39885	30188,14	8685	9442,143	12217,25	2225,936		
1996	23998		8493		9073,429			
1997	21888		6816		42589			
1998	36814		5342		7023,45			

1999	37240		3000		3697,516			
2000	34122		4005		2968,222			
2001	25780	29973,67	6480	5689,333	2086,048	11239,61	9013,674	-3752,81
2002	35499		10153		1763,032			
2003	47841		10351		1419,624			
2004	76242		16365		2471,025			
2005	98649		22416		1770,504			
2006	70461		33226		2186,916			
2007	99441	71355,5	56767	24879,67	450,3465	1676,908	-9562,7	19190,33
2008	82459		61013		438,6548			
2009	84813		61934		502,3046			
2010	94396		87316		1031,372			
2011	119699		119999		5966,583			
2012	93654		118183		3961,222			
2013	125776	100132,8	152254	100116,5	3553,23	2575,561	898,6532	75236,83
2014	99388		121599		792,6788			

2015	73948		86287		246,2634			
2016	106458		94610		335,2682			
2017	132055		90005		270,374			
2018	178637		112810		246,8877			
2019	139506	121665,3	119894	104200,8	126,054	336,2544	-2239,31	4084,333

Appendix 6: CMS decomposition oranges

Year	ev	av ora	IMP ASIA	AV IMP	MS ASIA	AV MS	CHANGE IN MS	CHANGE IN IMP
1989	84673		456021		56,87284			
1990	94966		465054		49,19319			
1991	120817		418706		72,91218			
1992	140484		500451		97,68553			
1993	120601		543886		93,5999			
1994	118984		591782		67,07444			
1995	162385	120415,7	642983	516983,3	82,47991	74,25971		
1996	124316		613037		73,94299			

1997	141812		644465		84,77456			
1998	152758		618698		94,73474			
1999	177268		516295		128,3123			
2000	133677		546657		115,3229			
2001	127947	142963	568564	584619,3	135,2676	105,3925	31,1328	67636,05
2002	131282		573952		160,7561			
2003	213471		676840		146,4082			
2004	270667		670435		174,6058			
2005	272764		738561		171,3841			
2006	317233		779352		175,2516			
2007	390211	265938	787005	704357,5	172,8106	166,8694	61,47689	119738,2
2008	434848		985619		154,2248			
2009	404841		1056190		103,6639			
2010	598730		1204317		127,6512			
2011	591732		1533010		126,819			
2012	583674		1477975		146,2139			

2013	591713	534256,3	1511049	1294693	180,5584	139,8552	-27,0142	590335,8
2014	595838		1551758		150,5682			
2015	613862		1588167		163,936			
2016	601179		1809659		139,3092			
2017	752509		2006215		144,9838			
2018	811649		2178095		135,8235			
2019	665405	673407	2058074	1865328	169,6535	150,7124	10,85717	570634,7

Appendix 7: CMS decomposition soft citrus

Year	ev sa	av ev	imp eu	av imo	MS EU	av ms	change in ms	change in imp
1989	1198		593498		0,002152			
1990	1215		764185		0,002156			
1991	2545		929528		0,004473			
1992	3931		935427		0,005838			
1993	4949		878541		0,005805			
1994	1536		984464		0,00164			

1995	6847	3174,429	979504	866449,6	0,010622	0,004669		
1996	5434		1171048		0,011658			
1997	10548		1021782		0,01959			
1998	20572		954504		0,031153			
1999	26829		916753		0,044169			
2000	18076		840602		0,036414			
2001	26356	17969,17	827719	955401,3	0,068155	0,03519	0,03052	88951,76
2002	20084		948375		0,044936			
2003	36223		1215359		0,04428			
2004	46229		1295777		0,045011			
2005	54621		1311117		0,04554			
2006	60056		1362715		0,044575			
2007	60386	46266,5	1675297	1301440	0,052245	0,046098	0,010908	346038,7
2008	70196		1810974		0,060829			
2009	71516		1850172		0,061948			
2010	90369		1810370		0,057253			

2011	102304		1864852		0,050645			
2012	112768		1852587		0,05383			
2013	126953	95684,33	1923460	1852069	0,065506	0,058335	0,012237	550629,2
2014	147307		1938042		0,073593			
2015	118225		1769273		0,064397			
2016	189221		1815158		0,093627			
2017	215204		1858892		0,113363			
2018	269147		1918822		0,140023			
2019	275857	202493,5	1811252	1851907	0,157942	0,107158	0,048822	-162,667

Appendix 8: CMS decomposition lemons and limes

Year	ev	ev average	imp v rf	aver imp	ms rf	aver rf	change in ms	change in import
1989	7376		0		0			
1990	8721		0		0			
1991	11365		0		0			
1992	15636		4654		0			
1993	9233		27000		0			
1994	12173		53281		192,6914			

1995	12279	10969	39152	17726,71	924,1333	159,5464		
1996	8861		36086		941,0667			
1997	10825		35458		249,3901			
1998	17145		29560		152,1377			
1999	18100		26261		139,6233			
2000	19866		27546		87,79258			
2001	19487	15714	38939	32308,33	50,70735	270,1196	110,5732	14581,62
2002	20373		49469		37,091			
2003	37826		57492		30,33373			
2004	55302		68328		42,7359			
2005	57012		89356		37,47266			
2006	52219		121496		31			
2007	54389	46186,83	134457	86766,33	16,88131	32,58577	-237,534	54458
2008	77314		128760		23,40528			
2009	73608		139930		34,83551			
2010	109337		168872		140,8338			

2011	133885		219753		156,0587			
2012	109971		207774		1594,5			
2013	129976	105681,8	226708	181966,2	1099,944	508,2629	475,6771	95199,83
2014	225974		210271		1035,09			
2015	231883		171400		198,5178			
2016	264946		187542		132,1071			
2017	292216		201400		112,1244			
2018	267468		191983		120,1853			
2019	281341	260638	203264	194310	98,16049	282,6975	-225,565	12343,83