ANALYSIS OF THE IMPACT OF INTERNATIONAL TRADE ON EMPLOYMENT AND WAGES IN THE SOUTH AFRICAN FRUIT INDUSTRY, 1990-2018

BY

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DECLARATION

I declare that **ANALYSIS OF THE IMPACT OF INTERNATIONAL TRADE ON EMPLOYMENT AND WAGES IN THE SOUTH AFRICAN FRUIT INDUSTRY, 1990-**2018 hereby submitted to the University of Limpopo, for the degree of **Doctor of Philosophy in Agriculture (Agriculture Economics)** has not been submitted by me for a degree at this or any other university; that it is my work in design and execution, and that all material contained herein has been duly acknowledge.

Molepo, NS (Mr)

29 November 2021
Date

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ABSTRACT

The study analysed the effects of international trade on employment and wages in the fruit industry of South Africa. However, the study prioritised six industries within the fruit industry which are pertinent contributors to economic growth, international trade, employment and source of wages. The six types of fruits considered for this study are apples, apricots, avocadoes, oranges, pears and table grapes. The relationship between international trade and labour market is continuously significant, especially with increasing number of trade agreements amongst countries and regions. The international trade has been identified by many economic authors to be amongst main contributors of employment and wage source in the exporting countries. The overarching theoretical framework guiding research on the impact of international trade on employment and wages is based on Krugman's theory of imperfect competition. The theory states that international trade on similar products amongst developed and developing countries works in favour of the developed countries based on the following arguments: developing countries export primary commodities; developed countries export beneficiated goods; firms in developed countries are mostly vertically integrated with a higher market share.

The overall aim of the study is to analyse the effects of international trade on employment and wages in the South African fruit industry between the period between 1990 and 2018. There are five objectives for the study and they are broken down as follows: outlining the performance of the South African fruit industry in terms on international trade, employment and wages; secondly, to analyse the impact of international trade flow on employment and wages in the selected six South African fruit industries; thirdly, to determine the causality effects amongst employment, wages and exports within the six South African fruit industry; fourthly, to determine the response of employment, exports and imports on changes in wages within the selected six South African fruit industries; and lastly, to determine the effects of European Union's Trade Development and Cooperation Agreement on wages in the South African fruit industry.

The study adopted various analytical techniques to address the objectives. Those analytical techniques were used as follows: descriptive statistics, to profile the six prioritised fruit industries; error correction model, to analyse the impact of international trade flow on employment and wages in the selected six South African fruit industries; granger causality test, to determine the causality effects amongst employment, wages and international trade within the six South African fruit industry; two-staged least squares approach, to determine the response of employment, exports and imports on changes in wages within the selected six South African fruit industries and ordinary least squares, to determine the effects of European Union's Trade Development and Cooperation Agreement on wages in the South African fruit industry.

The findings from descriptive analysis show that all six prioritised fruit industries contributes significantly to the international trade, employment and wages in South Africa. The error correction model for all six fruit industries indicates the existence of a long-run relationship amongst total employment, wages and international trade. Therefore, findings for all fruit industries show that exports output lead to an increase in total employment in a long run, while imports output lead to a decrease in total employment in a long run. The granger causality test for all six fruit industries highlight that there is a causality effect between total employment and exports output. However, there is no causality effect between total employment and imports output, even between exports output and imports output.

The results from the two-staged least squares indicate that the wages are affected positively by the exports output. However, there are other factors that affect wages positively such as net realisation from exports, local sales, total gross value of production and foreign direct investment. The wages are negatively affected by imports output, average exchange rate and average prices. The ordinary least squares for all estimated fruit industries show that the volumes of exports to the European Union market affect the wages positively, while other variables that are positively affected by the exports to EU market include amongst others the production volumes, productivity, total area planted and foreign direct investment. However, the volumes of exports to the European Union market negatively affect the processing volumes of the fruit industries in South Africa, domestic consumption per capita and average prices.

Conclusively, it is recommended that fruit producers, with support of government institutions responsible for trade promotions, should strengthen trade cooperation with various trading blogs, more particularly the European Union; United Kingdom; countries in Asia and Middle East; and African states. This exercise will highly enhance the capacity of South African fruit producers to exploit the untapped international trade opportunities from different markets. Furthermore, it is prudent to recommend that the government should continue to regulate the labour market so that employees could benefit from net realisation from international trade. This will probably reduce the instances of unfair labour practices such as lower wages, child labour, abnormal working hours and overall poor working conditions.

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LIST OF ACRONYMS

2SLS	Two-Stage Least Square
ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
BFAP	Bureau for Food and Agricultural Policy
BLUE	Best Linear Unbiased Estimator
CBS	Citrus Black Spot
CGA	Citrus Growers Association
CUSUM	Cumulative Sum of Recursive Residuals
DAFF	Department of Agriculture, Forestry and Fisheries
DALRRD	Department of Agriculture, Land Reform and Rural Development
DEL	Department of Employment and Labour
ECT	Error Correction Term
EU	European Union
FPE	Final Prediction Error
FSA	Fruit South Africa
FTA	Free Trade Agreement
GATT	General Agreement on Tariffs and Trade
GCT	Granger Causality Test
GDP	Gross Domestic Product
GMM	General Method of Moment
GTA	Global Trade Atlas
HA	Hectares
H-O	Heckscher-Ohlin
HORTGRO	Horticultural Growers Association
H-O-S	Heckscher-Ohlin-Samuelson

HS	Harmonised System
HQIC	Hannan-Quinn Information Criterion
ILO	International Labour Organisation
IPAP	Industrial Policy Action Plan
ISI	Import Substitution Industrialisation
ITC	International Trade Centre
KG	Kilograms
KMC	Knowledge Management Centre
LM	Lagrange Multiplier
MT	Metric Tonnage
NAMC	National Agricultural Marketing Council
NDP	National Development Plan
NMWA	National Minimum Wage Act
NMWC	National Minimum Wage Commission
OBS	Observations
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Square
QED	Quantec Easy Data
SAAGA	South African Avocado Growers Association
SACU	South African Customs Union
SADC	South African Development Community
SATGI	South African Table Grape Industry
SBIC	Schwartz Bayesian Information Criterion
SMMEs	Small Micro and Medium Enterprises
SPS	Sanitary and Phytosanitary
SA	South Africa
STATS SA	Statistics South Africa

TDCA	Trade Development and Cooperation Agreement
TGVP	Total Gross Value of Production
UK	United Kingdom
UN	United Nations
VECM	Vector Error Correction Method
WCDOA	Western Cape Department of Agriculture
WTO	World Trade Organisation
ZAR	South African Rand

CHAPTER 1
INTRODUCTION

1.1 Background

The interdependence of international trade and labour market is continuously significant, especially with increasing number of trade agreements between and amongst the countries and regions (Pasara & Dunga 2019). International trade and global value chain of the fruit industry affect employment either positively or negatively, but low skilled employees are often scared of losing their jobs (ILO 2011). The quantitative studies which put emphasis on the employment effects on international trade in the fruit industry are scarce and rarely determine the impact of trade on the total employment (Portella-Carbo 2016). According to Jansen and Lee (2007), international trade refers to exchange of goods and services across the world, which is administered on the principles of World Trade Organisation (WTO). The increased global competition in goods puts immense pressure on aggregate levels of employment and wages in the importing country (Grossman 2018).

South African fruit industry is subdivided into various categories such as stone fruit, pone fruit, subtropical fruit, citrus fruit, dried fruit and fruit juice. All categories of fruits are marketed in both domestic and international markets. The South Africa stone fruit industry was established in the 17th century as a sub-category of deciduous fruit industry (Boonzaaier et al. 2016). Due to a difference in chilling1 requirements for various stone fruit cultivars, the Western Cape Province is a main conducive environment for commercial production of stone fruit in South Africa. The production of South African stone fruit is equivalent to 1 per cent of global stone fruit production, while the country is responsible for approximately 16 per cent of stone fruit production within the southern hemisphere (Lubinga &

1 Infruitec units is used to measure the chilling requirements: High > 800; Medium 400 – 800; Low < 250 (Boonzaaier et al. 2016).

Phaleng 2018). The industry consists of 906 active producers, in which the majority are based in the Western Cape Province. The total stone fruit industry turnover in 2018 was estimated to be R2.64 billion. According to HORTGRO (2018), approximately 81 per cent of stone fruit industry income is generated through fresh sales. The key export markets for various sub-categories of stone fruit are the following: Middle East is responsible for 52 per cent of apricots produced in 2018, United Kingdom accounts for 43 percent of South African peaches, 57 percent of nectarines are destined to United Kingdom, 48 percent of plums are exported to European Union market and United Kingdom absorb 46 percent of cherries originating from South Africa.

Stone fruit industry employs approximately 24 000 permanent employees at the primary level, who are responsible to support around 95 000 dependents. Downstream activities such as pulping, juicing and drying depends on sustainable production of stone fruit, which give rise to more employment opportunities and creation of new agro-preneurs which contribute to economic growth of South Africa and international communities. According to Boonzaaier (2015), the export of stone fruit increased significantly post-deregulation in 1997, which most produce is demanded in the European Union (EU) and the United Kingdom (UK). The total exported consignment of stone fruit amounted to 56 184 tons in 2002/03, while during 2012/13 the exported volume increased to 76 462 tons. The share of South African stone fruit export value in the global stone fruit market is approximately 2.23 per cent and is sitting at 14.75 per cent of southern hemisphere stone fruit value. As postulated by HORTGRO (2018), the collective export value of stone fruit (which is comprised of apricots, cherries, nectarines, peaches, plums and prunes) was equivalent to a US$ 103.39 million during 2012/13 production season, which represent 52 per cent of the overall value of South African production.

The exports of stone fruit in terms of volumes are primarily propelled by plums and nectarines. The other members of stone fruit sub-sector such as peach and apricot are mainly consumed at the local markets. However, a new transition emerged during 2013/14 were peaches for domestic market declined whilst exports spiked. This positive trajectory of peach exports is gradually increasing, in which the main driver is processing industries in the importing markets (BFAP 2019).

Nectarines export quantity is estimated to 4.2 million cartons during 2017/18 season, in which the top export markets are United Kingdom accounting for 57% and European Union with 23%. First grade fruit with high quality are those prioritised for export markets and the revenue generated from nectarine exports continues to spur growth of stone fruit sub-sector (BFAP 2019).

South Africa is the leading exporter of apricots in the Southern Hemisphere, while it is ranked 24th exporter internationally. Notwithstanding production of cultivars yielding good quality, South Africa is continuously losing hectares despite growing demand in export markets. Apricots are produced in the Western Cape province in which drought had a huge negative effect on average production. The export volume decreased by 25 per cent on average as compared to the last 5 years running from 2008/09 to 2013/14, this is attributed to various factors such as old trees, drought and poor economic performance (BFAP 2019).

Plum is another family of stone fruit that is export oriented, with an average of 74 per cent total production over the past 10 years. The production volumes of plums are growing, which are attributed to an increase in production of Angelenos and African Delight cultivars. The production of Laetitia and Songold cultivars are declining, due to shrinkage in hectares of production, which lead to a decline in employment (BFAP 2019).

South Africa fruit production in 2018 was constituted by 2 million tons of citrus, 1.4 million tons of pome fruit, while 319 thousand tons was for stone fruit and 303 thousand tons for table grapes, respectively. The leading markets for South African fruit industry are European Union (EU) and United Kingdom (UK). Citrus is the largest fruit industry with a production capacity of 1.9 million tons in 2018.

The EU is responsible for 76 percent of citrus exports, while the UK accounts for 32 percent. The second largest industry in terms of exports to EU market is table grapes, which accounts for approximately 88 percent of total production. However, EU market account for 46 percent of pome fruit production, while stone fruit contributed 26 percent of total fruit production in 2018 (BFAP 2019). The exports are dominated by fresh produce segment of the fruit industry, which results in finished products such as fruit concentrate, juices and other fruit processed products being imported back to South Africa.

Overall, the citrus industry remains South Africa's major fruit sub-industry by value and volume. During 2017/18 season, over 77 million cartons of oranges were exported, which is equivalent to 46 thousand containers (CGA 2019). South Africa is the third top exporter of citrus globally in value, after Spain and Turkey, notwithstanding being ranked 17th in terms of quantity produced. The export volumes of soft citrus doubled from 2013 to 2018. South Africa maintained its position of being the 6th largest global exporter of soft citrus in terms of quantity. South Africa holds a number one spot as a grapefruit exporter in the world, however, China produces 10 times more than South Africa with a majority of its produce consumed locally. The increasing export trends to the Netherlands and Portugal are driven by health benefits associated with the nutritious elements contained by the fruit.

South Africa exceeded Argentina during the past season to be the 4th largest lemon and lime exporter, following Mexico, Spain and Turkey. South Africa was able to raise its market share in EU and UK, despite the fact that Mexico, Spain and Turkey are geographically positioned to serve these two big markets. Sub-Saharan African countries are a potential destination for South African citrus, depending on the buying power, consumer demand and cold logistics which are vital to propel exports growth into Africa. African imports of citrus are equivalent to 0.9 per cent of the entire global exports; despite 17 per cent of global population residing in Africa and population growth rate of Africa being the highest amongst all continents.

Table grapes industry is considered to be matured export-driven and continues to offer employment opportunities for both skilled and low skilled employees. The production costs per hectare are estimated at R 409 099 per hectare, the complete bearing and packaging costs are around R 278 434 per hectare and the fixed costs are projected at R 4 705 828 for single production unit (BFAP 2019). However, fixed and variable costs may vary per producer as different production unit requires specific investment and different types of variable assets. Approximately 95.3 per cent of table grapes production is destined for export market, which is considered to be the lowest yield in the past 5 years. Producers are sticking to the tried and tested variety such as Crimson seedless which continues to be a sustainable option in the international markets (BFAP 2019).

The table grapes industry has two-fold marketing channels which are supermarkets and open market channel. Supermarket option allows for more constant price, but guarantees more consistent demand. The latter is serviced mostly by the large leading dynamic producers with more than one production units, while the former is applicable to both producers with a single unit as well as those with multiple units. The producers with a single operation unit selling produce in an open marketing channel are exposed to price competition from both domestic and international competitors.

The performance of South African pome fruit industry in global markets is boosted by fresh apples and pears. South Africa is the 2nd leading exporter of both apples and pears in the southern hemisphere, while ranked 6th and 5th in the global markets, respectively. Furthermore, South African apple industry is holding 5th position internationally in terms of production efficiency and 5th position internationally when comes to infrastructure and inputs. The main competitors concerning apples in the Southern Hemisphere are New Zealand and Chile, which occupy 1st and 3rd position in terms of international exports, respectively. The challenge hindering South African pome fruit industry is when coming to supply other markets other than EU, Middle East and UK is associated with red tape, production subsidies, non-tariff barriers, technical barriers to trade as well as sanitary and phytosanitary (SPS) measures (BFAP 2019).

1.2 Problem statement

The economic literature examining the drivers of the decline in fruit manufacturing employment has reflected, among other factors, the effect of import competition from labour abundant countries. The international trade theory of Heckscher-Ohlin argues that trade between labour-abundant (such as South Africa) and labour-scarce (such as members of the European Union) countries would result in a decline of labour-intensive industries in the latter. International trade creates growth of capital-intensive industries in developed countries; employment losses in labour-abundant industries tends to be larger than employment gains in capital-abundant industries (Tuhin 2015).

Employment reactions to international trade are significantly found to be greater than wage responses to international trade (Abowd & Lemieux 1991; Freeman & Katz 1991; Grossman 2018; Revenga 1992). However, variations in employment tend to be the leading adjustment factor in the labour market. The picture tends to be different when trade unions are part of the labour market, in which wages are negotiated based on the wage scale linked to qualification of an employee. Gaston and Trefler (1994) highlight that when amendment happens in international trade space, unionised employees demand bigger wage adjustments than non-unionised employees. However, in the competitive labour market, the leading adjustment factor is employment opportunities since employees respond to lower wages by transitioning to other industries. South African union representatives within fruit fraternity are sometimes in a compromised situation of accepting lower wages in exchange for employment guarantees. Increased labour market competition leads to a lower demand for employees while eroding a wage gap between unionised and non-unionised employees (Gaston 1998; Tuhin 2015).

South African fruit industry was integrated into global markets through international trade liberalisation, which impacted negatively on labour market for unskilled workers, mainly on the downstream activities (Newfarmer & Sztajerowska 2012). International trade refers to exchange of goods and services across countries, which is regulated by the World Trade Organisation (Jansen & Lee 2007). However, Yanikkaya (2013) argues that international trade does not benefit developing countries like South Africa as they export primary commodities, while developed countries benefit as they export finished goods.

International trade liberalisation was subsequently followed by market deregulation and regulation of labour markets which contributed to the use of casual and contract employment model (Sender & Johnston 2004). Furthermore, the minimum wage is fixed relatively low at R20 per hour or R3 500 per month and at least 90 percent of the work force is associated with collective bargaining (DAFF 2018d; Rahmanian 2015). South African fruit industry was deregulated in August 1997, which resulted in phasing out of government support and price setting mechanism (Sandrey & Vink 2007). The deregulated market structure altered competitive shape of the industry by allowing market forces to determine the prices, while exposing producers to global competition. In 2000, fruit industry lost an estimated amount of R1 billion in export earnings and declared itself to be in crisis (Lubinga & Phaleng 2018). This study, therefore, attempts to analyse the impact (positive/negative) of international trade on employment and wages in the South African fruit industry for the period between 1990 and 2018.

1.3. Rationale

There are several studies conducted on the effects of international trade on employment and wages in manufacturing industries of both developed and developing countries (Abowd & Lemieux, 1991; Gaston 1998; Haouas & Yagoubib 2008; Jayanthakumaran 2006; Onaran 2011). However, limited studies have been conducted on how international trade flow impacts on employment and wages in agricultural sector of developing countries, particularly, in the South

African fruit industry. Therefore, this study will analyse the effect of European Union's Trade Development and Cooperation Agreement (TDCA) on employment in the South African fruit industry. The study will contribute to knowledge and literature on how international trade liberalisation impacts on employment and wages in the South African fruit industry. Additionally, this study will identify other factors that impact on employment and wages in the South African fruit industry. Furthermore, the study is expected to direct policy makers on how to approach international trade issues and how labour market should be treated when formulating international trade policy.

The overarching theoretical framework guiding this research on the impact of international trade on employment and wages is based on Krugman's theory of imperfect competition (Krugman 1979). Furthermore, international trade of similar product between countries in the North[2] and countries in the South works in favour of countries in the North based on the following arguments: (1) countries in the South[3] exports primary commodities, while countries in the North exports processed products; (2) firms in the Northern countries are mostly vertically integrated with a higher market share. North countries use primary commodities from South countries to process final consumer goods. There is existence of market distortions by North countries, since production is subsidised and import duties for commodities such as fruits are lower, while South countries are depending on primary production with less government support (Shaikh 2007).

1.4 Aim of the Study

The aim of the study is to analyse the impact of international trade on employment and wages in the South African fruit industry between the period of 1990 and 2018.

2 North countries refer to the developed countries, in which majority are situated in the Northern Hemisphere.

3 South countries refer to the developing or less developed countries, in which most of them are situated in the South African hemisphere.

1.5 Objectives of the Study

i. To outline performance of the South African fruit industry in terms of international trade, employment and wages;
ii. To analyse the impact of international trade flow on employment and wages in the selected six South African fruit industries;
iii. To determine the causality effect amongst employment, wages and exports in the six South African fruit industry.
iv. To determine the response of employment, exports and imports on changes in wages within the selected six South African fruit industries;
v. To determine the effects of European Union's Trade Development and Cooperation Agreement (TDCA) on wages in the South African fruit industry;

1.6 Research Hypotheses

i. International trade flow does not impact on employment and wages in the six South African fruit industry;
ii. There is no causality effect amongst employment, wages and exports in the six South African fruit industry.
iii. Employment, exports and imports do not respond to changes in wages within the selected six South African fruit industries;
iv. Trade Development and Cooperation Agreement (TDCA) does not impact on wages in the South African fruit industry;

1.7 Outline of the study

This section provides a detailed layout of the study, which consists of seven chapters. Chapter two outlines the relevant theoretical literature underpinning the study regarding the international trade liberalisation labour market and the empirical literature from various countries, concerning the effects on international trade on employment and wages in various sectors of the economy, including the evidence from selected groups of the South African fruit industry. Chapter three details the research methodology which consists of the types of data required, data management procedures and overview of the modelling techniques used to analyse each objective. Chapter four provides description and performance of the six selected fruits, with regards to international trade performance, employment and wages. Chapter five deal with the description of fruit production areas across South Africa, while detailed regional explanation is also being provided for the selected six members of the South African fruit industry. Detailed results and discussion of the findings of each objective are outlined in chapter six. Lastly, chapter seven provides the concluding remarks concerning the study objectives and recommendations that emanated from the findings.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The chapter aims at reviewing various theories underlying the effects of international trade on employment and wages. Furthermore, the chapter focuses on empirical research which examined the impact of international trade on employment and wages in developed and developing countries in general and on the fruit industry of South Africa in particular. The emphasis is on the fruit industry of South Africa. The chapter takes cognisance that South Africa belongs to the Southern Africa Customs Union (SACU) as well as the Southern Africa Development Community (SADC), hence the two structures are critical for one to understand how fruit industry benefits from international trade liberalisation and regional integration. International trade liberalisation and regional integration are regarded as vehicles to improve employment rate in the downstream industries, foreign earnings and wages of employees (Sigwele 2007). South Africa is a leading member of SACU and SADC in terms of fruit production and exports. International trade, labour market theories and empirical evidence are necessary to establish how South African labour market and wages within the fruit industry are affected by international trade, specifically with its leading trading partner (the European Union and United Kingdom).

Prior to exploring international trade theories, it is necessary to understand from the onset why countries trade. Knowledge on this issue is essential in appreciating the rationale for further trade liberalisation whilst also taking cognisance of the hesitance by other nations, including regional trading blocs. The establishments of the General Agreement on Tariffs and Trade (GATT) after the end of World War II and currently the World Trade Organisation (WTO) were intended to administer international trade, create employment opportunities and improve the wages of employees across the world (Sigwele 2007).

2.2 Theoretical foundations of international trade liberalisation

International trade liberalisation is regarded as a critical policy for economic growth, hence it is explored to analyse the reality faced by fruit producing firms operating in South Africa and somewhere else, especially on how it affects the employment and wages in the fruit and supporting industries. As posited by Bongsha (2011), markets are capable of providing growth if only regulators would refrain from posing unnecessary intervention. The principle of comparative advantage is embedded in the theory of international trade liberalisation, although under exceptional situation concerning the principle of infant industry protection. The principle of comparative advantage is consistent with the neo-classical free market assumptions of perfect market.

International trade liberalisation occurs when all types of trade barriers are eliminated and is oriented to two key establishments: uniformity, which indicates that barriers to trade, particularly tariffs should be removed for all trading partners; universality, which argues that benefits from international trade are extended to all nations regardless of their geographic and institutional positions. Nonetheless, it is unlikely as nations differ in every aspect; geographically, culture, factor endowments, history, labour market dynamics and developmental stage, all which affect the employability of all labourers and their wages thereof (Bongsha 2011; Kim 2011).

Flowing from the argument above it can be highlighted that international trade liberalisation entails the static comparative advantage and the notion of the lack of market failure in any format. Krugman (1979) posits that if the notion of free markets is accurate, the international trade liberalisation would assist all and create employment opportunities for all types of employees. However, markets are imperfect, which render the assumption of international trade liberalisation weak (Krugman 1979). This does not imply that protectionism is an ideal mechanism than international trade liberalisation.

When considering a two-by-two economic model with regard to a nation as well as commodities, while taking into cognisance Ricardo's method of analysis, which lead to the variations in labour productivity, triggers specialisation on the foundation of comparative advantage. The intuition is that taste and demand drive production of goods manufactured using endowed factors of production. However, when observing the Heckscher-Ohlin (H-O) theory, concentration is fuelled by the availability of production factors. The difference between the Ricardian and H-O theories is observed on how they treat technology, since the former argues that production technology to produce economic goods differs per country, while the latter view production technology as the same in all countries except that the difference only happens in the production process. The implication is that technology required to produce fruit is similar in all nations. The only difference is that H-O theory highlight technological differences in processing resource endowments, while Ricardian model argues that the technological difference happens in various countries (Bongsha 2011).

The assumption expressed by two theories is that nations should concentrate their efforts on the production and export of goods that utilise the abundant factors of production available within their countries. Notwithstanding the variance between the H-O and Ricardian models regarding the basis of comparative advantage, each nation distributes resources on the condition of the costs during the production period, which implies that comparative advantage as well as trade liberalisation are depending on market forces (Bongsha 2011).

Holding all factors constant, the structural arrangement of the factor endowments of each country, examines the average factor prices and the possible industrial arrangement (Lin & Chang 2009). Middle-income countries like South Africa, which have abundancy of natural resources and labour have a comparative advantage as well as competitiveness on primary industries such fruit (Bongsha 2011; Lin & Chang 2009).

The comparative advantage of the country defines its manufacturing direction and competitiveness. As argued by Ricardian and H-O theories, competiveness of the country solely relies on the factors of endowment available. Their argument is different to the new trade theory, which postulates that developing nations can only alter their comparative advantage by upscaling their manufacturing structure to the rate of developed countries (Bongsha 2011).

Prior to the firms opting to venture into certain industry, they firstly adopt available technologies that are compatible with the country's comparative advantage. These firms are capable of being competitive internationally and gaining possible biggest market shares. It must not be assumed that followers of the classical theory disregard dynamic thoughts; however, they show that those thoughts are highlighted in current costs and prices, which implies that developing countries like South Africa should concentrate on the production and export of labour intensive products such as fruit, due to their comparative advantage. In conjunction with the reasoning, South Africa is producing variety of fresh fruits such as citrus, pome, stone and sub-tropical categories, while it depends on the developed countries for the manufactured products such as fruit concentrate. This is regarded as a motivation for Import Substitute Industrialisation (ISI) policy for developing countries, due to the realisation that manufacturing is a critical sector for employment. However, it is unrealistic to conform to ISI based on this sentiment while neglecting the vigorous advantage possessed by each country through comparative and technological advantage.

There is a fallacy that shows that firms play no essential role in comparative advantage, which is assumed by the H-O model to be realised at the national economy level, while new trade theory raises a contrary assumption that multinational firms play a crucial role in all trade related matters (Bella & Quintieri 2000). According to Egger and Etzel (2012) many attributes are attained by the firms, which affect employment as well as wages, which include among others exchange rates, productivity, economics of scale, etcetera.

The principle of comparative advantage appears to be unrealistic and restrictive when taking into cognisance the present global phenomenon whereby large leading firms own facilities across the world while most developing countries are only producing components of the value chain or raw materials. The weight should be positioned on the notion that comparative advantage is a base of specialisation by countries and the critique of comparative advantage does not indicate the rejection of international trade liberalisation (Shafaeddin 1998).

The static comparative theory is founded on numerous ambiguous assumptions. Lall (2001) argues that comparative advantage theory does not emphasise that free trade is great, rather it highlights that some of the assumptions of comparative advantage are regarded positive by the developmental economists due to the fact that employment at the primary level and economic growth are realised. The emphasis made by Ricardian and H-O have suggestions on employment creation from natural endowments, which translates into the entire country growth (Castillo & Smith 2016).

Samuelson (1939: 195) cautions against a potential misunderstanding of the classical trade theory, which is the foundation of the international trade. Furthermore, it is postulated that autarky (absence of trade) is worse than international trade liberalisation. However, it is not highlighted that trade is the maximum tool to create employment opportunities and enhance wages in the labour market (Samuelson 1962: 260-6). The implication is that international trade liberalisation does not supersede any kind of trade (Samuelson 1939: 195).

Samuelson (1939: 195) argues that it is vital to understand the assumptions which establish international trade liberalisation, versus a need to evaluate against the real world facts. The assumptions put forward by international trade liberalisation are as follows: (1) Global production could be raised; provided there are no externalities, selfishness, monopolies and uncertainties. However, this assumption is inconsistent with the actual global dynamics. (2) International trade liberalisation does not give assurance that nations would realise maximum real income or consumption, which denotes that there are losers from international trade liberalisation. (3) It is notable that other countries might fail to benefit from international trade liberalisation, however autarky could make economic performance of countries worse as employment opportunities fade away and lower wages are remunerated to the working force due to availability of surplus labour.

The Heckscher-Ohlin-Samuelson (H-O-S) theory provides some clear assumptions concerning the effects of international trade on employment across economic sectors (Greenaway et al. 1999). The argument is that when barriers to trade are minimised, the import substitution industries diminishes because the export driven sector increases; *ceteris paribus*, employment in the former contracts, while in the latter it expands. Therefore, the simplified H-O-S theory is that international trade leads to transition of employment from the import competing sector towards the export driven sector (Greenaway et al. 1999).

2.2.1 Criticism of comparative advantage theory as based on international trade liberation

There is a great difference between the comparative advantage of developed and developing countries, as the former are endowed with the capital and technological intensive goods of secondary as well as tertiary industries and the latter has abundant unskilled labour-intensive goods of primary sector such as agricultural commodities. The intuition is that when trade barriers are detached, developed countries tend to specialise in exports of tertiary downstream goods (such as fruit concentrate and other processed fruit products). On the contrary, developing countries focus on exporting raw primary products (such as fresh fruits). The implication regarding international trade liberalisation according Ricardian model is that comparative advantage makes the developed nations richer, while impoverishing the developing countries. This argument contributed to the establishment of ISI theory.

In essence the intuition put forward by perfect competition is inconsistent with real world situation of firms' rivalry. Firstly, the processed products are huge and majority of firms involved are large lead, which aims to maximise profits due to a motive to recover investment from innovation and technological research. Secondly, the large lead firms in developed countries are making use of the intellectual property rights, which offer them an advantage over the infant firms in developing countries since they cannot afford the costs associated with intellectual property and patent registration. Thirdly, international prices are influenced largely by the multinational firms, however, all their influence are consistent with the terms of international trade, as administered by the WTO. Lastly, firms in developed countries amalgamate to take advantage of the economics of scale, which results in intra-industrial trade and the occurrence of imperfect competition results from monopolistic as well as oligopolistic conduct (Shafaeddin 1998).

Notwithstanding this, comparative advantage, knowledge, research and technological advancement comes with costs and are not transitioning from country to country or firm to firm as per assumption made by classical trade theory. Therefore, firms benefiting from the economics of scale in Research and Development (R & D) are large lead, technologically advanced and mostly are from the developed countries. The economics of scale and increasing returns to scale assist large lead firms to stimulate international markets through cost savings (Bongsha 2011; Shafaeddin 1998). The main critique expressed by some economists is that latest technology makes old technologies to become obsolete, which leads to employment losses and decrease in wages (Tokarick 2005).

The intuition of full employment highlights that when nations enter the international market results into reallocation of employees from importing sectors towards the export driven industries such as various fresh fruit categories in South African context. Practically most of the developing countries like South Africa have abundancy of unskilled labourers which are mostly not absorbable by the sectors benefiting from comparative advantage. South Africa and other developing countries have a pool of unskilled labourers as well as unemployed people. Adam Smith referred them as ‘unproductive labour’. However, such kind of labour offers the nation excessive production capacity, which offers labourers limited bargaining power over wages (Bongsha 2011).

The South African fruit industry continues to explore new varieties and continues to expand capacity on existing varieties. Therefore, those production yields are destined to export markets and are capable of creating employment opportunities. Furthermore, the industry is capable of supplying both the domestic and international markets, while creating stability within South African labour market by generating permanent as well as casual employment opportunities. The growth in exports is attributed to the allocation of endowed factors of production in the existing orchards as well as new extensions (Phaleng & Ntombela 2018; Lubinga & Phaleng 2018).

The argument of full employment is inconsistent with real world situation, more especially in developing countries, since is not possible to absorb the entire surplus labour. Lin and Chang (2009) postulate that conforming to comparative advantage could afford developing countries an opportunity to absorb the majority of their surplus labour, since manufacturing of goods emanating from abundant factor endowments is seen as a relevant approach to generate employment opportunities and enhance wage rates of the labour market. However, the static approach of comparative advantage does not elaborate on how developing economies like South Africa, which is exporting fresh fruit produce to the world, might expand its processing sector such as fruit concentrate and other value added fruit products that could absorb an increasing surplus labour (Fox 2016).

The principle of comparative advantage expresses international trade between developed and developing countries, in which the core argument is that production as well as exports is concentrated on the produce in which countries have comparative advantage. The theory does not provide clarity on international trade amongst developed countries which are focusing on trade in same produce, even clarity is lacking on trade between developing countries, particularly in Sub-Saharan Africa that has a similar factor endowments which are at the same stage of development (Kilic 2002).

2.2.2 Neoclassical theory

The argument postulated by neoclassical economists is on the provision of the 'law of demand and supply' which specifies that free markets have a propensity to full utilisation of factors of production, including employees. According to Eatwell and Milgate (2012) unemployment is subjective to one or few market imperfections which restrict the functionality of neoclassical adjustment mechanisms. Furthermore, neoclassical theory highlights that open markets and capital flows provide a huge opportunity to minimise unemployment and alleviate poverty (Shaikh 2007).

Kien and Heo (2009) demonstrate that neoclassical economic theory advocates for the transition of employees from comparatively uncompetitive sectors to comparatively competitive sectors. The movement of employees are driven by wage increase in the competitive industries, which in turn maximises global efficiency and improves firms' productivity.

❖ Theory of comparative advantage

The theory of comparative advantage was first developed by David Ricardo. The main argument of the theory is that countries export goods for which they have comparative advantage (for example, natural resources and other factors of production) and imports goods for which they do not have comparative advantage (Shaikh 2007). Furthermore, the theory is interrelated with the theory of comparative costs, which highlight that the terms of trade of each country automatically adjust in order to achieve a balance from international trade (Shaikh 2007).

The theory of comparative advantage postulates that employment rate in the long run does not depend on international trade flows and international concentration patterns. However, international trade liberalisation tends to enhance movement of skilled employees from comparative disadvantaged industries to those with comparative advantage. There is short-run unemployment resulting from frictions in the employees' transition process and leads to sectors benefiting in the expense of the others. Overall, the comparative advantage theory emphasises that international trade liberalisation enhances more efficient utilisation of labour (Ismail 2016; Shaikh 2007; Venebles & Smith 1986).

- New trade theory

The new trade theory of international trade was first introduced by Paul Krugman, which builds on the early theories developed by David Ricard, then Hecksher-Ohlin-Samuelson (Krugman 1979). The theorem of Hecksher-Ohlin-Samuelson argues that the base of comparative advantage depends on the various factor endowments possessed by each country. The countries tend to concentrate on its production of goods which utilises the factors of production that are in abundance, which make the costs of production to be relatively lesser. Furthermore, countries tend to import goods whose factors of production are scarce and costs of production are relatively expensive. However, during the 20th century, trade usually takes place amongst countries with the same level of endowments, which tends to oppose the predictions of Ricardo, Hecksher-Ohlin-Samuelson theories (Krugman 1979).

The intuition behind their theories is that comparative advantage and economies of scale afford various nations with competitive advantage when participating in the global markets. Furthermore, the theory indicates that as trading costs subside, the countries maximising on their factor endowments tend to penetrate into industrialisation and reduce its attention on primary industries (Shaikh 2007).

The argument put forward by new trade theory is that firms in developed countries tend to benefit from agglomeration economics that assist them to cement their economics of scale, productivity and continue to be competitive in global markets. Helpman (1990) postulates that North-South trade in same product benefits the developed countries due to the following facts: (1) the developed countries tend to export manufactured goods while developing countries export primary or intermediate goods, and (2) firms operating in developed countries tend to apply monopoly power. Imperfect competition happening between developed and developing nations is negatively affecting the performance of labour markets in developing countries. Despite the harmful effect to the labour markets and economic growth, imports of processed products emanating from developed countries offer clients with variety of goods (Helpman 1990).

This theory includes differentiated products, economics of scale and heterogeneous selection concerning brands to explain intra-industry trade. The major assumptions raised by the new trade theory are as follows: (1) a taste and preference of consumer on brands differs within and between countries, (2) agglomerated firms with economics of scale tend to benefit from international trade, and (3) differentiated products rely on adaptability to latest technologies and costs of raw materials. Industries in various countries produce imperfect goods which are differentiated by country of origin and remain substitutes based on taste as well as preference of consumers.

2.2.3 Heterodox approaches to trade and employment

The economists emanating from various schools of thoughts have confirmed the short-run distinctions in aggregate employment rate linked to business cycle and used several factors to describe them (Stirati 2012). However, Keynes postulates that the employment rate under full employment is common not only in the short-run, but similarly in long-run situation. It is established that the neoclassical mechanisms that reveal the trend of full-employment are scarce. As postulated by Keynes (1936), employment rate relies on various factors such as technological inclination, composition of wage and anticipated rate of effective demand. Furthermore, Keynes (1936) highlights that in the establishment of the level of employment and wages, it is essential to account for the correlation amongst expenditure, income generation and production.

Prior to Keynes, Marx postulated that unemployment is a usual outcome of capitalism and functional to its establishment. Marx indicated that in capitalism employees are powerless than capitals in the wage negotiation process. The main fact is that employees do not possess any means of survival except for selling their labour time. Furthermore, negotiation power is diminishing even more when the rate of underemployment and unemployment are high, as employees can simply be substituted by what Karl Marx called ‘reserve army’ (which refers to a pool of unemployed waiting at the factory gates for any opportunity) and most members of the reserve army are involuntarily unemployed (Pollin 2008: 5). Marx dismissal of the Say’s Law and exploration of the nature of capitalist production led him to conclude that capitalism creates a ‘reserve army’ of labour.

Keynes (1933) puts a critique to neoclassical and other liberals, which is of the view that countries should encourage self-sufficiency in a majority of products and finance, while service industries such as hospitality, ideas, knowledge, science and technology need to remain international in nature. Keynes further postulates that countries should be offered time and protection to develop their own industries, hence competencies such as innovation, knowledge and technology are viewed as international capabilities that can rescue local employment. It is established that financial and trade liberations are able to condemn the employment opportunities as well as the entire economic growth. Furthermore, Keynes establishes that a country would achieve its growth trajectory if unemployed factors of production are utilised to realise national growth.

Keynes notes the difficulties with the current account, when critiquing the neoclassical economists. Capital flow and international trade liberalisation pose a serious challenge of adjustment on the country which possesses the debtor status on the global balance of payments. Furthermore, a country with debtor status needs to adjust in order to be on equilibrium spot, hence those changes affect prices and wages within labour market, which lead to social burden. Typically the alteration process tends to be compulsory to debtor countries and becomes voluntary to the creditor countries (Pollin 2008; Perraudin et al. 2013; Saith 1969).

Kaldor (1980) establishes that international trade liberalisation can result in unemployment hence preference is given to a trading system which is regulated. The effects of international trade on employment are observed specifically on trade between developed and developing nations, due sensitivity on divergence, economies of scale and trade imbalances, which put a strain on employment (Malinvaud & Fitoussi 1980). Furthermore, Kaldor postulates that trade liberalisation helps developed countries to realise growth, since international trade tends to hamper manufacturing sector in developing countries and results in unemployment for majority of the work force. Kaldor (1980) further establishes that countries restricted by current account deficits should apply import controls on those countries whose imports are experiencing a positive balance of payments.

Heterodox authors put forward a further criticism against the assumptions of comparative advantage theory. For instance, the classical theory of competitive advantage claims that price of international goods is defined in the same modality as relative domestic prices (Shaikh 2007). Therefore, countries with high costs of production are more likely to realise trade deficits, which are sometimes covered by loans and subsidies. Consistent rise of trade imbalances adjusted through loans and subsidies are results of trade between unequally trading partners. Contrary to the theory of standard theory, trade liberalisation normally does not happen amongst equally competitive countries, hence weakest countries are exposed to competition from strongest countries (Porter 1990; Shaikh 2007).

As argued by Porter (1990), firms gain productivity if there is presence of direct international competition and functional supporting industries. Occurrences of international competitive producers of primary as well as intermediate goods create a huge advantage in downstream industries, which include among others: creation of economics of scale, low production costs, productivity and sustainability. For instance, in South Africa, most of production inputs (like fertilizers, fuel, herbicides) are procured internationally and that is subject to various factors such as custom duties, exchange rate and transportation costs. Furthermore, exports of upstream raw materials tend to provide employment opportunities in other countries and contribute negatively to the balance of payments when specialising in raw material exports (Jayanthakumaran 2006). Productivity of the fruit industry depends on quality and consistent use of the spraying programme as required by the market.

In conclusion, Keynes indicates that full employment is usual in both short-run and long-run, while trade liberalisation leads to unemployment. Marx argues that unemployment is fundamental to capitalism. Keynes argues that international trade liberalisation is able to cause injury to the employment of low skilled people and results in lower economic welfare. The section below addresses the evidence from empirical research concerning the effects of international trade on employment and wages.

2.3 Empirical evidence

Gaston and Trefler (1994) conducted the study to determine the Canadian employment reactions to the tariff cuts emanating from Canada-US Free Trade Agreement (FTA). The study shows that the implementation of FTA in 1988 resulted in Canada suffering a 19 per cent decline in employment on its non-tradeable sector. Furthermore, Canada continued to experience employment shock in most tradeable sector of the economy. Gaston and Trefler (1994) found that 9 to 14 per cent of employment losses were due to tariff cuts implemented through Canada-US FTA. Real earnings were constant, but unemployment figures were about 55 000. Their results point that the effects of tariff reduction were not the same across industries, hence other industries heavily affected by non-FTA issues such as strong dollar and high interest rates.

The study conducted by Sauve (1998), on behalf of Organisation for Economic Cooperation and Development (OECD), reveals that international trade is not the biggest contributor of employment in the OECD countries. However, adverse impacts on labour markets are mainly emanated from changes in business models, technological improvements and innovation. Furthermore, changes in domestic demand patterns, domestic competition and productivity are added to the basket of determinants of employment in OECD countries. It was found that trade contributed only 6 percentage point of employment in the U.S. manufacturing sector between 1978 and 1990. The results suggest that interrelation between investments, trade openness and improved technology are depressing the rate of demand for unskilled labour, and imports from developing countries are not the causal factor. Imports of manufactured goods emanating from developing countries since 1970s are valued to merely 1.6 per cent of OECD countries' inclusive output (Sauve 1998: 11). Verduzco-Gallo et al. (2014); Chang & Lin (2009); Tregenna (2015); Sauve (1998); Oqubay (2015), demonstrate that output and employment is derived from service sector in the majority of developing countries.

Assorted studies captured in OECD (2012) found that economy-wide employment losses are associated with innovation and technological change. This trend has resulted in increased demand for skilled workers and causes less appetite for unskilled workers, both in developed and developing countries. However, a majority of countries with extraordinary employment turnovers are faced with minimal import competition. Their results suggest that changes in the labour market are less explained by international trade. The primary contributor of changes in the labour market was found to be skill-biased technological change, not international trade.

Tokarick (2005) conducted a study using general-equilibrium model to disaggregate the international trade and technology-related variables on employment and wages in United States of America. The study was focusing on both skilled and unskilled workers and the period of review started in 1982 to 1996. The results show that trade-related variables (terms of trade, reduction in tariff and increase in trade deficit) had less impact on employment and wage differences. The primary contributor to employment decline is skill-biased technological change across all sectors of the economy. The results are consistent with OECD (2012) and neo-liberal economists' argument of global trade liberalisation.

Mann (1988) evaluates the impact of international competition on market share and prices towards employment in five import-sensitive industries within the United States of America. The analysis reveals that international competition in price and volumes is quiet an essential factor of local employment than the international employment. However, the results show that international trade liberalisation effect on employment is very minimal and argue that other factors such as input costs, fluctuations in demand and technological developments are primary determinants of employment in the United States of America. The findings are consistent with Sauve (1998), who suggests that bulk of changes in the labour markets are explained by differences in labour productivity, availability of raw materials, responsiveness of labour market, real wages and fluctuations in expenditure patterns.

Onaran (2011) estimated the impact of imports on employment and wages in the manufacturing industry of Austria, for the period starting from 1990 to 2005. However, the results show that there is less negative effect of imports on employment and wages. The paper tried to differentiate between final versus intermediate imports and countries of origin for all imports. Imports of finished products affect the labour market negatively, while imports of intermediate goods have a positive effect on employment and wages.

Acharya (2017) argues that global capital and trade liberalisation marked a spike in imports from developing countries such as Argentina, Brazil, China and Mexico, such trend affected employment of unskilled workers in Canada and other developed countries. The study reveals that trade liberalisation is positively affecting employment of skilled labour. Further empirical evidence from Acharya (2017: 848), shows that the share of employees with secondary or lower education dropped from 51 to 36 per cent. In contrast, Canada experienced an 8 per cent (36 to 44 per cent) increase on employment share of workers with post-secondary qualifications, while employment growth of workers in possession of university degrees got amplified by 7 per cent (as from 13 to 20). The demand side of the labour market constitutes a primary determinant of how trade and technology are affected by trade liberalisation, since labour tends to transit from import competing sectors to export based sectors and unskilled labour is left vulnerable to low wages or faces retrenchment (Lin & Chang 2009).

Jayanthakumaran (2006), analysed the linkages between intra-industry trade, labour market adjustments and trade reforms in Australia between 1989/90 to 2000/01. Two hypothetical situations were developed as follows: (i) trade reforms negatively impact overall employment as more openness enhances labour utilisation efficiencies; (ii) trade reforms have a positive effect on employment if trade flows are intra-industry. The primary assumption is that workers can move within the industry in order to fulfil their associated utility and they can only shift to other sectors if opportunities disappear. The above findings are consistent with labour literature which shows that exports are positively related to employment growth while imports are negatively related to employment growth.

Ma and Wooster (2009) studied whether trade between U.S. and China has an effect on employment and wages on countries along Mexico-U.S. boarder. Their paper disaggregated the data on the basis of industries in order evaluate the impact of trade with China on employment in four boarder counties[4]: (i) El Paso, Texas; (ii) Santa Cruz, Arizona; (iii) San Diego, California; (iv) Webb, Texas. When authors controlled for natural covariates, which include demand for domestic products, USA – Mexico exchange rates and alternative wages, their results suggest that imports from China are contributing to reduction in employment and wages along Mexico-USA boarder countries. Furthermore, their results reveal that the effect of imports from China is less for small economies such as San Diego, as its economy is less dependent on manufacturing and other three countries are heavily affected due to their dependency on the manufacturing sector (Ma & Wooster 2009; Mollick & Wvalle-vázquez 2006).

The literature suggest that many developing (south) countries have realised deindustrialisation, hence transition away from manufacturing to service sector is associated with increase in imports of tradeable goods (Amsden 1994b; Gaston 1998; Gaston & Trefler 1994; Revenga 1992; Rodrik 1992a; Tregenna 2015; Wood 1994). Furthermore, the decline in manufacturing employment, coupled with trade liberalisation in developing countries, means few remaining domestic firms are now exposed to intensive international competition. Gaston (1998) and Rodrik (1992b), suggest that firms in developing countries are not converging to technological frontiers developed in advanced countries and that result in structural change which affect productivity of tradeable sector.

Cirera et al. (2014) conducted a study to review the effect of tariff reduction on employment in developing countries using meta-analysis of econometric and Computable General Equilibrium (CGE) literature. The results show that the impacts of tariff reductions on employment are country specific and differ, depending on trade policies. Results from econometric studies that took control for endogeneity of tariffs, suggest that employment decreases gradually in short-run after implementation of trade liberalisation.

4 According to Ma and Wooster (2009), county refers to administrative subdivision of a state, which normally have a boundary and poses a level of authority.

Pinto and Michaelis (2014), conducted a study on labour market effects on trade liberalisation, which incorporated trade unions and heterogeneous labour on Melitz framework. The study argues that workers are different, based on their abilities. The main findings of their study are as follows: (i) trade liberalisation negatively affects low-ability workers, which normally transition to a long-term unemployment after losing job; (ii) high-ability workers are well-off in terms of ability to learn new technologies and can easily move to another firms or industries; and (iii) countries with abundancy of low-ability workers are negatively affected by trade liberalisation, which causes the unemployment rate to incline and that results in serious injury to the country's welfare.

As posited by Salvanes and Forre (2003), developed countries are experiencing a shift in labour market in favour of skilled workers and growth in employment rate of less skilled workers remains stunted. The changing trends in labour market result in swelling unemployment and falling of wages for unskilled workers. Their results suggest variations are explained by increased demand for skills required to operate skill-biased technology and increased imports from developing countries. Furthermore, the results reveal that employment for employees with below 10 years of schooling was declining, while employment for employees with above 10 years of schooling was increasing. Another contributing factor is the imports of tradeable finished goods (Salvanes & Forre 2003: 297).

Francis (2010) conducted the study to determine the relationship between declining costs of trade and increasing employment rate in the United States of America. The paper used Krugman's (1979) model of 'new geography', which demonstrates that the relationship between reduced trade costs and economics of scale benefits firms agglomerated in a specific location. The economics of scale, agglomeration and government support of fruit industries in the exporting countries provide them with a competitive edge to remain sustainable and profitable.

Bazen and Cardebat (2001) examined the impact of trade liberalisation on the wages and labour market demand for low-skilled workers in France. Their findings reveal that effects of trade liberalisation on employment in developed countries such as France is diverse based on the degree of competition in product markets, the elasticity of labour market and intensity of skills required by manufacturing firms. An econometric analysis has found that low-priced imported goods reduce the employment rate of low-skilled workers in the short-run and reduces their wages in the long-run. The shock on effects of international trade liberalisation on labour markets are more realised in sectors dominated by low-skilled employees.

Du-Caju et al. (2012) conducted the study to investigate the employment and wage structure effects of trade liberalisation in Belgium. The study is among the few to apply a detailed employer-employee data needed to compile wage per industry and also used panel data to determine the impact of international trade on labour markets. Furthermore, the simultaneous analysis of impacts of both exports versus imports was conducted, in which imports were examined, based on country of origin. The results suggest that exports are benefiting from international liberalisation and cause employment as well as industrial wage to increase.

Consistent with findings from Sigwele (2007), the study conducted by Kien and Heo (2009) in Vietnam also found that international trade liberalisation resulted in an increase of tradeable exports and that employment appreciated under the review period (as from 1999 - 2004). However, their empirical analysis using Cobb-Douglas production function, coupled with a generalised method of moment estimator (GMM) reveals that imports did not have a negative impact to employment. Kien and Heo (2009: 81), indicate that overall trade liberalisation in Vietnam since 1986 yielded a positive economic welfare such as 6 per cent growth in Gross Domestic Product (GDP) during the period of 1986 to 2005. Furthermore, GDP per capita increased from US$84 in 1986 to US$631 in 2005.

Domestic currency depreciated against US dollar, which boosted performance of Vietnamese exports to the world markets.

The findings from Haouas and Yagoubib (2008) are consistent with Onaran (2011) and other assorted studies that suggest that international trade has less effect on labour market elasticity. Haouas and Yagoubib (2008) used data from manufacturing industries to estimate the international trade liberalisation on labour market demand elasticity. The period under review is from 1971 to 1996. The findings argue for weak relationship between international trade liberalisation and labour market demand elasticities. Furthermore, their results show that international trade caused labour markets to be flexible, and firms were able to recruit contract workers in most industries.

Bella and Quintieri (2000) conducted the study to examine the effect of trade on employment and wages in Italian manufacturing industry, using panel data from different manufacturing industries. Their findings suggest that industrial response to labour market demand shocks is through alterations to labour force. Nonetheless, intensive exposure to international competition had a minimal impact on the Italian labour market, hence technological upgrading seems to play a key role in describing an increase in unemployment. Their study suggests that international trade liberalisation generate welfare gains for the entire country, therefore countries need to incentivise both workers and firms to adapt to fast changing global environment.

Cuyvers et al. (2003) conducted the study to determine the effects of European Union's trade with emerging economies on wage and employment. Their results show that wage is negatively affected by trade-induced technological change. However, the only affected group is workers employed in lower-skilled intensive sectors of the economy. The results suggest that wages are not affected at European Union countries. International trade liberalisation mostly affects workers employed in primary sectors. Notably, import competition from developing countries positively affects labour demand market of high-skilled workers.

2.4 Chapter Summary

The chapter explored both the theoretical and empirical literature on the effects of international trade on employment and wages. The arguments raised by Krugman's theory of imperfect competition shows that trade amongst the developed and developing countries tend to favour the developed countries since developed nations focus mostly on the beneficiated products, while developing countries concentrate on exporting primary commodities. The arguments made by Ricardian and H-O theories indicate that the competiveness of each country solely relies on the factor endowments available. Their argument is different to the new trade theory which postulates that developing nations can only alter their comparative advantage by upscaling their manufacturing structure to the rate of developed countries.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This chapter focuses on the data requirements, data management procedures, data analytical techniques and data sources used to estimate the different methods of achieving the study objectives. Intuitively, each objective needs a specific data and analytical technique hence each has been allocated a detailed methodological approach which addresses data requirements as well as the estimation techniques. The chapter starts with a broad overview of the six fruit industries selected for this study, followed by procedures adapted to measure the effects of international trade on the employment and wages within the selected fruit industries of South Africa. Furthermore, the chapter presents the procedures used to transform the variables from raw data and to deal with non-stationarity of the data as the study uses secondary data.

3.2 Focus of the study

The study focuses on the effects of international trade flow on employment and wages in the six South African fruit industries. The six selected fruits are as follows: apple, apricot, avocado, orange, pear and table grapes. The selection was influenced by the socio-economic contributions of those fruit industries, particularly on employment opportunities, wages and gross domestic product (GDP). These fruit industries considered under each of the objective differ according to their data requirements. The detailed analysis about each considered fruit industry is provided under the specific objective.

The study uses fruit industry data as from 1990 until 2018, empirical and theoretical literature to test the hypotheses. The South African fruit industry is export driven, in which EU shows to be a preferred destination for the industry. Despite the fact that EU offers developing countries non-reciprocal preferential treatment on most of their tariff lines, fruits are considered to be amongst the most sensitive products and are subjected to a number of regulations which might stand as barriers to trade.

3.3 Data and data sources

The data focuses on employment, wages, exports, imports and other economic variables of the six (apple, apricot, avocado, orange, pear and table grapes) South African fruit industries. The secondary data is sufficient to complete the study. The analysis concentrates on chapter 6 of the Harmonised Systems (HS) of nomenclature. The chapter is ultimately dedicated to fruits, whether fresh, chilled or frozen. The nomenclature system was developed in 1988 by United Nations (UN), in order to streamline the international recording of trade flows. The international trade information on the quantity traded for six fruit industries is used as from 1990 until 2018. All the international trade data was obtained from the Global Trade Atlas (GTA) and Trade-map database of the International Trade Centre (ITC). The database sourced from both GTA and Trade-map was adopted up to the HS 6-digit level of disaggregation, which is understood by countries across the world. The other data was sourced from the Bureau for Food and Agricultural Policy (BFAP), Department of Agriculture, Forestry and Forestry (DAFF); Department of Trade and Industry (DTI); South African Reserve Bank (SARB); Quantec Easy Data (QED); Statistics South Africa (StatsSA) and Western Cape Department of Agriculture (WCDOA).

In Table 3.1 below a number of variables adopted to analyse the apple industry throughout the study. There are in total eleven variables used in the apple industry analysis. There are at least three dependent variables which include total employment, wages output and volume of South African exports to European Union. There are in total eight regressors such as exports output, imports output, first lag of exports output, total gross value of production, first lag of wages output, first lag of total employment, first lag of production volumes and total area planted with apples. Table 3.1 include the abbreviations of the variables, unit of measurement and their expected sign of response to regressands.

Table 3. 1: The list variables used in the analysis of apple industry

Dependent variables	*Abbreviations*	*Unit of measurement*	
Total employment in the apple industry	$EMPG$	Total number of people employed in the apple industry.	
Wages output for the apple industry	$WAGO$	Total annual wage in the apple measured in South African Rand (ZAR).	
Volume of South African (SA) apple exports to EU	$VOSAXEU$	The volume of South African apple exports to EU expressed in metric ton.	
Independent variables	*Abbreviations*	*Unit of measurement*	*Expected sign*
Exports output in the apple industry	$EXPO$	The value of apple exports measured in ZAR.	Positive (+)
Imports output in the apple industry	$IMPO$	Value of apple imports measured in South African Rand.	Negative (-)
Previous year's exports output in the apple industry	$EXPO_{t-1}$	The value of previous year's apple exports expressed in ZAR.	Positive (+) / Negative (-)
Total gross value of production	$TGVP$	Total gross value of production in South African rand.	Positive (+)
Previous year's average wage in the apple industry	$WAGO_{t-1}$	The value of previous year's wage remunerated to employees in the apple industry expressed in ZAR.	Positive (+) / Negative (-)
Previous year's total employment in the apple industry	$EMPG_{t-1}$	The total number of previous year's employment in the apple industry	Positive (+) / Negative (-)
Previous year's production volumes of the apple industry	$PRODT_{t-1}$	The total apple production volumes of the previous year measured in metric tons.	Positive (+) / Negative (-)

The total area planted with apples	$AREAP$	The total area planted with apples expressed in hectares.	Positive (+)

Source: Author's compilation

Table 3.2 represents all variables used in the analysis of the apricot industry, which include descriptive statistics, error correction model, granger causality model, two-staged least squares and ordinary least squares. There are at least three regressands applied to apricot analysis, which consist of total employment, wages output and volume of South African apricot exports to European Union. The regressors applied in the apricot estimation are as follows: exports output, imports output, first lag of exports output, average exchange rate, local sales of apricots, gross value of fresh apricots, population size, net realisation, processing volume and foreign direct investment. The response of regressors to the regressands in analysing the effects of international trade on employment and wages are indicated through the mathematical signs in Table 3.2. The other information captured in Table 3.2 includes the abbreviations of variables and unit measurement.

Table 3. 2: The variables used in the analysis of apricot industry

$Dependent\ variables$	$Abbreviations$	$Unit\ of\ measurement$	
Total employment in the apricot industry	$EMPG$	Total number of people employed in the apricot industry.	
Wage output for the apricot industry	$WAGOAPR$	Total annual wage in the apricot measured in South African Rand (ZAR).	
Volume of South African (SA) apricot exports to EU	$VOSAXEU$	The volume of South African apricot exports to EU expressed in metric ton.	
$Independent\ variables$	$Abbreviations$	$Unit\ of\ measurement$	$Expected\ sign$
Exports output in the apricot industry	$EXPO$	The value of apricot exports measured in ZAR.	Positive (+)

Imports output in the apricot industry	$IMPO$	Value of apricot imports measured in South African Rand.	Negative (-)
Previous year's exports output in the apricot industry	$EXPO_{t-1}$	The value of previous year's apricot exports expressed in ZAR.	Positive (+) / Negative (-)
Average exchange rate	$AEXRT$	Annual benchmarking of ZAR on USD (a rate which is an indication for international competitiveness)	Positive (+)
Local sales of apricots	$LOCS$	Local sales of apricots expressed in metric ton.	Positive (+)
Gross value of fresh apricots	$GRVF$	Gross value of fresh apricots expressed in ZAR	Positive (+)
South African population	$POPU$	Total annual South African population expressed in numbers.	Positive (+)
Net realisation from apricot exports	$NETR$	Net realisation from apricot exports expressed in ZAR per metric ton.	Positive (+)
Processing volume	$PROCV$	Processing volume of apricot measured in metric ton.	Positive (+)
Foreign Direct Investment	FDI	Value of total investment measured in ZAR	Positive (+) / Negative (-)

Source: Author's compilation

As depicted on Table 3.3, all regressands and regressors included in the analysis of avocado industry are presented. There are three regressands included in all analysis of avocado, which are total employment, wages output and volume of South African avocado exports to the European Union market. The included regressors for avocado industry are as follows: exports output, imports output, average exchange rate, total gross value of production, productivity and foreign direct investment. The signs represent the expected response of regressors to the regressand which address the set objectives. The other key information included is the abbreviations of variables and unit of measurement.

Table 3. 3: The variables used in the analysis of avocado industry

Dependent variables	*Abbreviations*	*Unit of measurement*	
Total employment in the avocado industry	$EMPG$	Total number of people employed in the avocado industry	
Wage output for the avocado industry	$WAGO$	Total annual wage in the avocado measured in South African Rand (ZAR)	
Volume of South African (SA) avocado exports to EU	$VOSAXEU$	The volume of South African avocado exports to EU expressed in metric ton	
Independent var	*Abbreviations*	*Unit of measurement*	*Expected sign*
Exports output in the avocado industry	$EXPO$	The value of avocado exports measured in ZAR.	Positive (+)
Imports output in the avocado industry	$IMPO$	Value of avocado imports measured in ZAR.	Negative (-)
Average exchange rate	$AEXRT$	Annual benchmarking of ZAR on USD (a rate which is an indication for international competitiveness).	Positive (+)
Total gross value of production	$TGRVP$	Total gross value of production in ZAR.	Positive (+)
Productivity	$PRODTVT$	The rate of output per unit of labour (percentage).	Positive (+) / Negative (-)
Foreign Direct Investment	FDI	Value of total investment measured in ZAR.	Positive (+) / Negative (-)

Source: Author’s compilation

As depicted on Table 3.4, there are at least twelve variables identified to determine the effects of international trade on employment and wages in the orange industry. There are three dependent variables, which include the total employment, wages output and volume of South African orange exports to the

European Union market. The independent variables identified are as follows: exports output, imports output, the first lag of imports output, foreign direct investment, average price, average exchange rate, first lag of per capita consumption, net realisation from orange exports and local sales of oranges. Table 3.4 include the abbreviations of variables, unit of measurement and the expected signs of independent variables in response to variations in the dependent variables.

Table 3. 4: The variables used in the analysis of orange industry

Dependent variables	*Abbreviations*	*Unit of measurement*	
Total employment in the orange industry	$EMPG$	Total number of people employed in the orange industry.	
Wages output for the orange industry	$WAGO$	Total annual wage in the orange measured in South African Rand (ZAR).	
Volume of South African (SA) orange exports to EU	$VOSAXEU$	The volume of South African orange exports to EU expressed in metric ton.	
Independent variables	*Abbreviations*	*Unit of measurement*	*Expected sign*
Exports output in the orange industry	$EXPO$	The value of orange exports measured in ZAR.	Positive (+)
Imports output in the orange industry	$IMPO$	Value of orange imports measured in ZAR.	Negative (-)
Previous year's imports output in the orange industry	$IMPO_{t-1}$	The value of previous year's orange imports expressed in ZAR.	Positive (+) / Negative (-)
Foreign Direct Investment	FDI	Value of total investment measured in ZAR.	Positive (+)
Average price	$AVRP$	Average price of oranges in ZAR per metric ton.	Positive (+) / Negative (-)

Average exchange rate	$AEXRT$	Annual benchmarking of ZAR on USD (a rate which is an indication for international competitiveness).	Positive (+) / Negative (-)
Previous year's per capita consumption	$PCONS_{t-1}$	Previous year's per capita consumption measured by dividing the total quantity material goods consumed (or product value) by population size.	Positive (+) / Negative (-)
Net realisation from orange exports	$NETR_t$	Net realisation from orange exports expressed in ZAR per metric ton.	Positive (+) / Negative (-)
Local sales of oranges	$LOCS_t$	Local sales of oranges expressed in metric ton.	Positive (+)

Source: Author's compilation

Table 3.5 presents the variables included in the estimation of the pear industry throughout the study. There are three dependent variables in the pear analysis which consists of total employment, wages output and volume of South African pear exports to European Union. There are six independent variables in the entire pear industry analysis, which are as follows: exports output, imports output, foreign direct investment, production volumes of the pear industry, net realisation from pear exports and local sales of pears. Table 3.5 shows the envisaged signs of the independent variables in response to a unit shift in the dependent variable, the abbreviations of variables and unit of measurement.

Table 3. 5: The variables used in analysis of the pear industry

Dependent variables	*Abbreviations*	*Unit of measurement*
Total employment in the pear industry	$EMPG_t$	Total number of people employed in the pear industry.
Wage output for the pear industry	$WAGO_t$	Total annual wage in the pear measured in South African Rand (ZAR).
Volume of South African (SA) pear exports to EU	$VOSAXEU_t$	The volume of South African pear exports to EU expressed in metric ton.

Independent variables	*Abbreviations*	*Unit of measurement*	*Expected sign*
Exports output in the pear industry	$EXPO_t$	The value of pear exports measured in ZAR.	Positive (+)
Imports output in the pear industry	$IMPO_t$	Value of pear imports measured in ZAR.	Negative (-)
Foreign Direct Investment	FDI_t	Value of total investment measured in ZAR.	Positive (+)
Production volumes of the pear industry	$PRODT_t$	The total pear production volumes measured in metric tons.	Positive (+)
Net realisation from pear exports	$NETR_t$	Net realisation from pear exports expressed in ZAR per metric ton.	Positive (+)
Local sales of pears	$LOCS_t$	Local sales of pears expressed in metric ton.	Positive (+)

Source: Author's compilation

There are at least eleven variables included in the estimation of table grape industry throughout the entire study. The study adopted at least three regressands to be used in the analysis of table grape industry. Those regressands consist of the total employment, wages output and volume of South African table grape exports to the European market. However, there are at least eight regressors, which are exports output, imports output, foreign direct investment, total area planted with table grapes, average exchange rate, domestic consumption of table grapes, dried volumes of table grapes and local sales of table grapes. Table 3.6 incorporated the expected signage of the independent variables from the variations in the dependent variables, abbreviations of variables and the units of measurement.

Table 3. 6: The variables used in analysis of the table grape industry

Dependent variables	*Abbreviations*	*Unit of measurement*
Total employment in the table grape industry	$EMPG_t$	Total number of people employed in the table grape industry.

Wage output for the table grape industry	$WAGO_t$	Total annual wage in the table grape measured in ZAR.	
Volume of South African (SA) table grape exports to EU	$VOSAXEU_t$	The volume of South African table grape exports to EU expressed in metric ton.	
Independent variables	*Abbreviations*	*Unit of measurement*	*Expected sign*
Exports output in the table grape industry	$EXPO_t$	The value of table grape exports measured in ZAR.	Positive (+)
Imports output in the table grape industry	$IMPO_t$	Value of table grape imports measured in ZAR.	Negative (-)
Foreign Direct Investment	FDI_t	Value of total investment measured in ZAR.	Positive (+)
The total area planted with table grapes	$AREAP_t$	The total area planted with apples expressed in hectares.	Positive (+)
Average exchange rate	$AEXRT_t$	Annual benchmarking of ZAR on USD (a rate which is an indication for international competitiveness).	Positive (+) / Negative (-)
Domestic consumption of table grapes	$DCONS_t$	Domestic consumption of table grapes expressed in metric tons.	Positive (+)
Dried volumes of table grapes	$DRDV_t$	Dried volume of table grapes measured in metric ton.	Positive (+)
Local sales of table grapes	$LOCS_t$	Local sales of table grapes expressed in metric ton.	Positive (+)

Source: Author's compilation

3.4 Data Analysis and General Models

This study will test a theory of imperfect competition (Krugman 1979), which puts forward the assumption that North-South trade on similar goods works in favour of North countries. The reason is that developing countries tend to lag behind on innovation and technology which makes them to focus on primary commodities, while developed countries managed to climb the technological ladder which propel them to export processed goods.

3.4.1 Error correction model

The study used error correction model (ECM) to account for long-run relationship between employment as well as wages on international trade. The model also caters for short-run variations. The initial step required when estimating ECM is to measure the long-run relationship through the estimation of co-integration equation, after which the Engle-Granger test will be performed on this equation in order to verify the co-integrating relationship between the dependent and explanatory variables (Mollick & Wvalle-Vázquez 2006).

The error correction model (ECM) provides a way of reincorporating levels of variables together with their differences and it provides a model for long-run as well as short-run relationships amongst integrated variables. Furthermore, economic time series data needed to estimate the effects of international trade on employment and wages in the South African fruit industry consists of overtime trends, which are mostly non-stationary. Nonetheless, regression analysis might reveal significant results with high R^2 hence the results might be spurious and misleading. The ECM, co-integration analysis and instrumental variables model are relevant methods to overcome the challenge of spurious inferences (Gujarati & Porter 2009; Shoko 2014; Wooldridge 2013).

The ECM addresses the limiting dynamic specification and apprehends the forecast effects of international trade on employment and wages in the dynamic circumstances (Cetin 2016). Furthermore, ECM model is applicable to analyse non-stationary data that are identified to be co-integrated. This approach assumes the interrelation amongst the dependent and explanatory variables in the long-run. The general model is specified as follows:

$$\Delta lnY_{it} = \alpha + \beta_1 \Delta lnX_{1t} + \beta_2 \Delta lnX_{2t} + \beta_3 \Delta lnX_{3t} + \beta_4 \Delta lnX_{4t} + \beta_5 \Delta lnX_{5t} + \beta_6 \Delta lnX_{6t} + \beta_7 \Delta lnX_{7t} + \beta_8 \Delta lnX_{8t} + \beta_9 \Delta lnX_{9t} + \beta_{10} \Delta lnY_{10t-1} + \theta EC_{t-1} + \varepsilon_t \qquad (3.1)$$

Where Y is dependent variable, while X_1 until X_k represent the independent variables which are various factors that affect employment (see Table 3.1 until Table 3.6). Where t subscript represent a time dimension. Where Δ represents differencing notation, while ln (log) represents the natural logarithm and Y_{t-1} denote the lagged variables including dependent variable. The error correction term is denoted by θEC_{t-1}. The disturbance term is represented by ε_t. The specific VECM equation can be specified as follows:

$$\Delta lnEMPG_t = \beta_0 + \beta_1 \Delta lnIMPO_{1t} + \beta_2 \Delta lnEXPO_{2t} + \beta_3 MTDCA_{3t} + \beta_4 \Delta lnSHPC_{4t} + \beta_5 DRGT_{5t} + \beta_6 \Delta EXRT_{6t} + \beta_7 \Delta lnFDI_{7t} + \beta_8 \Delta lnINPC_{8t} + \beta_9 ICGDP_{9t} + \beta_{10} DCONS_{10t} + \beta_{10} \Delta lnEMPG_{10t-1} + \theta EC_{t-1} + \varepsilon_t \qquad (3.2)$$

Where $EMPG$ represents the dependent variable, while X_1 until X_k represent the independent variables which are various factors that affect employment (see Table 3.1 until Table 3.6). The t subscript represents a time dimension. Where Δ represents the differencing notation, while ln(log) represents the natural logarithm, θEC_{t-1} represents the error correction term and $EMPG_{t-1}$ denotes the lagged variables including dependent variable. Error term is represented by ε_t, which captures effects of variables not included on the regression.

$$\Delta lnWAGO = \beta_0 + \beta_1 \Delta lnPRODTVT_{1t} + \beta_2 \Delta lnIMPO_{2t} + \beta_3 \Delta lnEXPO_{3t} + \beta_4 MTDCA_{4t} + \beta_5 UNIM_{5t} + \beta_6 TWOR_{6t} + \beta_7 \Delta lnDCONS_{7t} + \beta_8 \Delta lnUNEMP_{8t} + \beta_9 \Delta lnDCONS_{9t} + \beta_{10} \Delta lnWAGO_{10t-1} + \theta EC_{t-1} + \varepsilon_t \qquad (3.3)$$

Where $\Delta lnWAGO$ denotes the dependent variable, while X_1 until X_k represent the explanatory variables which are various factors that affect wages (see Table 3.1

until Table 3.6). The t subscript represents a time dimension. Where Δ represents the differencing notation, while ln(log) represents natural logarithm, θEC_{t-1} represents error correction term and $WAGO_{t-1}$ denotes lagged variables including dependent variables. Disturbance term is represented by ε_t, which captures effects of variables not included on the regression. The ECM has been applied in a numerous international studies to examine the impact of international trade on employment and wages in the various sectors of the economy (Davids et al. 2015; Mollick & Wvalle-Vázquez 2006; Rahmanian 2015). Table 3.7 below indicates a specified model for all study objectives.

3.4.2 Granger causality test

The Granger causality test refers to an econometric hypothesis assessment for analysing whether one time series is responsible in causing another, which was first developed in 1969 by Clive Granger. The causality effects in economics are assessed by testing the ability to forecast the future responses of a time series when applying prior values of another time series. Ordinarily, a time series *X* is considered to Granger-cause *Y* if can be displayed using either t-tests or F-tests on lagged series of X, this is applicable when X values show a statistically significant information about future values associated with *Y*. Granger described the causality association depending on two ideologies: (1) the cause takes place prior to its effect; (2) the cause possess an exceptional information about the outlook values of its effect. Depending on these assumptions concerning causality, Granger suggested to assess the following hypothesis for classification of a casual effect of *X* on *Y*.

$$P[Y(t+1) \in A|\mathcal{T}(t)] \neq P[Y(t+1) \in A|T_{-X}(t) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (3.4)$$

Where P is denotes probability parameter, A refers to random non-empty set; while parameters $[\mathcal{T}(t) and\ T_{-X}(t)]$ represent the data available according to time t in the whole model, which includes the augmented model in which X series is incorporated. When the above mentioned hypothesis failed to be rejected, then the interpretation is that X Granger causes Y.

Intuition is that y and x axes are derived from a stationary time series. In order to assess the null hypothesis that x does not Granger cause y:

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + \cdots + a_m y_{t-m} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

The following equation is augmented by incorporating lagged variables of explanatory variables:

$$y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + \cdots + a_m y_{t-m} + b_1 x_{t-1} + \cdots + b_p x_{t-p} + \varepsilon_t + b_q x_{t-q} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (3.6)$$

The model above includes the retention of all lagged values of x that are statistically significant with regards to their t-statistics, for the fact that jointly they supplement explanatory power to the estimation according to an F-test value. Furthermore, the above augmented estimation shows that p denotes the shortest lag, while q represents the longest lag length with regards to its statistical significance.

3.4.3 Two-stage least square (2SLS) regression analysis

The two-stage least square (2SLS) regression model is a statistical approach that is utilised in the modelling of structural equations. There are several studies which have been conducted on the impact of international trade on the labour market with the manufacturing industry, with very few studies conducted on the fruit industry of South Africa or other African countries (Abowd & Freeman 1991; Abowd & Lemieux 1991; Grossman 2018; Lubinga 2014; Mokoena 2011). These studies provided a guidance regarding the relationships between the international trade liberalisation as well as labour relation dynamics in the sectors of the economy, but the empirical results remain inconclusive. The main aim of the study is to analyse the effect of international trade on employment and wages within the fruit industry of South Africa as from 1990 until 2018. Therefore, the two-stage least square model is best suited to address the endogeneity that might arise from the explanatory variables and disturbance term.

The two-stage least was adopted to minimise the intuition that the independent variables correlated with an error term and also its ability to address endogeneity problem. The evidence from literature argues that international trade and labour market variables are endogenous, hence there is a need for instrumental variables which might be lagged or differenced (Felbermayr et al. 2009; Gallup et al. 2008; Hansson et al. 2004). The approach is suitable for secondary data in most instances due to possibility of correlation amongst explanatory variables, dependent variables and disturbance term. Therefore, the ordinary least square would render produce and estimates which are spurious and results that are biased.

The two-stage least square makes use of variables called proxy variables, which are relatively close to endogenous variables. The advantage of proxies is that they are highly correlated with exogenous variables while are not correlated to the disturbance term. It is well documented that the two-stage least square could perform poorly when using fixed samples with weak or many instruments (Easterly & Nyarko 2008; Felbermayr et al. 2009) It is crucial to test the instruments, whether they are strong or weak, as weak instruments render 2SLS estimator more biased than an Ordinary Least Square (OLS) model (Gujarati 2015; Gujarati & Porter 2009; Gujarati 2003; Wooldridge 2013). The general equation for 2SLS is estimated as follows:

$$y_1 = \beta_0 + \beta_1 \hat{y}_2 + \beta_2 z_1 + \cdots + \beta_k z_{k-1} + \varepsilon_1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

The specific equation required to analyse the effects of international trade on employment in the selected fruit (apple, apricot, avocado, oranges, pears and table grapes) sub-categories is expressed below. The approach is not linear as it takes into consideration the logarithms and lagged variables. The equation for employment and international trade includes the first lag of employment as well as log of import output and export output. Gujarati (2015) indicates that 2SLS is an extension of OLS which addresses the problem of endogeneity and multicollinearity.

$$\log(EMPG) = \beta_0 + \beta_1 lnIMPO_t + \beta_2 lnEXPO_t + \beta_4 EMPG_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots (3.8)$$

The same approach is adopted to examine the effects of international trade on wages in the selected fruit sub-categories (apple, apricot, avocado, oranges, pears and table grapes). The equation is adopting similar analysis with the employment formula, where normal series is combined with lagging, logging and differencing of variables. The lag of dependent variable is used to control for endogeneity and biasness of the regression.

3.4.4 Ordinary least squares model

The Ordinary Least Squares (OLS) analytical technique refers to a statistical approach that assesses the relationship between dependent variables and independent variables. The technique assesses the relationship by reducing the sum of the squares between the predicted and observed values of the regressand when arranged as a straight line (Gujarati & Porter 2009).

Statistically, it is practically the sum of the squared detachments, parallel to the axis of the regressand variable, among each individual data point in the dataset and the matching point on the estimation surface. The minor the variations, the better the model fits the dataset. The outcome regressand can be articulated by a simple procedure, more particularly in the situation of a simple linear estimation, where a single regressor is situated on the right side of the estimation equation (Wooldridge 2013).

The OLS regression is reliable when the explanatory variables are exogenous and ideal in the session of linear unbiased estimators, when dealing with errors that are homoscedastic and serially uncorrelated. When the model conforms to all the OLS assumptions, it provides a least variance and unbiased regression when errors consist of finite variances. It is worth noting that errors are normally distributed, in such situation OLS is a normal maximum likelihood estimator. For the purpose of this study, OLS estimation is argued in the perspective of a multivariate regression, which is an estimation consisting of more than one explanatory variables. The general equation for the OLS model is as follows:

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{t2} + \beta_3 x_{3t} + \cdots + \beta_p x_{ipt} + \varepsilon_{it} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.9)$$

Where y_i represents the regressand, *while* i^{th} denotes the observations of all the variables included in the estimation. The parameters x_{1t} until x_{pt} represent all the explanatory variables and ε_{it} denote an error term (unobserved random variables). The error term is responsible for effects of the responses on y_i from factors other than the explanatory variables (x_{1t} until x_{pt}). Therefore, the specific equations for six fruits are detailed below:

Specific model for the apple regression is detailed in Table 3.1 as follows:

$$InVOSAXEU_t = \beta_0 + \beta_1 InWAGO_{1t} + \beta_2 AREAP_{2t} + \beta_3 FDI_{3t} + \varepsilon_i \ldots \ldots \ldots \ldots \ldots (3.10)$$

The description of dependent and independent variables are detailed in Table 3.2, which includes the units of measurement. The specific equation for apricot regression is detailed as follows in equation 3.8:

$$\begin{aligned} InVOSAXEU_t = \beta_0 &+ \beta_1 InWAGO_{1t} + \beta_2 FDI_{2t} + \beta_3 InGRVF_{3t} + \beta_4 InGRVF_{4t} \\ &+ \beta_5 InPOPU_{5t} + \beta_6 InPOPU_{6t} + \beta_7 InNETR_{7t} + \beta_8 InNETR_{8t} \\ &+ \varepsilon_i \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.11) \end{aligned}$$

The narrative of dependent and independent variables are detailed in Table 3.3, which include the units of measurement. The specific equation for avocado regression is detailed as follows in equation 3.9:

$$InVOSAXEU_t = \beta_0 + \beta_1 InWAGO_{1t} + \beta_2 FDI_{2t} + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots \quad (3.12)$$

The description of regressand and explanatory variables are detailed in Table 3.4, which includes the units of measurement. The specific equation for orange estimation is detailed as follows in equation 3.10:

$$InVOSAXEU_t = \beta_0 + \beta_1 InWAGO_{1t} + \beta_2 FDI_{2t} + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots.\ldots\ldots. (3.13)$$

The narrative of dependent and independent variables are detailed in Table 3.5, which includes the units of measurement. The specific equation for pear regression is detailed as follows in equation 3.11:

$$InVOSAXEU_t = \beta_0 + \beta_1 InWAGO_{1t} + \beta_2 PRODT_{2t} + \varepsilon_i \ldots\ldots\ldots\ldots\ldots..\ldots\ldots.\ldots\ldots. (3.14)$$

The description of dependent and independent variables are explained in Table 3.6, which consists of the units of measurement. The specific equation for table grape estimation is provided as follows in equation 3.12:

$$InVOSAXEU_t = \beta_0 + \beta_1 InWAGO_{1t} + \beta_2 FDI_{2t} + \beta_3 InEMPG_{3t} + \beta_4 DRDV_{4t} + \beta_5 DCONS_{5t} + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots.\ldots\ldots. (3.15)$$

Table 3.7 presents five analytical procedures adopted by the study, which is comprised of descriptive statistics, error correction model, granger causality test, two-staged least squares and ordinary least squares. Furthermore, the table also reveals how each analytical technique is linked to the study objectives. The different analytical techniques are specified and described accordingly using mathematical equations and how they address the study objectives.

Table 3. 7: Analytical technique for each objective

Data analysis to address objectives	Model specification	Model description
1st Objective Descriptive statistics	Descriptive statistics using either of the following statistical packages, i.e. EViews or STATA or Microsoft Excel	This will summarise data by providing measures of central tendency which include mean, median, mode, maximum, minimum, standard deviation and skewness.
2nd Objective Error Correction Model (ECM)	$\Delta lnY_{it} = \alpha + \beta_1 \Delta lnX_{1t} + \beta_2 \Delta lnX_{2t} + \beta_3 \Delta lnX_{3t} + \beta_4 \Delta lnX_{4t} + \beta_5 \Delta lnX_{5t} + \beta_6 \Delta lnX_{6t} + \beta_7 \Delta lnX_{7t} + \beta_8 \Delta lnX_{8t} + \beta_9 \Delta lnX_{9t} + \beta_{10} \Delta lnY_{10t-1} + \theta EC_{t-1} + \varepsilon_t$	Where Y is dependent variable, while X_1 until X_k represent the independent variables which are various factors that affect employment. Where t subscript represents a time dimension. Where Δ represents the differencing notation, while ln (log) represents the natural logarithm and Y_{t-1} denotes the lagged variables including dependent variable. The error correction term is denoted by θEC_{t-1}. The disturbance term is represented by ε_t
3rd Objective Granger Causality Test	$y_t = \beta_0 + \beta_1 y_{t-1} + \cdots + \beta_k y_{t-m} + \alpha_0 X_t + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \cdots + \alpha_q X_{t-n} + \varepsilon_t$	Where m and n are lagged time period, ε_t is the error term and β_i's represent coefficient for short run and α_1's represent coefficients for long run relationship.
4th Objective Two-staged Least Square Model	$Q(\beta_q) = \sum_{i:y_i \geq x'_{j\beta}}^{N} q \left\| y_i - x'_j \beta_q \right\| + \sum_{i:y_i < x'_{j\beta}}^{N} (1-q) \left\| y_i - x'_j \beta_q \right\| + \mu_{it}$	Two-staged least squares regression is designed to estimate a relationship between *X* and *Q*, *Q*. $Q(\beta_q)$ is the dependent variable, $\sum_{i:y_i \geq x'_{j\beta}}^{N} q \left\| y_i - x'_j \beta_q \right\|$ represents the different regressors. Where μ_{it} represent the error term.

5th Objective Ordinary Least Square Model	$y_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_k X_k + \beta_2 z_1 + \cdots + \beta_k z_{k-1} + \varepsilon_t$	Where y_{it} is dependent variable, X_2 is suspected to be endogenous and z_1 is exogenous. The z_{k-1} represent lagged proxy variable on X_2 until X_k and ε_t is an error term.

Source: Author's compilation

3.5 Chapter Summary

The chapter presented the data requirements, data management procedures, data analytical techniques and data sources used to estimate the different methods of achieving the study objectives. The chapter commenced with a broad overview of the six fruit industries selected for this study, followed by procedures adapted to measure the effects of international trade on the employment and wages within the selected fruit industries of South Africa. Furthermore, the chapter outlined the procedures used to transform the variables from raw data and to deal with non-stationarity of the data since the study adopted secondary data.

CHAPTER 4
PERFORMANCE AND DESCRIPTIVE STATISTICS OF SELECTED FRUIT SUB-CATEGORIES

4.1 Introduction

This chapter provides a detailed outline on the performance of the South African fruit industry with regard to international trade, employment and wages. The attention of this chapter is to address the first objective. However, due to broadness of the South African fruit industry, then the study focuses on six fruit sub-categories which play a socio-economic contribution to the South African fruit industry at large. The selected fruit sub-categories are drawn from the citrus, deciduous, grapes and subtropical fruits. Therefore, six fruit sub-categories adopted by the study are as follows: apple, apricot, avocado, orange, pear and table grape.

4.2 Apple industry

Apples are classified as vital deciduous fruits cultivated in South Africa, due to its contribution towards employment opportunities, foreign exchange earnings and forward as well as backward linkages with other support industries. In 2017 production season, the apples contributed approximately 5.5 billion of gross value to the South African deciduous fruits. Notably, South Africa has a per capita consumption of 20.66 kilograms per annum for both deciduous and subtropical fruits in 2018 (DAFF 2018; HORTGRO 2018).

South Africa is amongst the dominant apple producers in the southern hemisphere together with Chile, Argentina, Brazil, New Zealand and Australia. This industry is export driven with approximately 50 per cent of its produce being destined for export market. The seasonality difference with countries situated on the northern hemisphere places South African apples on a great competitive situation, as southern hemisphere apples are available during winter and spring of the northern hemisphere (DAFF 2018a). The large proportions of sales are done using contractual agreements through marketing or export companies. The bulk of production is marketed through the dominant international and domestic supermarket chain stores. Despite the industry supplying international and local consumers, marketing as well as exporting companies facilitates transactions because of profit for maximisation for themselves as well as the apple production companies. The prices are determined by market forces (demand and supply), since this industry was deregulated in 1997 (DAFF 2018a).

South African apple industry contributes significantly to direct employment during production, value adding and processing. Other permanent indirect employment opportunities are created at the ancillary and support industries such as packaging, logistics, bottling, cartons, cold chain management, etcetera. Furthermore, casual employment opportunities are generated during production process in areas where apples are produced. During the period of 2017/18, the estimated number of permanent direct employment with this industry was 27 297 people with 109 187 dependents (DAFF 2018a).

Majority of permanent workers employed by the apple industry are rendering specialised tasks such as supervision, irrigation management, pests and diseases control, operating farm machinery (mostly forklift and tractors), pruning of trees and daily technical duties. Furthermore, employees are expected to perform thinning activity during blooming. The casual employees are normally required for short periods of time for harvesting purposes.

The wage structure of this industry is regulated by the Minimum Wage Act which was implemented from January 2019. The Minimum Wage Act is applicable to all workers including those employed in value chain process of the fruit industry. The Act prescribed that farm employees are eligible to receive a minimum wage of R18 per hour, which is equivalent to R144 per day and R2 880 per month. However, this is subject to farm employees working for 8 hours per day and 20 days per month, but if employees are working extended hours they must be paid overtime allowance. A majority of farms specialising in apple production are export-oriented and that requires employees to work overtime and often create new employment opportunities to casual employees. Under the Act, there is a provision for establishment of the National Minimum Wage Commission, which is responsible for continuously reviewing the national minimum wage and providing recommendations to the Minister of the Department of Employment and Labour (DEL) on justifications for proposed adjustments (DAFF 2018a; Lubinga & Phaleng 2018).

4.2.1 The analysis of apple industry value chain

The apple industry value chain is amongst the biggest contributor to the economy of South Africa due to its potential to create permanent and seasonal employment opportunities in most remote rural areas. Furthermore, the industry is contributing in growing South Africa's export base and gross domestic product (GDP). Domestic apples are marketed through four channels which include international markets, processing, domestic wholesalers as well as supermarket chain stores and fresh produce market. The intuition is that all four marketing channels are responsible for additional employment opportunities and wages which are critical to support the livelihoods of many independents. More than 60% of the harvested apples are sold for fresh consumption through retailers and fresh produce markets. The continuous development in the global value chains brought a huge competition in the industry, which resulted in keeping some countries (developing countries) as the supplier of the primary products while others are manufacturers (developed countries). Figure 4.1 below shows the schematic explanation of the apple value chain (DAFF 2018).

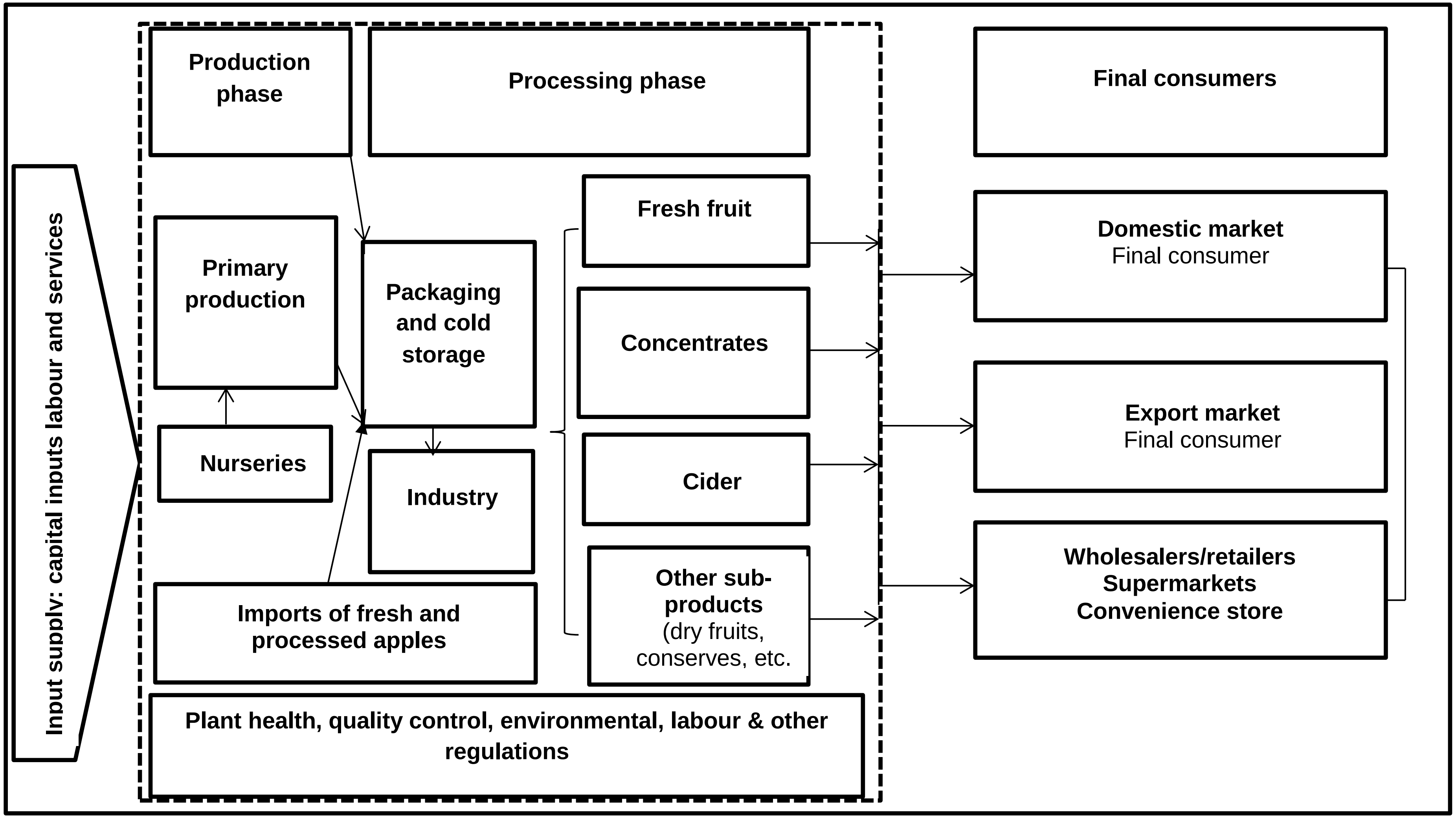

Figure 4. 1: The apple industry value chain
Source: Author's computation

4.3 Apricot industry

The South African apricot industry is well developed industry, with a general objective of providing quality apricots to the downstream markets such as drying, processing and value adding. Over 50 per cent of South African apricots are destined for processing and canning, thereafter are exported to several international destinations. The large chunk of sales to customers is conducted through the use of contractual agreements with the large lead international and domestic supermarket chain stores. Furthermore, several export agents perform transactions on behalf of producers and packers in various lucrative markets. During 2017 season, there was approximately 2 808 hectares (ha) of apricots planted in South Africa, which altogether contributed 3.5% of the entire hectares planted for deciduous fruits (79 912 ha). However, the area planted with apricots dropped by almost 20 ha between 2016 and 2017, this is attributed to climate change and imports of apricots products from countries with more competitive edge (DAFF 2018b).

The South African apricot industry provides a significant contribution to direct permanent employment in primary and processing phases. The industry has backward and forward linkages with other industry, hence it generates indirect employment opportunities in apricots producing areas. During 2017 production season, the industry generated approximately 3 342 permanent direct employment with over 13 367 dependents. There was a slight decline of two per cent in the number workers employed in the apricot industry as compared to 2016 season (DAFF 2018b).

Similar to other agricultural enterprises, the wages for apricot workers are regulated by the Minimum Wage Act 9 of 2019 which became effective from January 2019. The employers are obliged to remunerate workers accordingly; hence farm workers are expected to receive at least R18 per hour according to this Act. Under this Act, the National Minimum Wage Commission has been established to periodically review the national minimum wage taking into consideration key factors of the economy such as inflation rate, consumer price index, exchange rates and producer price index. Thereafter, the recommendation should be tabled to the minister responsible for employment and labour.

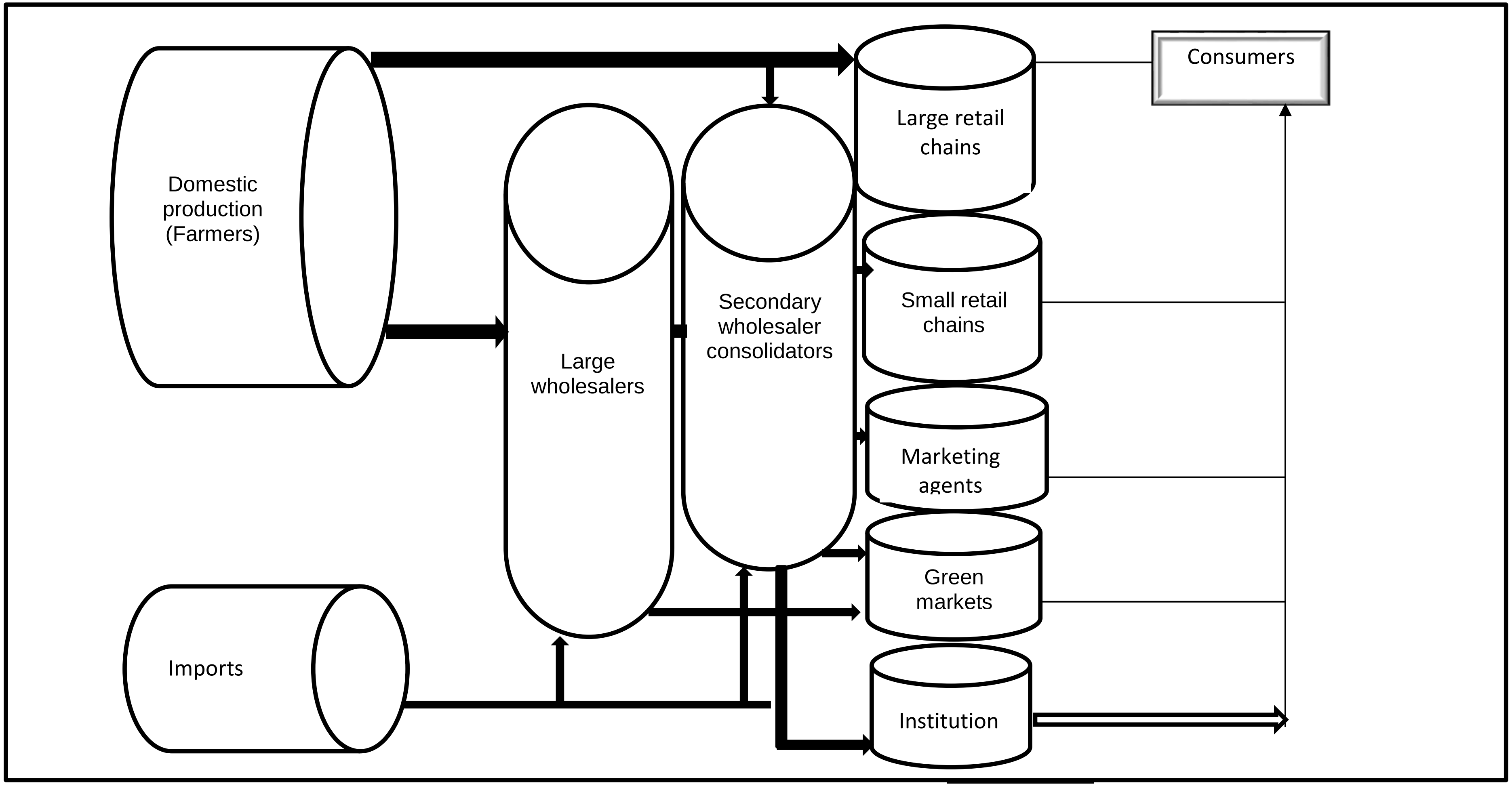

Figure 4. 2: The apricot industry value chain
Source: Author's computation

4.4 Avocado industry

The South African avocado production is an established industry which is export driven and European Union countries are its traditional market. The favourable areas of production are mainly warm subtropical regions of South Africa such as northern Limpopo, Mpumalanga and Kwa-Zulu Natal provinces. The variation on climatic conditions in the growing areas provides the country an opportunity to have an extended production period for most of the main cultivars (DAFF 2018c). South Africa is able to produce quality avocados from February to November, due to climatic variations in different production areas. During the 2017 production season, approximately 45 percent of South African avocadoes were destined to export market, while at least 21 percent was distributed at the national fresh produce markets and the remaining chunk were released to informal markets which are dominated by hawkers as well as other retailing outlets (DAFF 2018c).

South Africa has experienced an increase in total area planted with avocado, during the 1970s the country had at least 2 000 hectares which increased to more than 12 500 in 2016/17 (DAFF 2018c). The industry is completely deregulated since 1997 and prices are determined solely by demand and supply. The industry's body for avocado is called the South African Avocado Growers Association (SAAGA). This industry body was established in the late 1960s with a mandate to enhance the economic viability of the entire avocado value chain (from production until products reaches the final consumers). Furthermore, the industry body is increasing the competitiveness, profitability, sustainability and viability of the South African avocados. It has a membership of more 500 avocado producers, who are responsible for approximately 85 per cent of the South African avocado production. As postulated by DAFF (2018c), the industry is focusing on diversifying its export markets, developing private cultivars, integrating fruit production, building capacity of downstream industries, growing domestic markets and venturing into new markets.

The South African avocado industry plays a fundamental role when it comes to employment creation in the entire South African fruit industry, in which a majority of these employment opportunities are generated in the rural areas. As posited by DAFF (2018), the avocado industry is responsible for approximately 23 000 permanent and casual workers in 2018. The dependency of household members on the employees of this industry is estimated at 36 000 on an annual basis (DAFF 2018c).

Similar to other agricultural industries, South African avocado industry remunerates its employees using the national minimum wage as prescribed by the Minimum Wage Act 9 of 2019. The farm employees under this Act are eligible to receive a minimum wage of R18 per hour. Any violation of the minimum wage law is reported to the National Minimum Wage Commission or the Department of Employment and Labour (DAFF 2018c).

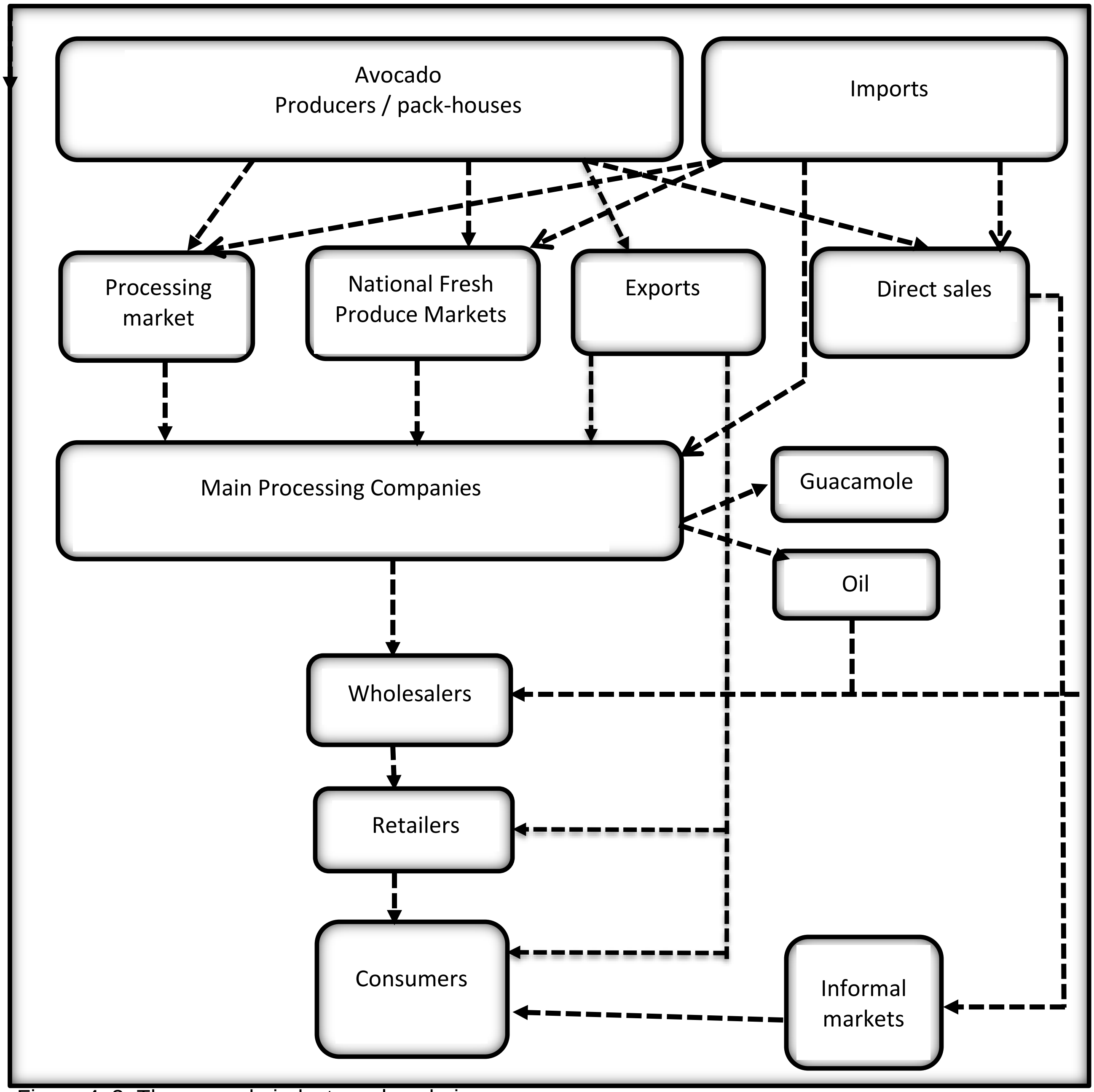

Figure 4. 3: The avocado industry value chain
Source: Author's own computation

4.5 Orange industry

The orange industry is falling under the citrus industry, in which the industrial representative body is the Citrus Growers Association (CGA). The citrus industry is considered to be amongst the third largest fruit industry contributing to international trade and employment. The orange industry has experienced challenges with respect to phytosanitary measures emanating from countries testing for Citrus Black Spot (CBS), these challenges were more prevalent within the EU market. South African citrus industry contributed at least R19.1 billion to the entire gross value of agricultural production in 2017 (DAFF 2018d). Furthermore, this industry contributed at least 25% (R57.3 billion) of overall gross value of horticultural industry during 2017 period (DAFF 2018d).

Collectively, the South African citrus industry is considered labour intensive industry which employs approximately 100 000 employees, in which the majority of people are employed in the orchards and packing facilities. The indirect permanent employment opportunities are generated by the support industries such as allied services, logistics, port handling, packaging, etcetera. As postulated by DAFF (2018d), over one million households are depending on this industry for livelihood survival.

The remuneration structure for citrus workers is regulated by the Minimum Wage Act 9 of 2019, which prescribes that any farm worker is eligible for an amount R18 per hour. Compliance with this regulation is non-negotiable as government has established a National Minimum Wage Commission to deal with issues and is empowered to make adjustment recommendations with minister of Department of Employment and Labour (DAFF 2018d).

4.5.1 The value chain analysis of the orange industry

The breakdown analysis of the orange marketing value chain starts on pre-planting phase which include the development of the varieties, soil type analysis and research component to maximise the profit, then the value chain continues until it reaches the final consumers. Post-harvest oranges are channelled through the different marketing channels which include amongst others fresh produce market, export market, wholesale, supermarket chain stores, processing, etcetera. Development and growth of global value chains accelerated competition in the fruit industry which influenced the usage of mechanisation, which has negative impact on employment creation.

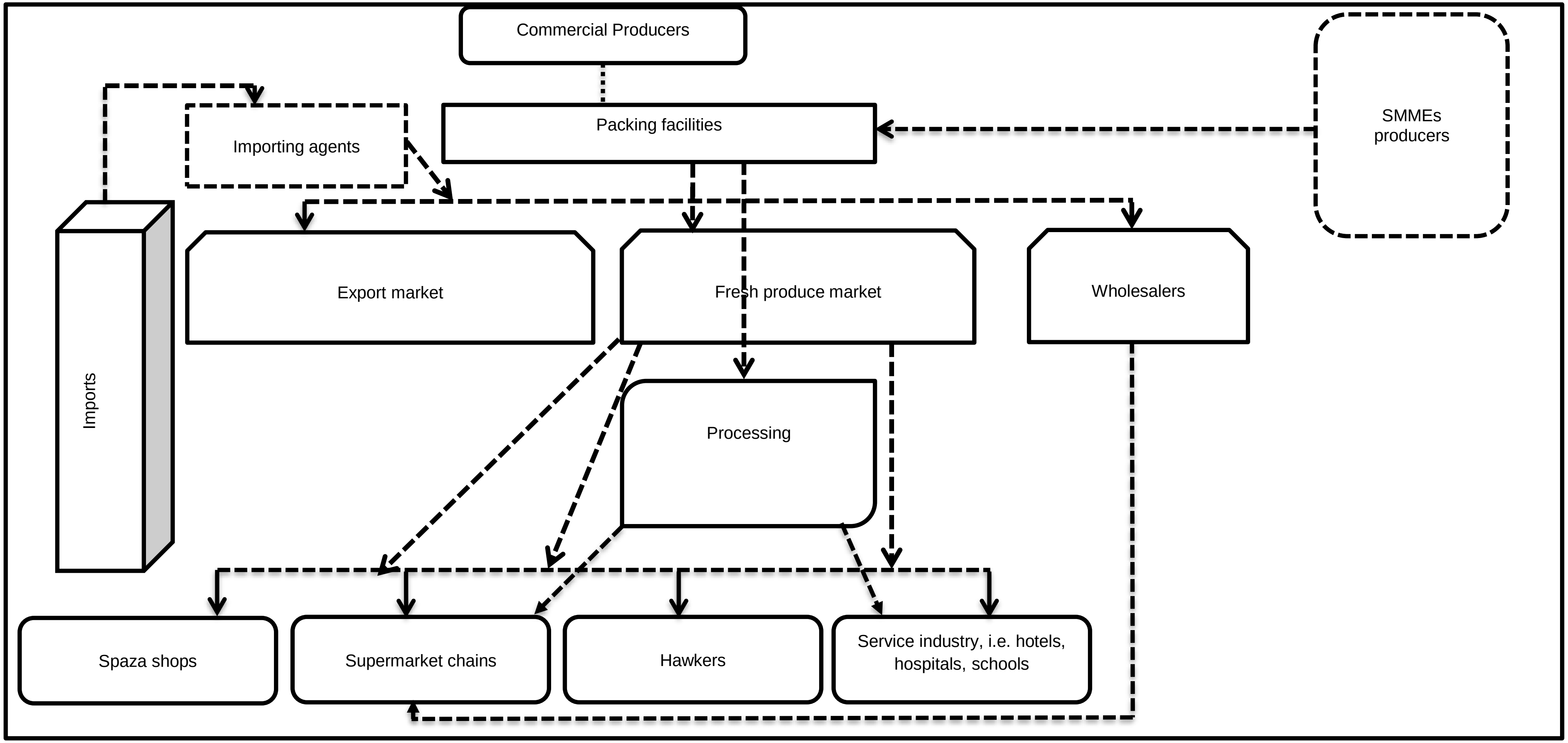

Figure 4. 4: The orange industry value chain
Source: Author's computation

4.6 Pear industry

The South African pear industry is amongst the essential deciduous fruit which contributes significantly to employment generation, earnings of foreign exchange and its interlinkage with other supporting industries such as logistics, cold chain, packaging, etcetera. In 2018, this industry contributed at least 14.1% (R2.7 billion) of the entire gross value of the South African deciduous fruits which is approximately R19 billion. As postulated by (DAFF 2018e), an average per capita consumption of both deciduous and subtropical fruit is estimated to be 20.6 kilograms per annum. Furthermore, the South African pear industry is export-driven and over 50% of pear production is destined to the export market. The prices are controlled fully by the market forces (DAFF 2018e).

The pear industry provides permanent employment opportunities to many South Africans and foreign internationals through its entire value chain. South African pear industry also creates indirect employment opportunities in most of the ancillary and support industry such as value addition, packaging, logistics, etcetera. During the 2017 season, the industry was responsible for 13 124 permanent employment with 52 495 dependents. According DAFF (2018e), the number of people employed in the pear industry decreased by at least 1.1 percent in 2017 production season as compared to 2016 season.

The employees of this industry are also remunerated according to the prescripts of the National Minimum Wage Act 9 of 2019. The Act makes provision for farm workers to receive a minimum wage of at least R18 per hour. Failure to comply with this regulation could result in employers being reported to the National Minimum Wage Commission or either the Department of Employment and Labour and the Department of Agriculture, Land Reform and Rural Development (DAFF 2018e).

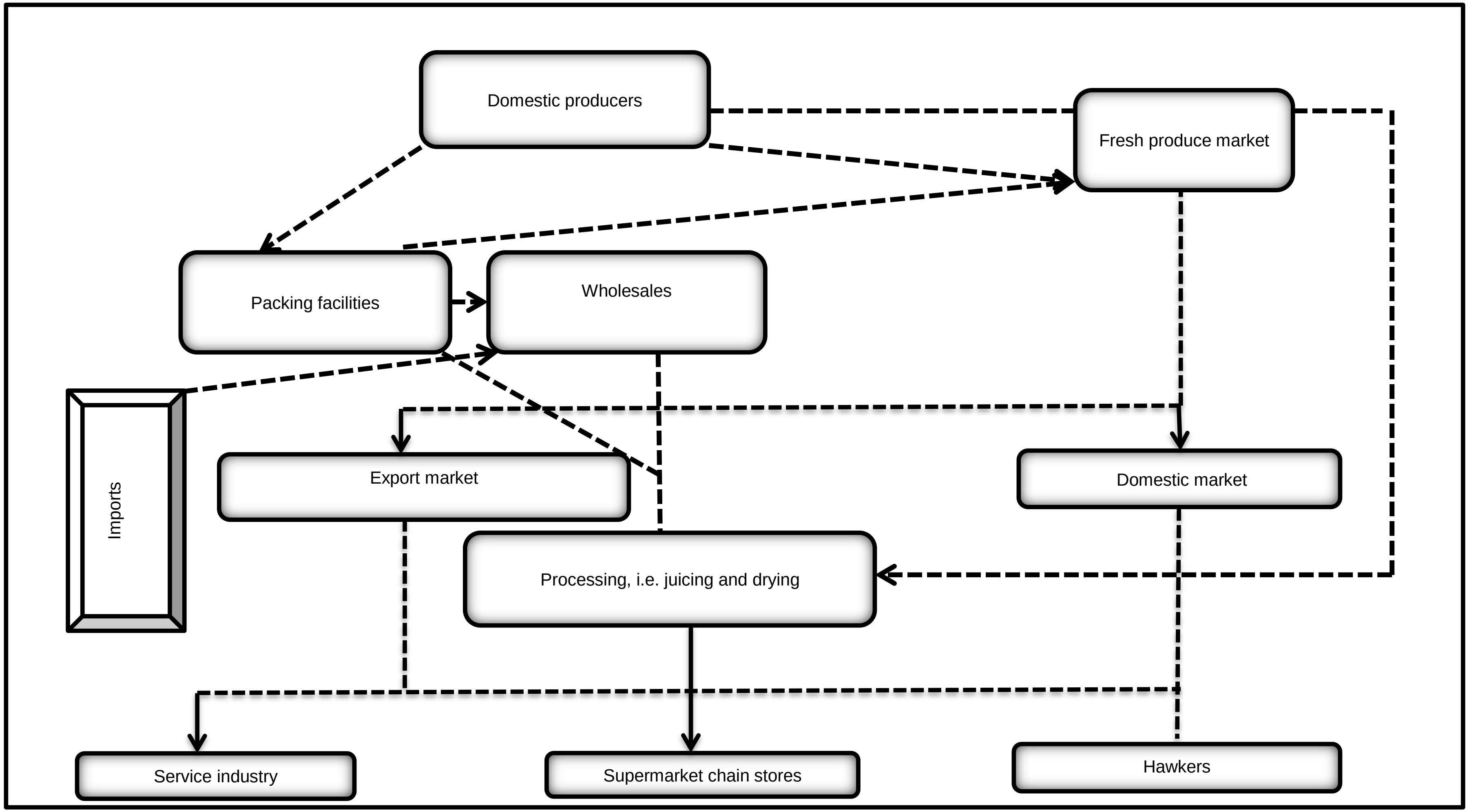

Figure 4. 5: The pear industry value chain
Source: Author’s computation

4.7 Table grape industry

Members of the South African Table Grape Industry (SATGI) are producing to cater for both domestic and international market. This industry is a reliable and stable supplier of table grapes in the European Union countries and the United Kingdom. Furthermore, the industry grows grapes for various usages such as fresh distribution, dried fruit market, pressing and other downstream usage. Contrary to wine grapes, table grapes are normally preferred to be consumed when fresh. Nonetheless, table grapes are characterised by low sugar content as compared to wine grapes and are more flavourful when consumed fresh. During winter season in the northern hemisphere, which is their off-season for table grapes, the South African table grapes become available for their consumers. The industry has suffered a decline in production from 2014, 2015 and 2016, respectively. According to DAFF (2019), South African Table Grape Industry is considered to be amongst the essential part of deciduous fruit sector planted in South Africa, due to its enormous contribution to employment creation, foreign exchange earnings and its linkage with other downstream industries. For example, the industry is contributing significantly to indirect employment in the agri-tourism in most production areas appearing in Table 4.1. In 2018, the contribution of both table and dry grapes was 29% (21 798 ha) of the entire area planted to deciduous fruits (75 850 ha) in South Africa.

The total employment number for both permanent and seasonal employees is presented in Table 4.1, which shows employment figures by production regions as well. The industry was responsible for 9 752 permanent and 49 501 seasonal employees in 2018 production season (DAFF 2019). The employees were responsible to support the livelihoods of approximately 183 836 dependents. The employment figure increased by 17 percent in 2018 production season (9 752) as compared to 2017 production season (8 339). The spike in employment figures in the South Africa table grape industry is providing a much needed boost to curb the higher unemployment rate in South Africa (DAFF 2019).

Table 4.1: The employment numbers in the table grape industry, 2017-2018

Production region	*2017*		*2018*	
	Seasonal	*Permanent*	*Seasonal*	*Permanent*
Berg River	11 719	1 916	10 896	2 169
Hex River	7 467	3 104	8 360	3 417
Northern Provinces	7 165	1 100	9 325	1 468
Olifants River	4 488	804	3 994	723
Orange River	12 415	1 415	16 926	1 975
Total	43 254	8 339	49 501	9 752

Source: SATGI statistical yearbook, 2019

The number of seasonal employees required depends largely on the quantity of fruit to be harvested during that production season. The permanent employees are needed mainly to perform more specialised activities such as grafting, irrigation management, pests control, trimming, thinning, supervision, pruning, maintenance and operation of machinery. Similar to other agricultural industries, wages are determined based on the Minimum Wage Act 9 of 2019, which became effective in 2019. The farm employees are eligible to receive an amount of R18 per hour, hence failure to adhere to this regulation could lead to a farm worker or their representative approaching the National Minimum Wage Commission.

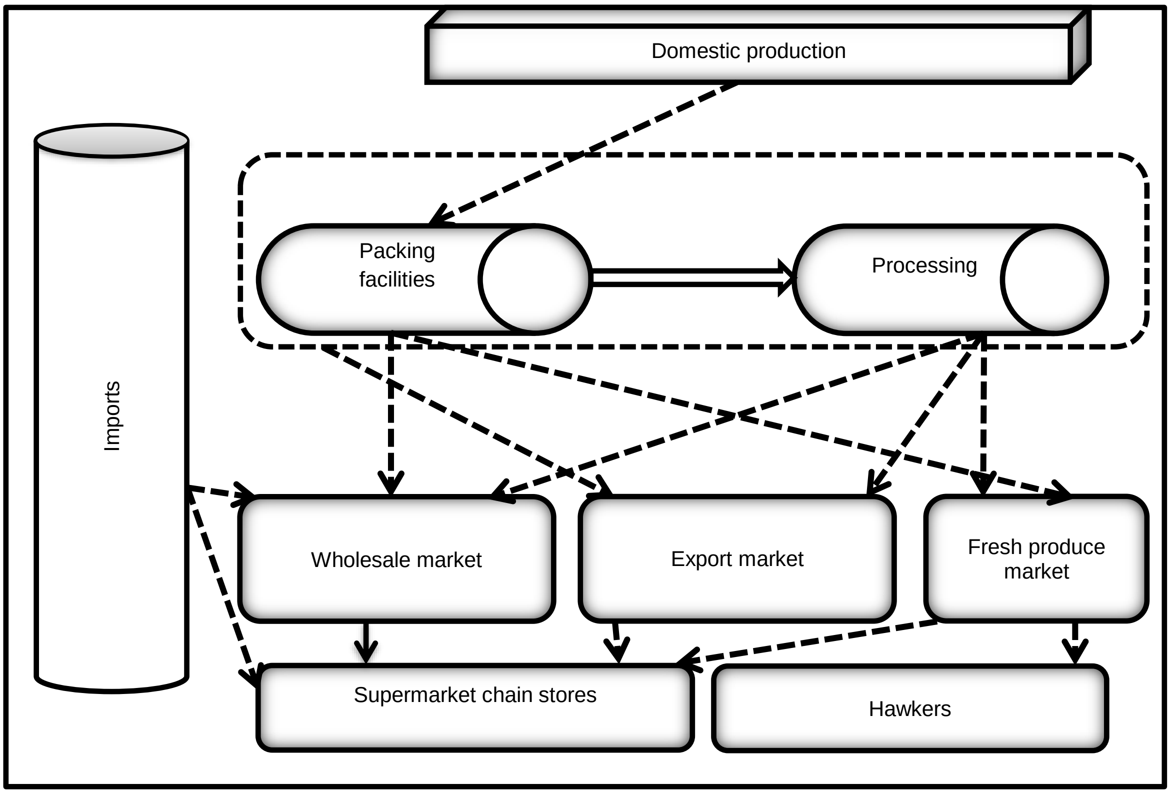

Figure 4. 6: The table grape industry value chain
Source: Own contribution

4.8 Chapter Summary

The chapter presented the detailed outline on the performance of the South African fruit industry with regard to international trade, employment and wages. Furthermore, the chapter addressed the first objective, which was mainly about profiling the South African fruit industry, more particularly the six selected fruits. The findings from this section are that all the selected six fruit industries are of economic importance to the country, since they play a critical role in generating employment, serve as a source of income and contribute to international trade.

CHAPTER 5
DESCRIPTION OF THE STUDY AREA

5.1 Introduction

This chapter provides detailed information regarding the study area of selected fruit industries such as apple, apricot, avocado, orange, pear and table grape. The concentration of the study is South Africa, which is officially known as the Republic of South Africa. It is situated at the most southern tip of Africa as depicted in Figure 5.1. The country is sub-divided into nine provinces (Eastern Cape, Free State, Gauteng, Kwa-Zulu Natal, Limpopo, Mpumalanga, Northern Cape, North West and Western Cape). It has a coastline of about 2,798 kilometres, which is made of Atlantic Ocean on south-west and Indian Ocean on south-east. As shown on Figure 5.1, South Africa is sharing boarders on the north-western part with Botswana, Namibia and Zimbabwe, while on the north-eastern part is neighboured by Mozambique, Swaziland and Zimbabwe. Lesotho is an enclave which is surrounded by the South African territory (Peter 2017; Shoko 2014).

Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape and Western Cape provinces are the main fruit producing regions of South Africa. The fruit production regions are depicted by purple colour on Figure 5.1 below, which indicates that majority of fruits are produced in the Western Cape, followed by Limpopo, Eastern Cape, Kwa-Zulu Natal, Mpumalanga and Eastern Cape, respectively. South Africa produced approximately 4.7 million tons of fruits in 2017, of which 59% was exported, whereas 29% was used for processing and 12% was consumed in local market (Phaleng & Ntombela 2018).

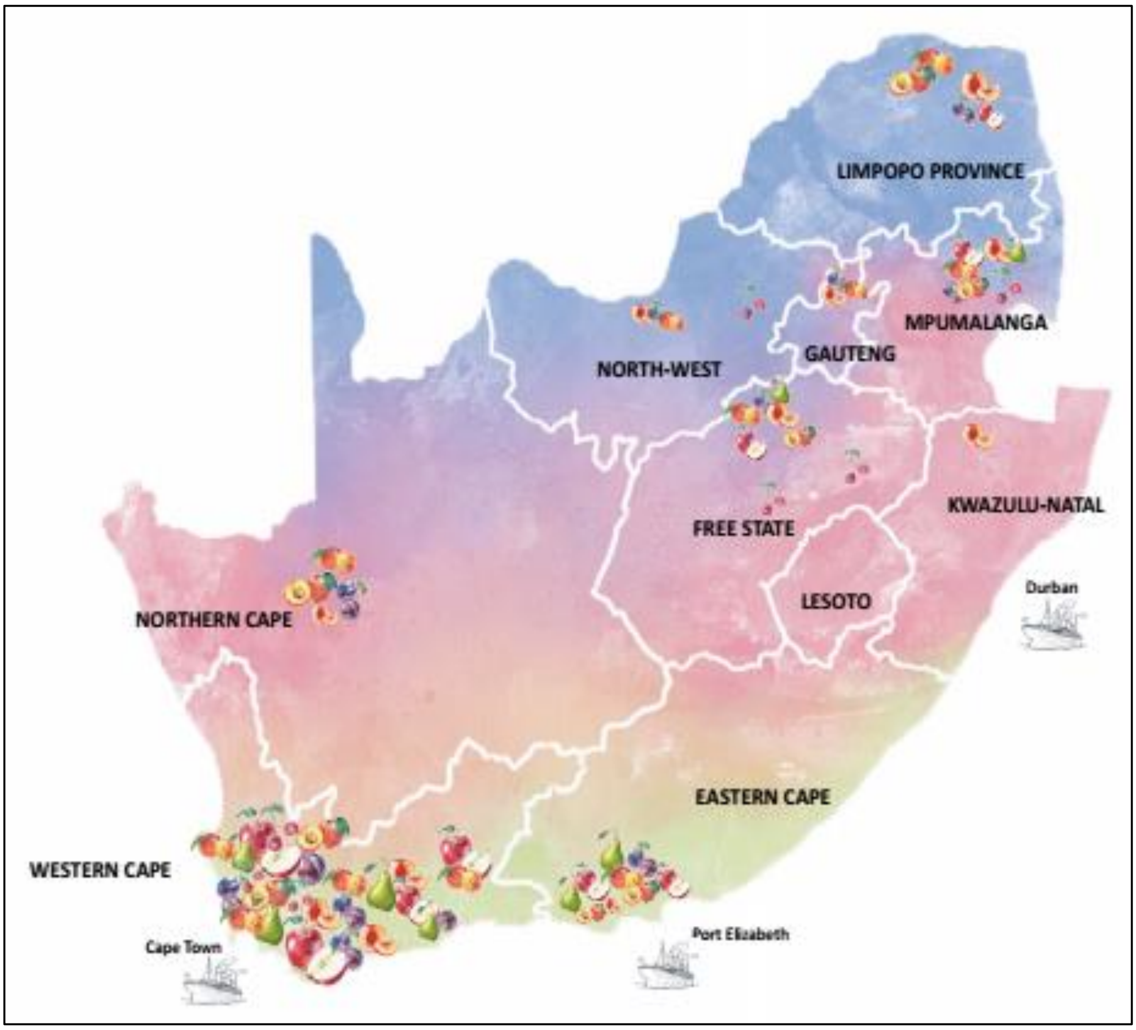

Figure 5. 1: South African fruit production regions
Source: Hortgro key deciduous fruit statistics, 2018

5.2 Production of apple

There are three provinces producing apples in South Africa, which are the Western Cape, Eastern Cape and Free State provinces; this is attributed to their climatic as well as soil conditions. The dominant apple production areas in the Western Cape are Ceres, Groenland and Villiersdorp (DAFF 2018a). In the Eastern Cape, apples are produced predominantly in Langkloof. However, the Western Cape alone accounts for more 50 per cent of apple produced in South Africa. Table 5.1 shows that the biggest three apple producers in South Africa are Ceres with approximately 10 944 132 trees, followed by Groenland with 9 199 178 trees and Villiersdorp with 4 753 408 trees respectively (DAFF 2018a).

Table 5.1: Production of apple in South Africa

	2018	
Production region	*Number of trees*	*Areas (Ha)*
Ceres	10 944 132	7 461
Groenland	9 199 178	6 517
Villiersdorp	4 753 408	3 784
Langkloof East	4 087 783	3 412
Langkloof West	1 144 792	891
Free State	726 853	486
Southern Cape	762 407	478
Klien Karoo	332 444	311
Piketberg	434 641	296
Mpumalanga	275 739	195
Somerset West	443 029	184
Northern Cape	52 766	51
Worcester	82 978	48
Tulbagh	35 447	26
Eastern Cape	3 739	15
Stellenbosch	20 869	15
Paarl	6 221	4
Franschoek	3 036	2
North West	528	1

Source: Hortgro statistics booklet, 2018

5.3 Production of apricot

The dominant apricot production area in South Africa is the Western Cape Province. The main reason is that apricot production requires a Mediterranean type of climatic conditions, which are comprised of cold winter and hot dry summer. The major production area within the Western Cape Province is the Little Karoo, which accounts for approximately 78% (2196 ha) of the entire area planted to apricots in South Africa (DAFF 2018b). Table 5.2 presents the apricot production areas in South Africa.

Table 5.2: Production of apricot in South Africa

	2018	
Production region	*Number of trees*	*Areas (Ha)*
Klein Karoo	1 412 523	2 108
Piketberg	80 584	120
Ceres	104 935	115
Worcester	66 849	93
Langkloof West	45 395	65
Langkloof East	32 724	50
Villiersdorp	40 574	48
Southern Cape	20 489	30
Paarl	15 780	27
Tulbagh	21 676	26
Northern Provinces	22 942	21
Upper Orange River	7 245	9
Mpumalanga	4 936	8
Cape Town	3 690	6
Eastern Cape	2 902	5
Free State	700	3
Stellenbosch	2 577	2
Total	**1 886 521**	**2 737**

Source: Hortgro key deciduous fruit statistics, 2018

5.4 Production of avocado

The South African avocado production is mainly taking place in the warm subtropical areas of the Limpopo and Mpumalanga provinces, which are concentrated in the north-east region of the country. Avocados production requires an area with higher annual rainfall, but there are some orchards situated in semi-arid areas with a mild rainfall per annum. As highlighted by DAFF (2018), approximately eight percent of commercial avocado orchards in the Kwa-Zulu Natal province where the climatic conditions are cooler. The difference in climatic conditions in South Africa makes it possible for different cultivars to be available for extended period of time. For instance, ‘Fuerte’ cultivar is ready for harvest in the middle of March to the end of May in both Limpopo and Mpumalanga, while is harvested between July and August in the Kwa-Zulu Natal province (DAFF 2018c). Figure 5.2 shows the avocado production areas in South Africa.

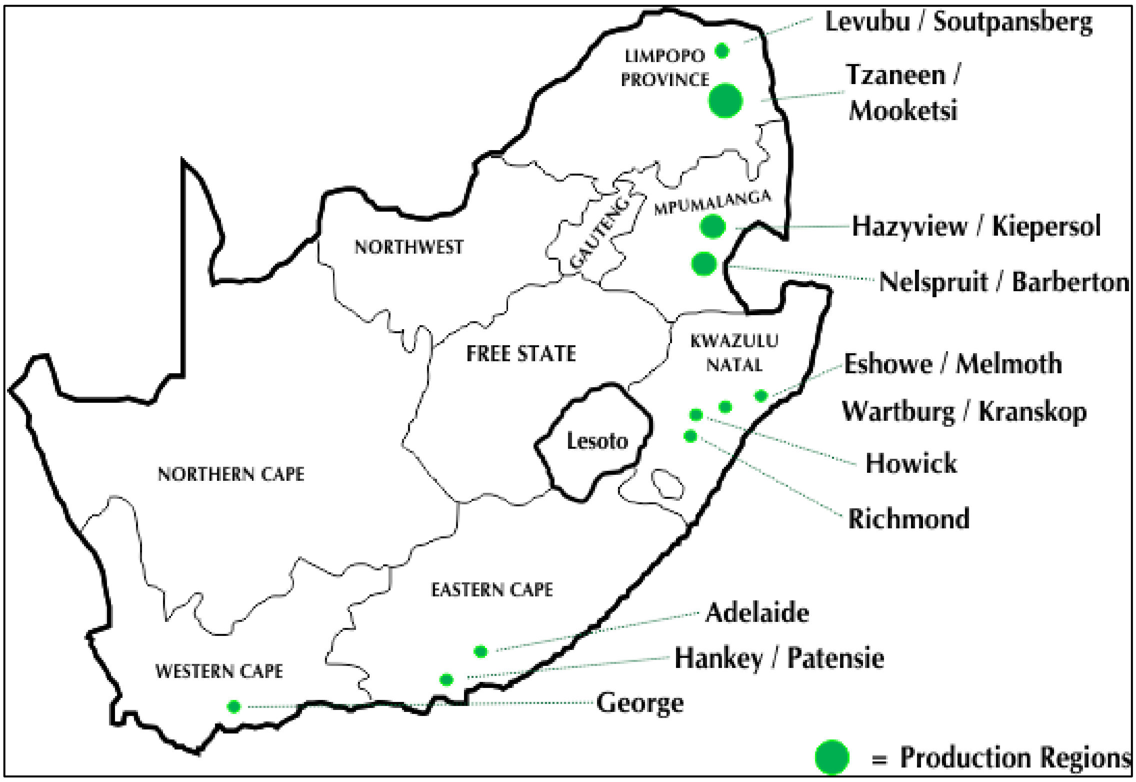

Figure 5. 2: Production of avocado in South Africa
Source: The South African Avocado Growers' Association, 2019

5.5 Production of orange

The oranges are regarded as the most essential fruit industry in South Africa by value and quantity. The South African oranges are produced predominantly in Limpopo, Western Cape, Mpumalanga, Eastern Cape, Kwa-Zulu Natal and Northern Cape, respectively. The dominant orange producing regions in Kwa-Zulu Natal province are as follows: Kwa-Zulu Natal Midlands, Nkwalini and Pongola. The production areas in the Western Cape include Boland region and Ceres area. There were approximately 77 708 ha of land under citrus cultivation in South Africa during 2017 production season (DAFF 2018d). The oranges in Limpopo province are produced in Groblersdal, Hoedspruit, Letsitele, Vhembe and Zebediela. In Mpumalanga province the major orange production areas are Nelspruit, Onderberg and Senwes while in the Eastern Cape are Eastern Cape Midlands, Patensie and Sundays River Valley (DAFF 2018d).

The production of oranges is scattered around different provinces due to variations in climatic conditions suited for various cultivars. The cooler citrus producing provinces in South Africa are considered to be Eastern Cape and Western Cape, which are focusing on producing Navel oranges. The production from both the Eastern Cape and Western Cape are supplying the market for easy peelers. These provinces are characterised by smaller farm sizes which normally harvested by hired cooperatives (DAFF 2018d).

The production in Limpopo, Kwa-Zulu Natal and Mpumalanga caters for cultivars such as Valencia oranges which are suited for warmer climatic conditions. The normal farm sizes in these regions are bigger and majority of producers use privately owned packing facilities which have a smaller capacity (DAFF 2018d). Figure 5.3 presents the orange production areas in South Africa.

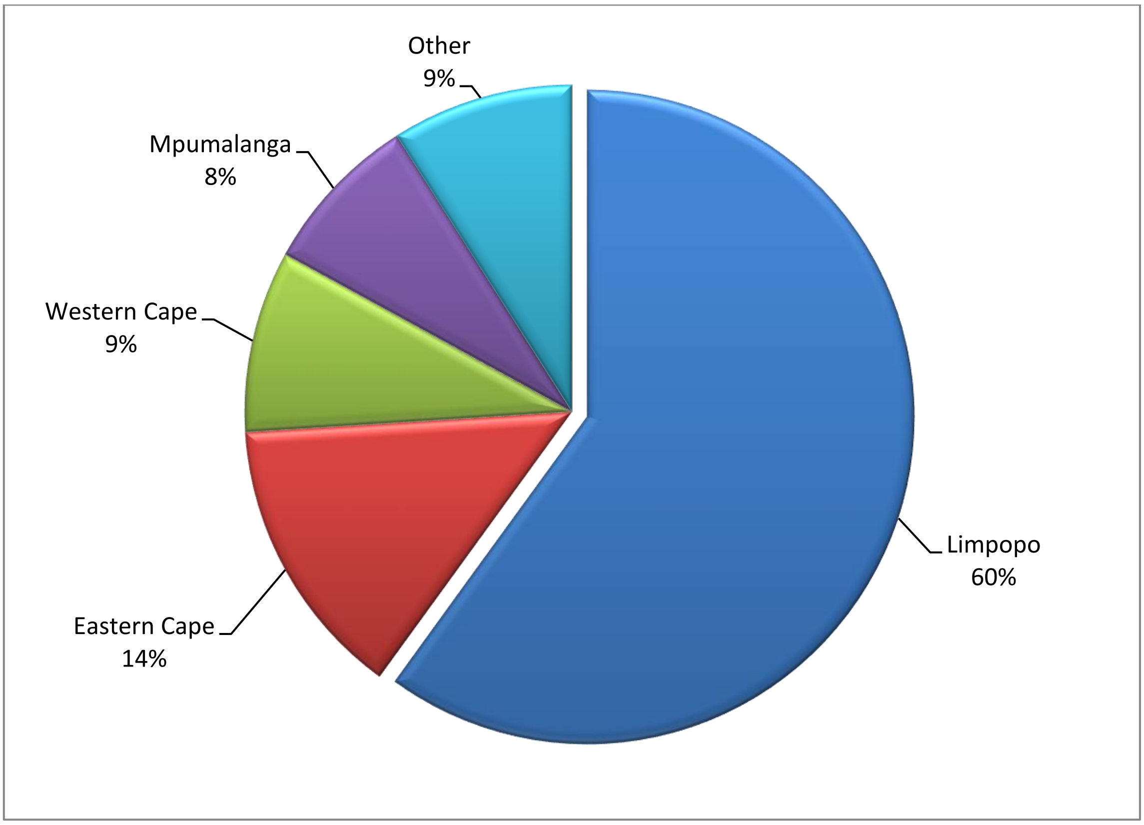

Figure 5. 3: Production of citrus in South Africa
Source: Citrus growers' association, 2019

5.6 Production of pear

The two main pear producing provinces are the Eastern Cape and Western Cape. The production regions in the Western Cape are as follows: Ceres, Groenland, Tulbagh, Vyeboom, Klein Karoo, Langkloof West, Piketberg, Southern Cape and Somerset West. Furthermore, over 50% of the pears produced are coming from the Western Cape Province. The main pear production area in the Eastern Cape is only Langkloof East (DAFF 2018e). Table 5.3 presents the pear production areas in South Africa.

Table 5.3: Production of pear in South Africa

	2018	
Production region	*Number of trees*	*Areas (Ha)*
Ceres	6 067 440	4 577
Langkloof East	2 149 711	1 696
Tulbagh	2 156 928	1 506
Groenland	2 165 551	1 430
Villiersdorp	1 576 799	1 090
Klien Karoo	1 004 944	930
Langkloof West	287 946	238
Piketberg	245 395	202
Southern Cape	229 804	167
Somerset West	294 004	150
Worcester	181 608	128
Paarl	144 088	99
Stellenbosch	117 169	83
Franschoek	17 796	13
Eastern Cape	10 470	11
Mpumalanga	858	1
Total	16 650 511	12 319

Source: Hortgro key deciduous fruit statistics, 2018

5.7 Production areas for table grape

The dominant production province for table grapes in South Africa is the Western Cape Province. The detailed production areas are as follows: Berg River, Hex River, Limpopo Province, Olifants River and the Orange River. As postulated by

DAFF (2019), the entire area planted to table grapes is equivalent to 21 789 ha. During 2018 production season, the Hex River contributed approximately 30% (6 619 ha) of the entire area (21 789) planted to the South African table grapes. After Hex River it was Orange River and Berg River with approximately 28% and 24% respectively (DAFF 2019). The contribution emanating from both Limpopo Province and Olifants River are 2 589 ha (12%) and 1 185 ha (5%) respectively, which makes them to be considered the least contributors of table grapes in terms of area planted in 2018 (DAFF 2019). Figure 5.4 presents the table grape production areas in South Africa.

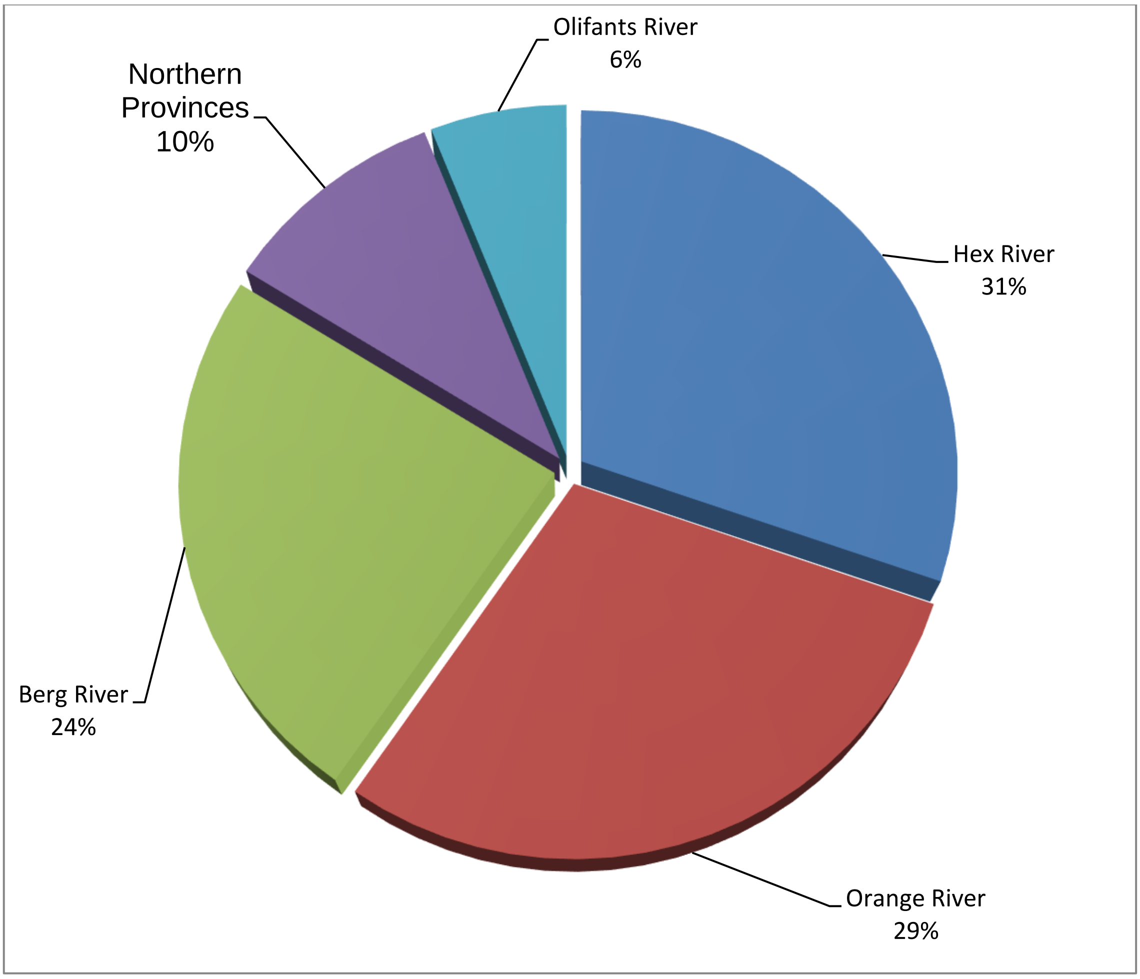

Figure 5. 4: Table grapes production areas in South Africa
Source: South African Table Grape Industry statistics, 2019

5.8 Chapter Summary

The chapter presented study areas for the entire South African fruit industry and detailed information about the selected six fruit industries. The study highlighted that the Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape and Western Cape provinces are the main fruit producing regions of South Africa. The chapter provided detailed information regarding the tonnages coming from each fruit producing province. Furthermore, the chapter indicated the contribution of each fruit industry to both international trade and labour market.

CHAPTER 6
RESULTS AND DISCUSSIONS

6.1 Introduction

This chapter provides detailed findings and discussion of the effects of international trade on employment and wages within the six selected fruit industries of South Africa. The first results presented are descriptive statistics, which addresses the first objective about outlining performance of the South African fruit industry in terms of employment, international trade and wages. Secondly, the error correction model (ECM) is dealing with the second objective which is concerning the analysis of the impact of international trade flow on employment and wages in prioritised six fruit industries. Thirdly, the granger causality test (GCT) focuses on determining the causality effect amongst employment, wages and exports in six South African fruit industries. Fourthly, the two staged least square (2SLS) focuses on determining the response of employment, exports and imports on variations in wages within six South African fruit industries. Lastly, the ordinary least square (OLS) concentrates on determining the effect of European Union's Trade Development and Cooperation Agreement (TDCA) on wages in the South African fruit industry.

6.2 Descriptive statistics

This section outlines basic feature of dataset adopted in the study. The descriptive paint summaries of a sample and guides the selection of inferential techniques. Furthermore, it offers various indicators to clarify the type of data in use. Therefore, always when a large set of data is described with a particular indicator, there is the risk of misrepresenting the original dataset (Gujarati 2015: 6-10).

6.2.1 Apple

The minimum total employment of apple estimation is equivalent to 23 thousand, while its maximum value is about 29 thousand; the average value is 26 thousand and standard deviation is equivalent to 2 thousand. The implication is that apple is amongst the biggest contributor towards total employment within the fruit industry. Table 6.1 shows that the minimum exports output (South African Rand) is ZAR 202 billion, the maximum exports output is ZAR 527 billion, mean is about ZAR 277 billion and standard deviation is equivalent to 168 thousand. The minimum imports output is about zero, while the maximum imports output is equivalent to ZAR 10 million, the mean is about ZAR 1.5 million and the value of standard deviation is equivalent to 24 thousand.

Table 6.1 highlights that the minimum wage output is about zero, the maximum wage per month is about ZAR 3 thousand, while average wage output is about ZAR 1.5 thousand and standard deviation is equivalent to one. The least total gross value of production (TGVP) is ZAR 39 billion, while the maximum value is about ZAR 61 billion; the average value of TGVP is ZAR 43 billion and standard deviation is equivalent to 191. The minimum production volumes for apple industry are about 40 million tonnes; the maximum production volumes are equivalent to 95 million tonnes, the average production volumes are about 67 million tonnes and the standard deviation is about 662. The average area planted with apple is 22 million hectares, while the minimum area planted is equivalent to 20 million hectares, the maximum area planted is about 27 million hectares and standard deviation is 219. As illustrated in Table 6.1, the average volume of South African apple exports to EU are about to ZAR 79 billion, the minimum apple exports to EU are equivalent to zero, the maximum exports to EU are equivalent to ZAR 183 billion and the standard deviation is about the 976.

Table 6. 1: Summary statistics for the apple industry

Descriptive Statistics	*Apple (000 units)*			
	Min	*Max*	*Mean*	*Std. dev*
$EMPG_t$	23	28540	26055	2
$EXPO_t$	202000	527000	277000	168
$IMPO_t$	0	9921	1457	24
$WAGO_t$	0	3	1.5	1
$TGVP_t$	38900	61300	42700	191
$PRODT_t$	40344	95269	67284	662
$AREAP_t$	20449	27126	22373	219
$VOSAXEU_t$	0	182983	78591	976

Source: Calculated from apple dataset

6.2.2 Apricot

As depicted in Table 6.2, the descriptive statistics of the variables utilised in the apricot estimation indicates that variables included are nine regressors and three regressands. On average, the apricot industry generates six thousand employment opportunities, the minimum employment is equivalent to three thousands, the maximum employment opportunities is about 9 thousands and the standard deviation is equivalent to one thousands. According to Table 6.2, the minimum imports output for the period under review is zero, while the maximum imports output is equivalent to ZAR 1. 9 million, the average imports are valued at ZAR 357 thousand and the standard deviation is about 52 thousand. On average, the exchange rate is about 7 percent, the minimum value of exchange rate is equivalent to 3 percent, while the maximum value is about 15 percent and the standard deviation is 3. The minimum wage in the apricot is equivalent to zero, but the maximum wage is about ZAR 3 thousand, while the mean is 0.1 and the standard deviation is about one. The minimum local sales is valued at ZAR 1 thousand, the value associated with maximum local sales is ZAR 5 thousand while the average local sales is ZAR 2 thousand and the standard deviation is equivalent to one thousand.

As depicted on Table 6.2, the minimum exports output is about ZAR 3 million, the maximum is equivalent to ZAR 90 million while the mean is ZAR 40 million and the standard deviation is 29 million. The minimum volume of exports to the European

Union market is about zero, maximum exports of apricots are about 4 thousand tonnes while the mean is about 2 thousand tonnes and the standard deviation is one thousand. The minimum gross value of fresh apricot is ZAR 21 million, the maximum value is about ZAR 198 million while the average gross value of fresh apricot is equivalent to ZAR 92 million and the standard deviation is about 56 million.

The minimum population in South Africa is about 30 million while the maximum population size is equivalent to 58 million, the average population is 45 million and the standard deviation is about 7 million. Table 6.2 shows that the minimum net realisation is about ZAR 3 thousand per ton, the maximum net realisation per metric ton is equivalent to 24 thousand, on average the net realisation is about ZAR 9 thousand per ton and the standard deviation is about 6 thousand. It is evident from Table 6.2 that the minimum processing volume for apricot industry is about 21 thousand tonnes while the maximum processing volume is about 81 thousand tonnes; on average the processing volume from apricot industry is 43 thousand tonnes and the standard deviation is about 14 thousand tonnes. The minimum foreign direct investment is equivalent to zero, the maximum foreign direct investment intended to the apricot industry is estimated at 80 billion while the average foreign direct investment is about 26 billion and the standard deviation is equivalent to 3 billion.

Table 6. 2: Summary statistics for the apricot industry

Descriptive Statistics	*Apricot (000 units)*			
	Min	*Max*	*Mean*	*Std. dev*
$EMPG_t$	3	9	6	1
$IMPO_t$	0	1884	357	52
$AEXRT_t$	3	15	7	3
$WAGO_t$	0	3	0.1	1
$LOCS_t$	1	5	2	1
$EXPO_t$	2560	90040	40119	29258
$VOSAXEU_t$	0	4	2	1
$GRVF_t$	20604	198431	92781	56461
$POPU_t$	29908	57726	45383	7348
$NETR_t$	3	24	9	6
$PROCV_t$	21	81	43	14
FDI_t	0	80138296	25924551	2514832

Source: Calculated from apricot dataset

6.2.3 Avocado

The minimum employment for avocado industry is equivalent to 3 thousand, maximum employment is about 14 thousand; on average the people employed by the industry are around 7 thousand and the standard deviation is 3 thousand. On average, the exports output from avocado industry is estimated at ZAR 329 million, the minimum exports output is about ZAR 44 million while the maximum exports output is ZAR 2 billion and the standard deviation is about 4 million. As depicted on Table 6.3, the minimum imports output is ZAR 11 thousand, the maximum is about ZAR 95 million while the mean is equivalent to ZAR 21 million and the standard deviation is three million.

As depicted in Table 6.3, the minimum gross value of production is estimated at ZAR 66 million, the maximum gross value of production about ZAR 1.2 billion, the mean is equivalent to ZAR 391 million and standard deviation is equated to 373514. On average, the exchange rate of avocado is 7 percent, while the minimum exchange rate of avocado is equivalent to 3 percent, maximum exchange rate is about 15 percent and standard deviation is three. As displayed in Table 6.3, the minimum wage output is zero while maximum wage output equivalent to ZAR 3 thousand, the average wage is ZAR 946 and standard deviation for wage output is one. The data shows that the minimum productivity is 15 percent while the maximum productivity is estimated at 149 percent, the mean is 46 percent and the standard deviation is around 34 percent. The minimum foreign direct investment is about zero while the maximum is equivalent to ZAR 80 billion, an average foreign direct investment for avocado industry is estimated at ZAR 26 billion and standard deviation for foreign direct investment is equivalent to 26 billion. Lastly, the minimum volume of exports to the European Union market is equivalent to zero, while the maximum volume of exports to the European Union market is approximately 83 thousand tonnes, the average volume of exports to the European Union market is equivalent to 27 thousand tonnes and finally the standard deviation is about 25 thousand.

Table 6. 3: Summary statistics for the avocado industry

Descriptive Statistics	*Avocado (000 units)*			
	Min	*Max*	*Mean*	*Std. dev*
$EMPG_t$	3	14	7	3
$EXPO_t$	44450	1529348	329264	3861
$IMPO_t$	11	95266	21065	2673
$TGVP_t$	66222	1244721	390987	373514
$AEXRT_t$	3	15	7	3
$WAGO_t$	0	3000	946	1
$PRODTVT_t$	15	149	46	34
FDI_t	0	80138296	25924551	26148319
$VOSAXEU_t$	0	83	26500	24607

Source: Calculated from avocado dataset

6.2.4 Orange

According to Table 6.4, the minimum employment for the orange industry is 15 thousand, the total employment for the industry is 25 thousand while the average employment is 19 thousand and the standard deviation is about 2 thousand. On average, exports output is equivalent to ZAR 3 billion, the minimum exports output about ZAR 246 million while the maximum value is equated to ZAR 11 billion and the standard deviation is 309 million. The minimum imports output is estimated at ZAR 96 thousand, the maximum imports are valued at ZAR 51 million, the mean is about ZAR 8 million and the standard deviation is one million. As depicted in

Table 6.4, the average price is estimated at ZAR 1 thousand per ton, while the minimum price is about ZAR 513, the maximum price per ton is valued at ZAR 4 thousand and the standard deviation is 855.

Table 6.4 reveals that the average exchange rate is equivalent to 7 percent, as the minimum exchange rate is about 3 percent while maximum exchange rate is equivalent to 15 percent and the standard deviation for three. The minimum net realisation per ton is about ZAR 710, the maximum net realisation is equivalent to ZAR 7 thousand while the standard deviation is two thousand and the average net realisation per ton is about ZAR 3 thousand. The minimum volume of South African orange exports to EU is equivalent to zero, the maximum volume exports to EU market about 465 thousand metric tonnes, the average volume exports to EU market is equivalent to 223 thousand tonnes and the standard deviation is about 197 thousand. On average, the wage output is equivalent to ZAR 1 hundred while the minimum wage output is about zero; the maximum wage output is equivalent to ZAR 3 thousand and standard deviation is about one thousand. The minimum foreign direct investment is about zero while the maximum foreign direct investment for the orange industry is estimated at ZAR 80 billion, the average foreign direct investment is estimated at ZAR 26 billion and the standard deviation is 3 billion.

Table 6. 4: Summary statistics for the orange industry

Descriptive Statistics	*Orange (000 units)*			
	Min	*Max*	*Mean*	*Std. dev*
$EMPG_t$	15	25	19	2
$EXPO_t$	245706	10758240	3085666	309467
$IMPO_t$	96	50892	7997	1188
$AVRP_t$	0.1	4	1	0.1
$AEXRT_t$	3	15	7	3
$NETR_t$	0.1	9	3	2
$VOSAXEU_t$	0	465	223	197
$WAGO_t$	0	3	0.1	1
FDI_t	0	80138296	25924551	2614831

Source: Calculated from orange dataset

6.2.5 Pear

Table 6.5 shows that the minimum employment for pear industry is estimated at 10 thousand, maximum employment around 16 thousand while the average employment is equivalent to 13 thousand and the standard deviation is 2 thousand. The minimum exports output is equated to ZAR 133 million while the standard deviation is 854 million, the maximum value is approximately ZAR 3 billion and average exports output is about ZAR 872 million. The minimum imports output for pear is estimated at zero, the maximum imports output about ZAR 4 million while the mean is about ZAR 650 thousand and standard deviation is 103 thousand. According to Table 6.5, the minimum wages output is zero, the average wages output is about ZAR 946 while the maximum wages output ZAR 3 thousand and standard deviation is about 1 thousand.

As depicted in Table 6.5, the average net realisation is amounted to ZAR 5 thousand per ton, the minimum net realisation is about ZAR 1 thousand while the maximum net realisation is equivalent to ZAR 11 thousand and the standard deviation is about 3 thousand. The minimum foreign direct investment is equivalent to zero, as maximum value attached to foreign direct investment is ZAR 80 billion while the average foreign direct investment is about ZAR 26 billion and the standard deviation is equivalent to 3 billion.

Table 6.5 shows that the minimum local sales is about ZAR 23 thousand, the maximum local sales amounted to ZAR 60 thousand while the standard deviation is about 6 thousand and the average local sales are amounted to ZAR 43 thousand. On average, the volume of South African pear exports to EU is about 22 thousand metric tonnes, as the minimum volume of South African pear exports to EU is zero while the maximum volume of South African pear exports to EU for the period under review is about 111 thousand metric tonnes, and the standard deviation is equivalent to 41 thousand. The minimum production volumes of pear are equivalent to 195 thousand metric tonnes, the maximum pear production volumes about 433 thousand metric tonnes while the average production volumes of pear are equivalent to 317 thousand metric tonnes and the standard deviation associated with production volumes about 70 thousand.

Table 6. 5: Summary statistics for the pear industry

Descriptive Statistics	*Pear (000 units)*			
	Min	*Max*	*Mean*	*Std. dev*
$EMPG_t$	10	16	13	2
$EXPO_t$	132977	2792323	871989	854058
$IMPO_t$	0	4061	650	103
$WAGO_t$	0	3000	946	1
$NETR_t$	1	11	5	3
FDI_t	0	80138296	25924551	2614831
$LOCS_t$	23	60	43	6
$VOSAXEU_t$	0	111	22	41
$PRODT_t$	195	433	317	70

Source: Author’s compilation from pear dataset

6.2.6 Table grape

Table 6.6 presents the descriptive statistics for the table grape industry for the period under review. The minimum employment for table grape industry is about 219 thousand, as the maximum employment is estimated at 276 thousand, the standard deviation associated with table grape employment is about 17 thousand and the average employment in the table grape industry about 243 thousand. According to Table 6.6, the minimum exports output of the table grape industry is valued at ZAR 154 million, as the maximum exports output is translated to ZAR 7 billion, the standard deviation linked to exports output is about ZAR 2 billion and the average exports output is about ZAR 2 billion.

As depicted In Table 6.6, the minimum imports output is equivalent to ZAR 3 thousand, as the maximum imports output is about ZAR 217 million, the average imports output is about ZAR 41 million and the standard deviation associated with imports output of table grape is equivalent to 6 million. It is evident from Table 6.6 that the minimum wages output is zero, as the maximum wages output is equivalent to ZAR 3 thousand while the average wages output is about ZAR 9 hundred and the standard deviation is equivalent to 1 thousand. Table 6.6 indicates that the minimum domestic consumption is about ZAR 1 million, as the maximum domestic consumption is valued at ZAR 2 million, while the average value is equivalent to ZAR 1 million and the standard deviation associated with domestic consumption for table grape is about 190 thousand. On average, the net realisation for the table grape industry is about ZAR 10 thousand per ton, minimum net realisation per ton is equivalent to ZAR 3 thousand while the standard deviation associated with net realisation is 6 thousand and the maximum is equivalent to ZAR 23 thousand.

Table 6.6 highlights that the minimum local sales for the table grape industry is valued at ZAR 19 thousand, as the maximum local sales is equivalent to ZAR 30 thousand, the standard deviation is estimated at 3 thousand and the average local sales are equivalent to ZAR 23 thousand. On average, the area planted with table grapes is about 111 thousand hectares, as the minimum area planted is equivalent to 100 thousand hectares while the maximum area planted with table grapes is about 126 thousand hectares and the standard deviation is about 8 thousand.

It is evident that the minimum volumes of South African table grape exports to EU is zero, as the maximum volumes of South African table grape exports to EU are valued at ZAR 210 thousand while the average volume of South African table grape exports to EU are about ZAR 106 thousand and the standard deviation associated with table grape is about 91 thousand. The minimum dried volumes of table grape are about 113 thousand tonnes, as the maximum dried volumes are equivalent to 262 thousand tonnes, the standard deviation associated with dried volumes are 40 thousand and the average dried volumes are 166 thousand tonnes. As depicted in Table 6.6, the minimum foreign direct investment is zero, as the maximum foreign direct investment is valued at ZAR 80 billion while the average foreign direct investment is equivalent to ZAR 26 billion and the standard deviation is about ZAR 3 billion.

Table 6. 6: Summary statistics for the table grape industry

Descriptive Statistics	*Table grape (000 units)*			
	Min	*Max*	*Mean*	*Std. dev*
$EMPG_t$	219	276	243	17
$EXPO_t$	154092	7208821	2380438	2201106
$IMPO_t$	3	217	40954	5976
$WAGO_t$	0	3000	0.1	1
$DCONS_t$	1158	1765	1440	190
$NETR_t$	3	23	10	6
$LOCS_t$	19	30	23	3
$AREAP_t$	100	126	111	8
$VOSAXEU_t$	0	210	106	91
$DRDV_t$	113	262	166	40
FDI_t	0	80138296	25924551	2614832

Source: Author's compilation from table grape dataset

6.3 Augmented Dickey-Fuller (ADF) test

The study adopts the ADF test to check for stationarity of all variables used in estimating the econometric models. According to Bongsha (2011: 223) secondary data is susceptible to non-stationarity, which results in spurious estimation and misleading findings. The ADF provides three separate equations to test for stationarity of series. The initial equation has a constant only (a_0), succeeded by the equation with an intercept term (a_0) and trend, thirdly the equation has neither intercept nor a deterministic trend (t). The intuition is that disturbance term in all three equations is independent with equally distributed variance (Chamalwa & Bakari 2016; Gujarati 2003; Wooldridge 2013). Notably, all three equations are referred as ADF tests and presented below:

$\Delta Y_t = \beta_1 + ZY_{t-1} + a_i + \varepsilon_t$ (Constant only)… … … … … … … … … … … … … . … … . . (6.1)

$\Delta Y_t = \beta_1 + \beta_2 + ZY_{t-1} + a_i + \varepsilon_t$ (Constant and trend)… … … … … … . . … … … … (6.2)

$\Delta Y_t = ZY_{t-1} + a_i + \varepsilon_t$ (No constant, no trend)… … … … … … … … … … … … … … (6.3)

Where Y_t represents the variable of interest, t denotes a time trend, β_1 is the constant, $t-1$ shows a lag length while Z is the coefficient of the lagged variable and ε_t 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 statistic value 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. The stationarity test using ADF for all identified variables is adopted for the six selected fruit industries. The information displayed in Tables 6.7 until 6.12 are ADF test results of the selected six fruit industries.

Table 6. 7: Unit root test for apple variables using ADF test

$Variables$	$Order\ of\ integration$				$Conclusion$
	$Level\ [I(0)]$		$First\ difference\ [I(1)]$		
	$t-stats$	$critical\ value\ (5\%$	$t-stats$	$critical\ value\ (5\%)$	
$lnEMPG_t$	0.643	-1.950	-4.957***	-1.950	Stationary at $I(1)$
$EXPO_t$	0.759	-2.972	-5.705***	-2.976	Stationary at $I(1)$
$IMPO_t$	-1.568	-2.972	-5.642***	-1.950	Stationary at $I(1)$
$lnWAGOAPP_{t-}$	-0.019	-1.796	-2.468**	-1.812	Stationary at $I(1)$
$lnEXPO_{t-1}$	-0.267	-1.711	-2.990***	-1.950	Stationary at $I(1)$
$lnTGVP_t$	0.266	-2.986	-5.596***	-2.986	Stationary at $I(1)$
$lnWAGO_{t-1}$	0.158	-3.099	-3.474**	-3.120	Stationary at $I(1)$
$lnEMPG_{t-1}$	-3.422**	-2.976			Stationary at $I(0)$
$lnPRODT_{t-1}$	-14.356***	-2.976			Stationary at $I(0)$
$lnAREAP_t$	-4.794***	-2.972			Stationary at $I(0)$
$lnVOSAXEU_t$	-1.685	-3.066	-3.922**	-3.145	Stationary at $I(1)$

Notes: the difference between the calculated t-statistics and critical value at 5% level is used to test a presence of a unit root, *** denotes rejection of hypothesis for unit root at 1% level (p≤0.01) while ** shows rejection of hypothesis for unit root at 5% level (p≤0.05), respectively.

There are eleven identified variables to analyse the effects of international trade on employment and wages within the apple industry of South Africa. The detailed description of variables used in the apple industry is depicted in Table 3.1 and the ADF results for apple industry variables are displayed in Table 6.7. The ADF findings highlight that eight variables were stationary at first difference [$I(1)$] and three were stationary at levels [$I(0)$]. The variables were applied to three econometric techniques, namely: descriptive statistics; vector error correction model; two-staged least squares (2SLS) model and granger causality test. The assumption for the VECM model is that all variables applied in the equation should be stationary at first difference (Jain & Gupta 2019). The stationarity of variables provides non-spurious estimates and unbiased findings. Furthermore, one of the assumptions underlying Ordinary Least Square (OLS) is that all variables included in the estimation should be tested for stationarity in order to predict the Best Linear Unbiased Estimate (BLUE).

Table 6. 8: Unit root test for apricot variables using ADF test

$Variables$	$Order\ of\ integration$				$Conclusion$
	$Level$ [$I(0)$]		$First\ difference$ [$I(1)$]		
	$t - stats$	$critical\ value$ (5%)	$t - stats$	$critical\ value$ (5%)	
$lnWAGO_t$	-0.030***	-3.081	-3.587**	-3.099	Stationary at $I(1)$
$lnIMPO_t$	-4.168***	-3.021			Stationary at $I(0)$
$lnAEXRT_t$	1.325	-2.972	-3.701***	-2.976	Stationary at $I(1)$
$lnEMPG_t$	0.042	-2.981	-6.392***	-2.981	Stationary at $I(1)$
$lnLOCS_t$	-0.464	-2.976	-10.252***	-2.976	Stationary at $I(1)$
$lnEXPO_{t-1}$	-1.280	-2.981	-7.539***	-2.981	Stationary at $I(1)$
$EXPO_t$	-1.030	-2.972	-6.854***	-2.976	Stationary at $I(1)$
$lnVOSAXEU_t$	-1.002	-3.066	-4.991***	-3.081	Stationary at $I(1)$
$lnGRVF_t$	-1.583	-2.976	-6.056***	-2.981	Stationary at $I(1)$

$lnPOPU_t$	-2.748	-2.972	-4.884***	-2.976	Stationary at $I(1)$
$lnNETR_t$	-1.070	-2.972	-6.528***	-2.976	Stationary at $I(1)$
$lnPROCV_t$	-1.224	-2.976	-11.948***	-2.976	Stationary at $I(1)$
FDI_t	-2.763	-2.972	-6.025***	-2.986	Stationary at $I(1)$

Notes: the difference between the calculated t-statistics and critical value at 5% level is used to test a presence of a unit root, *** denotes rejection of hypothesis for unit root at 1% level (p≤0.01) while ** shows rejection of hypothesis for unit root at 5% level (p≤0.05), respectively.

Table 6.8 shows the results for all variables included on analysis of apricot industry in order to determine the effects of international trade on employment and wages. The clear description, unit of measurement and sources for all the variables are indicated on Table 3.1 in Chapter 3. The total of thirteen variables were identified to test the hypotheses, only one variable was stationary at level $[I(0)]$ and the remaining twelve variables were found to be stationary at first difference $[I(1)]$. The results of ADF suggest that only the logarithm of import output $(lnIMPO_t)$ is significant at level $[I(0)]$ since the calculated ADF statistic value (-4.168) is greater than t-statistic value (-3.021) and the p-value less than 0.05. Therefore, the null hypothesis of non-stationary is rejected and conclusion is that the logarithm of import output is stationary at level.

Table 6. 9: Unit root test for avocado variables applying ADF test

$Variables$	$Order\ of\ integration$				$Conclusion$
	$Level\ [I(0)]$		$First\ difference\ [I(1)]$		
	$t-stats$	$critical\ value\ (5\%)$	$t-stats$	$critical\ value\ (5\%)$	
$lnWAGO_t$	-0.030	-3.081	-3.587**	-3.099	Stationary at $I(1)$
$lnEMPG_t$	-2.708	-2.986	-7.314***	-2.986	Stationary at $I(1)$
$EXPO_t$	2.442**	-1.722			Stationary at $I(0)$
$IMPO_t$	3.028***	-1.950			Stationary at $I(0)$
$TGVP_t$	1.719	-2.792	-3.546**	-2.976	Stationary at $I(1)$
$AEXRT_t$	-0.537	-2.972	-4.012***	-2.976	Stationary at $I(1)$

$lnPRODTVT_t$	-0.037	-2.976	-7.624***	-2.976	Stationary at $I(1)$
FDI_t	-2.764	-2.972	-6.025***	-2.986	Stationary at $I(1)$
$lnVOSAXEU_t$	-1.054	-3.081	-7.768***	-3.081	Stationary at $I(1)$

Notes: the difference between the calculated t-statistics and critical value at 5% level is used to test a presence of a unit root, *** denotes rejection of hypothesis for unit root at 1% level (p≤0.01) while ** shows rejection of hypothesis for unit root at 5% level (p≤0.05), respectively.

There are twelve variables identified to estimate the effects of international trade on employment and wages in the South African orange industry, which is a sub-category of the South African citrus industry. The ADF test was conducted using E-views version eight depicted in Table 6.10 shows that all identified variables are stationary after first differencing [$I(1)$] except for imports output, lagged imports output, average price of oranges per metric ton and local sales of oranges which were all stationary at levels [$I(0)$].

Table 6. 10: Unit root test for orange variables using ADF test

$Variables$	$Order\ of\ integration$				$Conclusion$
	$Level$ [$I(0)$]		$First\ difference$ [$I(1)$]		
	$t-stats$	$critical\ value$ (5%)	$t-stats$	$critical\ value$ (5%)	
$lnEMPG_t$	-2.205	-2.972	-4.764***	-2.976	Stationary at $I(1)$
$EXPO_t$	2.093	-3.588	-6.358***	-3.588	Stationary at $I(1)$
$IMPO_t$	5.190	-3.005***			Stationary at $I(0)$
$lnIMPO\_L1_t$	-1.716	-2.976	-7.770***	-2.981	Stationary at $I(1)$
$AVRP_t$	4.073***	-2.981			Stationary at $I(0)$
$lnAEXRT_t$	-1.325	-2.972	-3.701***	-2.976	Stationary at $I(1)$
$lnPCONS\_L1_t$	-2.655	-2.976	-5.640***	-2.981	Stationary at $I(1)$
$NETR_t$	-0.221	-3.581	-5.989***	-3.588	Stationary at $I(1)$
$LOCS_t$	-3.363	-2.972			Stationary at $I(0)$

$lnVOSAXEU_t$	-2.520***	-3.066	-3.411**	-3.145	Stationary at $I(1)$
$lnWAGO_t$	-0.030	-3.081	-3.586***	-3.099	Stationary at $I(1)$
FDI_t	-2.764	-2.972	-6.025***	-2.986	Stationary at $I(1)$

Notes: the difference between the calculated t-statistics and critical value at 5% level is used to test a presence of a unit root, *** denotes rejection of hypothesis for unit root at 1% level (p≤0.01) while ** shows rejection of hypothesis for unit root at 5% level (p≤0.05), respectively.

Table 6.11 reflects the ADF test results all regressors identified to estimate the effects of international trade on employment and wages in the pear industry of South Africa. All identified regressors are stationary after first differencing [$I(1)$]. The calculated ADF critical values were less than t-statistics at 5% level, which implies that all variables were non-stationary at levels. After integration process the regressors were all stationary and ready to be included on the econometric estimations. Three econometric modeling techniques used to address the hypotheses require all variables to be stationary, in order to avoid spurious estimation and biased results.

Table 6. 11: The unit root test for pear variables applying ADF test

$Variables$	$Order\ of\ integration$				$Conclusion$
	$Level$ [$I(0)$]		$First\ difference$ [$I(1)$]		
	$t-stats$	$critical\ value$ (5%)	$t-stats$	$critical\ value$ (5%)	
$lnEMPG_t$	-2.796	-2.972	-9.824***	-2.976	Stationary at $I(1)$
$EXPO_t$	0.848	-2.972	-5.628***	-2.976	Stationary at $I(1)$
$IMPO_t$	-1.526	-2.972	-5.841***	-2.981	Stationary at $I(1)$
$lnWAGO_t$	-0.030	-3.081	-3.587**	-3.099	Stationary at $I(1)$
$NETR_t$	0.882	-2.972	-6.638***	-2.976	Stationary at $I(1)$
FDI_t	-2.764	-2.972	-6.025***	-2.986	Stationary at $I(1)$
$LOCS_t$	-2.380	-2.972	-5.385***	-2.976	Stationary at $I(1)$
$lnVOSAXEU_t$	-1.238	-3.520	-3.036***	-2.044	Stationary at $I(1)$

$lnPRODT_t$	0.360	-2.976	-8.506***	-2.976	Stationary at $I(1)$

Notes: the difference between the calculated t-statistics and critical value at 5% level is used to test a presence of a unit root, *** denotes rejection of hypothesis for unit root at 1% level (p≤0.01) while ** shows rejection of hypothesis for unit root at 5% level (p≤0.05), respectively.

According to Table 6.12, there are total of thirteen variables included in the analysis of the table grape industry, in which three variables were found to be stationary at levels [$I(0)$] and ten variables were stationary after first differencing [$I(1)$]. The three variables found to be stationary at levels were exports output, imports output and total area planted. The variables were transformed to be stationary using first difference.

Table 6. 12: Unit root test for table grape variables using ADF test

$Variables$	$Order\ of\ integration$				$Conclusion$
	$Level\ [I(0)]$		$First\ difference\ [I(1)]$		
	$t - stats$	$critical\ value\ (5\%)$	$t - stats$	$critical\ value\ (5\%)$	
$lnEMPG_t$	0.618	-1.954	-9.252***	-1.954	Stationary at $I(1)$
$EXPO_t$	-0.508	-3.581	-3.841**	-3.588	Stationary at $I(1)$
$IMPO_t$	-1.586	-1.950	-5.642***	-1.950	Stationary at $I(1)$
$lnWAGO_t$	-0.030	-3.081	-3.587**	-3.099	Stationary at $I(1)$
$lnEXPO_t$	-2.814***	-1.950			Stationary at $I(0)$
$lnIMPO_t$	-3.320**	-2.972			Stationary at $I(0)$
$lnDCONS_t$	-1.761	-2.972	-6.309***	-2.976	Stationary at $I(1)$
$AEXRT_t$	-0.537	-2.972	-4.012***	-2.976	Stationary at $I(1)$
$LOCS_t$	-0.472	-1.950	-5.151***	-2.976	Stationary at $I(1)$
$AREAP_t$	-3.471**	-2.972			Stationary at $I(0)$
$lnVOSAXEU_t$	-1.418	-3.066	-4.835***	-3.081	Stationary at $I(1)$
$lnDRDV_t$	-0.902	-2.976	-7.101***	-2.981	Stationary at $I(1)$

FDI_t	-2.764	-.972	-6.025***	-2.986	Stationary at $I(1)$

Notes: the difference between the calculated t-statistics and critical value at 5% level is used to test a presence of a unit root, *** denotes rejection of hypothesis for unit root at 1% level ($p \leq 0.01$) while ** shows rejection of hypothesis for unit root at 5% level ($p \leq 0.05$), respectively.

The unit root tests were succeeded by statistical inferences to estimate the effects of international trade on employment and wages. The economic theory suggests that when dealing with secondary is always required to perform a stationarity test before running analytical technique in order to avoid spurious results (Gujarati & Porter 2009; Gujarati 2015; Wooldridge 2013). The following section would provide detailed results and interpretation from three economic analyses. The economic models involved in the study are: vector error correction model, two-staged least square, ordinary least square and granger causality test. The findings are expected to be shared through international publications and also inform policy making processes.

6.4 Results of the econometric analysis

This section displays the estimation results and interpretations from four analytical frameworks, namely: vector error correction model which tests the impact of international trade flow on employment and wages in the selected six South African fruit industries; secondly, the two-staged least square which determines the response of employment, exports and imports on changes in wages within the selected six South African fruit industries; thirdly, the ordinary least square which focuses on the effect of European Union’s Trade Development and Cooperation Agreement (TDCA) on wages in the South African fruit industry; lastly, the granger causality test which concentrates on the causality effect amongst employment, wages and exports in the six South African fruit industries.

6.4.1 Vector Error Correction Model (VECM)

The VECM falls within a group of multiple time series analytical frameworks usually utilised for dataset where the fundamental variables possess a long-run stochastic trend, commonly known as co-integration. Furthermore, the VECMs are theoretically-propelled methodology valuable for modelling both short-term and long-term effects of a certain time series. The word error-correction ties to the point on how the last-period's derogation from a long-run equilibrium, *the error*, impacts its short-run dynamics. Therefore, the VECMs unswervingly estimate the speed at which a regressand returns to equilibrium after a variation in regressors (Ahmed & Jie 2019; Jain & Gupta 2019; Maria & Andrei 2015).

❖ The VECM results for the South African apple industry

Table 6.13 shows the first stage of vector error correction model which is to determine the number of lag to be utilised throughout the estimation process. There are numerous criteria for selecting the lag length when using a time series, namely: Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQIC) and Schwartz Bayesian Information Criterion (SBIC). The study adopts the AIC as the preferred criterion which take cognisance of out-sample prediction error (Chamalwa & Bakari 2016; Kilian & Lutkepohl 2016; Ratombo 2019). As depicted in Table 6.13, the optimum lag for the apple estimation is on level 2, which indicates that two lags would be adopted throughout the estimation procedure on apple regression.

Table 6. 13: The lag selection criterion for the apple industry

Lag	$LogL$	LR	FPE	AIC	$HQIC$	$SBIC$
0	-865	NA	1.1	72.96	72.41	72.42
1	-857	11.39	5.6	72.39	72.55	72.98
2	-851	11.45	7.7	72.37*	72.35*	73.52*
3	-846	11.06*	5.4*	72.67	73.94	74.70
4	-840	17.48	1.9	73.23	73.74	75.15

Source: Author's compilation

The Johansen Co-integration test for apple estimation is shown in Table 6.14, which test the following hypothesis: H_0: The results shows that at least two co-integrating relationships occur amongst the international trade flow, employment and wages. The test for co-integration requires that all included series be stationary at same level and all series be stationary after first differencing. The entire series is taken at level through the use of log transformation. Co-integration is adopted at two levels, which are as follows: trace and maximum statistics at 5 percent level of significance. The test condition for co-integration is most applicable to test the linear deterministic trend with intercept (without trend). Furthermore, the trace test is beneficial if there are two or more co-integrating relationships in the estimation process (Sharma & Mathur 2019; Suharsono et al. 2017). However, based on co-integration test on the apple regression as depicted in Table 6.14, the results fail to reject the null hypothesis of the existence of co-integrating relationship and reject the alternative hypothesis of non-existence of co-integration relationship.

Table 6. 14: The estimation of integrating vectors for the apple industry (trace)

Hypothesized No. of CE(s)	*Eigenvalue*	*Trace Statistic*	0.05 *Critic value*
None	0.47	38.69	29.80
At most 1	0.35	17.59	15.49
At most 2	0.003	0.074	3.84*

Note: trace indicates no integration at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level.

The identified variables in the apple estimation was found to possess one or more co-integrating vectors, VECM[5] is identified to be an appropriate modelling technique. The VECM is a suitable time series estimation technique which is usually adopted to observe both the short-run and long-run dynamics of the series if all non-stationary time series are further integrated to first order *I(1)*, and discovered to be co-integrated. The VECM is known to utilise the non-exogenous variable as all included variables are usually endogenous. As posited by Sreedharan (2004), the VECM could be applied to directly examine the rate at which a variable can be taken back to equilibrium position after a shock on other variables.

[5] The VECM approach is adopted on various economic studies to examine the effects on international trade on employment and wages in different sectors of the economy (Bulagi et al. 2016; Bulagi 2014; Khanssa et al. 2018; Žiković et al. 2014).

The VECM is estimated to be subsequent to assessment of whether variables are stationary through the application integration process and has a co-integrating relationship. The VECM highlights the long-run effects of proxy variables to converge to their long-run equilibrium while allowing extensive range of short-run dynamics. As presented in Table 6.15, the coefficient associated with an Error Correction Term (ECT) for total employment carries a correct sign. Furthermore, it is statistically significant at 5 percent and its convergence speed towards equilibrium is 2.39 percent.

The results indicate that in a short-run, the total employment needs to be adjusted by 2.39 percent of last year's deviation from the equilibrium. The ECT value is small, which implies that the adjustment speed is slower. The other variables included in the regression are first and second lags of total employment, exports output and imports output. The two variables that show to be positive as well as statistically significant include first lag of imports output which is significant at 1 percent level and second lag of imports output which is statically significant at 1 percent level.

The ECT coefficient associated with exports output shows a negative sign and is statistically significant at 5 percent level. The coefficient value associated with ECT of exports output is about 1.24, which implies that the adjustment speed towards equilibrium is equivalent to 1.24. It translates to the stability of the equation and convergence towards equilibrium route in the situation of any disturbance in the system. However, the restoration to equilibrium route will be slower since ECT value is small (1.24). The statistically significant coefficients of the ECT show that the variables cause one another in a long-run.

Table 6.15 shows that the ECT's coefficient for imports output is negatively significant at 1 percent level. The coefficient value associated with ECT is equivalent to 4.03, which determines the speed of adjustment towards the equilibrium. The implication is that the system is constant and the speed of adjustment to equilibrium is slow. Basically, the statistical significance of all coefficients associated with ECTs for each model suggests that they cause one another in the long-run.

The outcomes from Table 6.15 indicate that fitted degrees of VECM's R^2 for all three estimations are about 0.59, 0.34 and 0.61, respectively. The values of AIC and SBIC as presented in Table 6.15 are about 71.95 and 73.21, respectively. The value associated with log likelihood is equivalent to 909.37 which is higher than AIC and SIC, indicating the strength of the regression. The findings suggest that at least 45 percent of variations in the total employment regression are described by all regressors. Furthermore, Table 6.15 suggests that 88 percent of variations in the exports output model are clarified by the independent variables. For imports output estimation, the indication is that 45 percent of variations in the imports output regression are explained by explanatory variables.

Table 6. 15: The VECM estimation results for the apple industry

$Error\ Correction$	$D(lnEMPG)$	$D(EXPO)$	$D(IMPO)$
$EC\ term\ (Speed\ of\ adjustment)$	-0.69**	-1.24**	-4.03***
	(-2.39)	(-2.49)	(-2.95)
$InEMPG_{t-1}$	0.003	-2.76	1.16
	(0.01)	(-1.08)	(0.84)
$InEMPG_{t-2}$	0.31	-2.65	1.51
	(1.45)	(-1.40)	(1.49)
$EXPO_{t-1}$	-9.47	0.08**	-0.0004
	(-0.36)	(2.36)	(-0.31)
$EXPO_{t-2}$	-3.09	0.20	0.0006
	(-1.17)	(0.86)	(0.44)
$IMPO_{t-1}$	2.13***	-57.92	-0.02
	(3.93)	(-1.21)	(-0.08)
$IMPO_{t-2}$	1.14***	-40.14	0.11
	(2.59)	(-1.03)	(0.54)
$Constant$	0.12***	212.3	65.0***
	(2.39)	(0.01)	(2.80)
R-squared	0.59	0.34	0.61
Log likelihood		-909.37	
Akaike Information Criterion		71.95	
Schwarz Information Criterion		73.21	

Source: Author's compilation

Normality test

Table 6.16 presents the normalised co-integrating coefficients, which reveal the t-statistics for the series $EXPO_t$ and $IMPO_t$ with response to $lnEMPG_t$ are statistically significant and thus the presented signs are interpreted in a reversed form. The cointegrated equation and its value of t-statistics permit the study to recognise the direction and level of impact generated by other explanatory variables on the international trade flow, employment and wages in the South African apple industry. The results from Table 6.16 are interpreted as follows: a 1 percent increase in $EXPO_t$, leads to an increase of about 3.06 percent of total employment in the long run, while a one percent increase in $IMPO_t$ leads to a decrease of about 2.37 of total employment in the long run. Table 6.16 shows that the t-statistics of $EXPO_t$ and $IMPO_t$ are statistically significant at 1 percent level. The occurrence of stable equilibrium interrelation is witnessed by finding co-integrated equation among the international trade flow, employment and wages in the apple equation.

Table 6. 16: The normalised co-integration coefficients for apple estimation

$Cointegrating\ Equation$:	$CointEq1$
$lnEMPG_t$	1.00
$EXPO_t$	-3.06***
	(-5.15)
$IMPO_t$	2.37***
	(4.19)
Constant	-9.99

Note: t-statistics in presented in parentheses
Source: Author's compilation

The study adopted the Langrage Multiplier (LM) test to examine the existence of autocorrelation on the lag order of regression. The rule of thumb associated with LM test is that the null hypothesis for non-existence of auto-correlation is rejected when the p-value is less than 5 percent. Conversely, the alternative hypothesis for non-existence of autocorrelation cannot be rejected when p-value is higher than 5 percent. The results presented in Table 6.17 highlight that the null hypothesis of non-existence of autocorrelation is not rejected as p-value is more than 5 percent.

In a nutshell, the estimation with the first lag is free from autocorrelation and this supports the robustness of the model.

Table 6. 17: Langrage-multiplier test for the apple industry

Lag	x^2	$Probability$
1	6.1293	0.72691

Source: Author's compilation

Table 6.18 presents the test for normality of the distributed disturbance term using the Jarque-Bera. The rule of thumb is that the errors are normally distributed when the p-value is over 5 percent. Conversely, errors are not normally distributed when the p-value is lower than 5 percent. The outcomes displayed in Table 6.18 show that errors are normally dispersed for total employment and imports output. However, the errors are not normally distributed for exports output and for the whole regression.

Table 6. 18: The Jarque-Bera test for the apple industry

$Equation$	x^2	$Probability$
$DlnEMPG_t$	0.40	0.81997
$DlnEXPO_t$	10.65	0.00486
$DlnIMPO_t$	5.48	0.06469
ALL	16.53	0.01119

Source: Author's compilation

Table 6.19 presents the results for model stability of apple's VECM model. The findings show that the VECM estimation renders at least two moduli, which is applicable for both eigenvalue and modulus. The outcomes of the regression meet the conditions for eigenvalue stability condition, as the values of modulus of individual eigenvalue are below 1, except for the first two columns. In a nutshell, the test for stableness condition shows that the model is stable.

Table 6. 19: The eigenvalue stability condition for the apple industry

$Eigenvalue$	$Modulus$
1	1
1	1
0.3948716 + 0.7483875i	0.846172
0.3948716 + 0.7483875i	0.846172
-0.8141914	0.814191
-0.34536 + 0.4626359i	0.577326
-0.34536 – 0.4626359i	0.577326
-0.4146108	0.414611
0.3483021	0.348302

Source: Author's compilation

Granger causality test for apple industry

The Granger causality test is adopted to test the causality effects amongst variables included in the regression. Table 6.20 highlights a bi-directional causality effects between the exports output, as both their p-values are less than 0.05. This is ascribed to the fact that exports trigger total employment, as producers tend to increase the production capacities and it translates into long-term causality effects between the two variables. Therefore, Table 6.20 shows that in a long run, there is no causality effects amongst imports output and total employment as well as no causality effects between exports output and imports output.

Table 6. 20: Granger causality test for the apple industry

$Null\ hypothesis$	$F-statistic$	$P-value$
EXPO does not Granger-cause LNEMPG	4.24	0.0130
LNEMPG does not Granger-cause EXPO	5.81	0.0256
IMPO does not Granger-cause LNEMPG	3.27	0.5720
LNEMPG does not Granger-cause IMPO	1.04	0.3695
IMPO does not Granger-cause EXPO	1.77	0.1931
EXPO does not Granger-cause IMPO	2.93	0.0743

Note: the relationship with p-values below 0.05 percent signifies the causality effects between the variables, while the relationship with p-value over 0.05 percent denotes no causality between the variables.

❖ The ECM findings for the South African apricot industry

The AIC lag selection criterion is adopted to select the optimal lag length for Johansen co-integration analysis for the South African apricot industry. As depicted in Table 6.21, the fourth lag is the optimal lag length for the apricot industry. The fourth lag will be utilised throughout the empirical analysis of the apricot industry. According to Felbermayr et al. (2009) and Rodrik et al. (2004), the AIC optimal lag selection criterion picks the most parsimonious lag due to its association with the log likelihood function.

Table 6. 21: The lag selection criterion for the apricot industry

Lag	$LogL$	LR	FPE	AIC	$HQIC$	$SBIC$
0	-776	NA	3.1*	64.90	64.94*	65.05*
1	-767	17.75	3.1	64.91	65.07	65.50
2	-759	16.68	3.5	64.97	65.24	66.00
3	-751	15.89	4.2	65.06	65.45	66.53
4	-737	26.77*	3.7	64.69*	65.20	66.60

Note: ***denotes the selected optimal lag length based on each criterion

Ramirez (2016) posits that the Johansen co-integration test is conducted using uncorrelated errors depending on the outcomes of optimal lag length selection criterion. Table 6.22 shows that all included variables are integrated as there is more probability of an equilibrium match amongst them. The decision rule regarding the co-integration is that there is a presence of co-integration when trace statistics is smaller than 5 percent critical value (Maria & Andrei 2015; Wooldridge 2013). Furthermore, the null hypothesis of co-integration is rejected when trace statistics is larger than 5 percent critical value.

The Johansen co-integration technique is applied to check the presence of a long-run equilibrium interrelation amongst the variables. Therefore, Table 6.22 analyses the long-run relationship amongst exports output, imports output and total employment. Nonetheless, the trace statistics as presented in Table 6.22 shows the presence of two co-integrating equations from our regression as trace statistics value is smaller than 5 percent critical value. Notably, the findings reveal the presence of a long-run co-integrating relationship amongst the exports output, imports output and total employment.

Table 6. 22: The estimation of co-integrating vectors for the apricot industry

$Hypothesized$ $No. of\ CE(s)$	$Eigenvalue$	$Trace$ $Statistic$	0.05 $Critic\ value$
None	0.30	34.91	29.80
At most 1	0.16	25.15	15.50
At most 2	0.018	0.494	3.841

Note: The results highlight the presence of two co-integrating equation in this model, *represents the co-integrating equation

All included variables are stationary after first differencing [*I(1)*] and there is a presence of two co-integrating equations amongst on the estimation. The VECM is adopted due to the existence of at least two co-integrating interrelation of equations. As suggested by the AIC optimum lag selection criterion, three lags of all variables are included in VECM estimation. The VECM results for apricot indicate the long-run impacts of endogenous variables which converge to their long-run equilibrium while allowing a greater range of short-run dynamics. As depicted in Table 6.23, the coefficient of ECT for the total employment carries the expected negative signage, while it is statistically significant at 1 percent level and has a speed of convergence equivalent to 0.12 percent towards equilibrium.

The apricot results imply that in a short-run, the total employment needs to be corrected by 0.12 percent from last year's deviation towards equilibrium. According to Gujarati (2015), the higher value of the ECT coefficient denotes that equilibrium proxies reduce a greater percentage of imbalances associated to each period. Notably, the low coefficient values are linked to the slow speed of adjustment towards equilibrium. Therefore, the results suggest that the total employment towards equilibrium is very slow. Other variables included on the total employment regression are first to third lags of total employment, which are statistically insignificant and possess a negative signage except for $InEMPG_{t-2}$.

Table 6.23 shows that the ECT coefficient associated with exports output possess an expected negative sign and it is statistically significant at 10 percent level. The results show that the coefficient associated with exports output carries at least 20.30 percent speed of convergence towards equilibrium. Notably, the exports outputs are converging by at least 20.3 percent of previous year's derogation from equilibrium in a short-run. Therefore, the system is stable and speed of adjustment towards equilibrium is fast. Additional variables included on the exports output regression are first to third lags of exports output, which are statistically insignificant, with positive sign except for $EXPO_{t-1}$.

As depicted in Table 6.23, the ECT linked to imports output carries a negative sign and it is statistically significant at 10 percent level. Therefore, the ECT coefficient for imports output has at least 87.33 percentage speed of convergence towards equilibrium. The implication is that exports output converge by 87.33 percent towards equilibrium in the short-run. The results suggest that the system is constant and adjustment speed towards equilibrium is faster.

Table 6.23 shows that the R^2 results from three regressions are as follows: 0.72, 0.39 and 0.59, respectively. The outcomes indicate that AIC and SBIC are 64.58 and 66.29, respectively. These two values are far below the log likelihood value, which is equivalent to 772.30. The R^2 value for total employment suggests that the 72 percent of variations in total employment equation are explained by explanatory variables. Table 6.23 highlights that 39 percent of variations in exports output is clarified by all included regressors. For imports output equation, 59 percent of variations in the equation are explained by all independent variables.

Table 6. 23: The VECM estimation results for the apricot industry

$Error\ Correction$	$D(lnEMPG)$	$D(EXPO)$	$D(IMPO)$
$EC\ term\ (Speed\ adjustment)$	-0.12***	-20.30*	-87.33*
	(-2.92)	(-2.70)	(-2.87)
$InEMPG_{t-1}$	-0.94***	-93.87	-17.72***
	(-3.81)	(-0.05)	(-2.91)
$InEMPG_{t-2}$	-0.59**	82.90	-15.06**
	(-2.06)	(0.04)	(-2.15)
$lnEMPG_{t-3}$	-0.21	-97.72	-46.27

	(-0.79)	(-0.05)	(-0.70)
$EXPO_{t-1}$	3.91	-0.33	-0.01
	(0.94)	(-1.12)	(-1.19)
$EXPO_{t-2}$	-5.56	0.02	-0.002
	(-1.15)	(0.05)	(-0.14)
$EXPO_{t-3}$	-3.36	0.40	-0.01
	(-0.77)	(1.28)	(-0.97)
$IMPO_{t-1}$	-1.54	1.64	-0.36
	(-1.41)	(0.21)	(-1.32)
$IMPO_{t-2}$	-3.07***	7.26	-0.16
	(-2.72)	(0.91)	(-0.59)
$IMPO_{t-3}$	-1.80	5.66	-0.75***
	(-1.48)	(0.65)	(-2.49)
$Constant$	-0.16**	445.39	-10.36
	(-2.12)	(0.00)	(-0.06)
R-squared	0.72	0.39	0.59
Log likelihood		-772.30	
Akaike Information Criterion		64.58	
Schwarz Criterion		66.29	

Notes: Robust z statistics are represented in parenthesis below coefficients, *** denotes significant at 1% level (p≤0.01), ** denotes significant at 5% level (p≤0.05) and * represents at 10% significant level (p≤0.1).

Normality test

The Johansen normalisation restrictions which referred as the long-run equation are presented in Table 6.24. The target variable for the Johansen normalisation restriction test is the total employment as shown in Table 6.24. The findings reveal that the t-statistics for both $EXPO_t$ and $IMPO_t$ are statistically significant, with expected signs. The decision rule is that a sign of statistically significant normalised co-integrating coefficient is reversed when comes to interpretation. The outcomes show that a 1 percent increase in exports output results in an increase of 4.90 percent in total employment in the long-run. The results show that in the long-run 1 percent rise in imports output will decrease the total employment by 1.75 percent. On average, the exports output displays positive long-run effects on the total employment, while the imports output suggests negative long-run effects on the total employment.

Table 6. 24: The normalised co-integrating coefficients for the apricot industry

$Cointegrating\ Equation$:	$CointEq1$
$lnEMPG_t$	1.00
$EXPO_t$	-4.90***
	(-3.94)
$IMPO_t$	1.75**
	(2.02)
Constant	-11.44

Note: *** denotes statistically significant at 1% level, **represents statistically significant at 5% level, while the sign of the significant coefficient is reversely interpreted and the signs of the insignificant coefficient are interpreted as they appear.

The existence of autocorrelation on the lag order of the regression was applied using the Langrage Multiplier (LM) test. The null hypothesis when using LM test for no autocorrelation is rejected when the probability value is lower than 5 percent. The alternative hypothesis for no autocorrelation cannot be rejected when probability value is more than 5 percent. Therefore, the study fails to reject the null hypothesis of no autocorrelation, as all p-values are more than 5 percent. In a nutshell, the entire four lags are free from autocorrelation and the strength of the model is satisfactory.

Table 6. 25: The LM test for the apricot industry

Lag	x^2	$Probability$
1	14.85	0.10
2	5.03	0.83
3	12.51	0.19
4	8.26	0.51

Source: Author's own compilation

The Jarque-Bera test is adopted to check if whether the errors are normally distributed or not. The errors are normally distributed when the p-value is greater than 5 percent, while the errors are not normally distributed when p-values are less than 5 percent. Table 6.26 shows that the errors are normally distributed for the total employment, exports output, imports output and for overall model.

Table 6. 26: The Jarque-Bera test for the apricot industry

$Equation$	x^2	$Probability$
$DlnEMPG_t$	2.15	0.34212
$DlnEXPO_t$	2.00	0.36772
$DlnIMPO_t$	0.63	0.73139
ALL	4.77	0.57341

Source: Author's own compilation

Table 6.27 outlines the outcomes for model stability condition of VECM regression model. The outcomes reveal that the VECM estimation displays about two unit moduli, which exists on both eigenvalue and modulus rows. The regression outcomes meet the eigenvalue strength condition, since modulus of each eigenvalue is less than 1, excluding only two conditions which has eigenvalue and moduli equivalent to 1. Therefore, the assessment for stableness condition shows that the model is constant.

Table 6. 27: The eigenvalue stability condition for the apricot industry

$Eigenvalue$	$Modulus$
1	1
1	1
-0.8727849	0.872785
-0.5215591 + 0.6274363i	0.815905
-0.5215591 - 0.6274363i	0.815905
0.8050588	0.805059
-0.9818322 + 0.7059797i	0.712774
-0.9818322 - 0.7059797i	0.712774
0.3326435 + 0.5392453i	0.633591
0.3326435 – 0.5392453i	0.633591
-0.5562639	0.556264
0.5056783	0.505678

Note: The VECM specification imposes 2 unit moduli

Granger causality test for apricot regression

The granger causality test was adopted to check the causality effects amongst the identified variables. As presented in Table 6.28, there is a bi-directional causality effect existing between the total employment and exports output, as their probability values are less than 0.05. This is ascribed to the fact that exports output triggers economic growth which results in an increased total employment in the apricot industry. Nonetheless, there is no causality amongst the total employment and imports output, as well as between imports output and exports output. Therefore, the implication is that in the long-run, exports granger causes total employment.

Table 6. 28: Granger causality test for the apricot industry

$Null\ hypothesis$	$F-statistic$	$P-value$
EXPO does not Granger-cause LNEMPG	2.06	0.0150
LNEMPG does not Granger-cause EXPO	4.23	0.0031
IMPO does not Granger-cause LNEMPG	0.49	0.6220
LNEMPG does not Granger-cause IMPO	0.82	0.4537
IMPO does not Granger-cause EXPO	2.89	0.0766
EXPO does not Granger-cause IMPO	0.67	0.5196

Note: The relationship with p-values below 0.05 percent signifies the causality effects between the variables, while the relationship with p-value over 0.05 percent denotes no causality between the variables.

❖ The ECM results for the South African avocado industry

Table 6.29 presents the optimum lag selection criterion for Johansen co-integration test of the avocado industry. The AIC was adopted as the lag selection criterion for Johansen co-integration analysis. As shown on Table 6.29, the first lag is regarded as the optimum lag for the entire avocado analysis using VECM. The justification for using AIC criterion is that it selects the most parsimonious model since it is centred on log likelihood function.

Table 6. 29: The lag selection criterion for the avocado industry

Lag	$LogL$	LR	FPE	AIC	$HQIC$	$SBIC$
0	-865	NA	5.4*	72.37*	72.41*	72.52*
1	-857	17.48*	5.6	72.39	72.55	72.98
2	-851	11.45	7.7	72.67	72.94	73.70
3	-845	11.06	1.1	72.96	73.35	74.43
4	-840	11.39	1.9	73.23	73.74	75.15

Note: *indicates the selected optimal lag length based on each criterion

The analysis of co-integrating errors for the avocado was conducted using the Johansen co-integration test, which is grounded on the optimal selected lag. Table 6.30 shows that all identified variables were integrated as there was a possible likelihood of an equilibrium convergence amongst them. As postulated by Gujarati (2015), the null hypothesis of no co-integration is rejected when the trace statistics is below 5 percent critical value. Therefore, the null hypothesis of no co-integration cannot be rejected when trace statistics is higher than 5 percent critical value.

Table 6.30 presents the results of assessment of long-run interrelation amongst the total employment, exports output and imports output. Notably, the results show the presence of at least two co-integrating equations, since trace statistics is smaller than 5 percent critical value. The implication is that there is a presence of long-run co-integrating relationship amongst the exports output, imports output and total employment.

Table 6. 30: The estimation of co-integrating vectors for the avocado industry

$Hypothesized$ $No. of\ CE(s)$	$Eigenvalue$	$Trace$ $Statistic$	0.05 $Critic\ value$
None	0.67	38.00	29.80
At most 1	0.22	18.99	15.50
At most 2	0.07	2.04	3.84*

Note: Trace test indicates 2 co-integrating equations at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level.

The variables included in the VECM regression become stationary after subjected to first differencing [*I(1)*] and there is the presence of at least 2 co-integrating equations. The results of the VECM suggest the long-run impacts posed by endogenous variables which move towards long-run convergence, while allowing a massive range of short-run dynamics.

As presented in Table 6.31, the coefficient linked to an ECT of total employment possesses a correct negative signage, while its pace of convergence towards equilibrium is about 0.69 percent. Consequently, in the short-run total employment is corrected by at least 0.69 percent of last year’s deviation from the steadiness and it shows to be statistically significant at 5 percent level. The bigger value associated with the ECT coefficient shows that the steadiness agents reduce a higher percentage of disequilibrium linked to each specific period. Therefore, the higher value (0.69 percent) of total employment signifies the faster speed of convergence towards equilibrium. The remaining variables included on the regression are two lags of total employment, exports output and imports output.

The ECT coefficient linked to exports output has an expected negative sign, while it is statistically significant at 10 percent level. The coefficient linked to ECT for exports output has about 1.24 speed of convergence towards equilibrium. Nonetheless, the interpretation is that in the short-run, exports output is adjusting by at least 1.24 percent of previous year's derogation from equilibrium. The results suggest that the model is steady and speed of convergence towards equilibrium is fast.

The coefficient of ECT linked with imports output for avocado industry shows an expected negative sign, while it is statistically significant at 1 percent level. The outcomes reveal the steadiness of the system, while it portrays smoother convergence rate towards equilibrium. Table 6.31 shows that the ECT coefficient for avocado has about 4.03 speed of convergence towards equilibrium. Notably, in the short-run, imports output is adjusting by at least 4.03 percent of previous year's derogation to equilibrium. The results indicate that estimation is stable and speed of convergence to equilibrium is sluggish.

Table 6.31 presents the fitted R^2 values from VECM estimation which are as follows: 0.59 for total employment, 0.34 for exports output and 0.61 for imports output. Therefore, 59 percent of variations in the total employment equation are clarified by all explanatory variables. The R^2 value for exports output shows that 34 percent of variations in exports output is explained by included independent variables. For imports output, 61 percent of variations in the equation are explained by all regressors. In addition, the values associated with AIC and SBIC are 71.95 and 73.21, respectively. Furthermore, the results show that the value associated with log likelihood is equivalent to 909.37, which is greater than both AIC and SBIC values. The greater log likelihood signifies the good strength of the model.

Table 6. 31: The VECM estimation results for the avocado industry

$Error\ Correction$	$D(lnEMPG)$	$D(EXPO)$	$D(IMPO)$
$EC\ term\ (Speed\ of\ adjustment)$	-0.69**	-1.24*	-4.03***
	(-2.39)	(-2.19)	(-2.95)
$InEMPG_{t-1}$	0.003	-2.76	1.16
	(0.01)	(-1.08)	(0.84)
$InEMPG_{t-2}$	0.31	-2.65	1.51
	(1.45)	(-1.40)	(1.49)
$EXPO_{t-1}$	-9.47	-0.08	-0.0004
	(-0.36)	(-0.36)	(-0.31)
$EXPO_{t-2}$	-3.09	0.20	0.0006
	(-1.17)	(0.86)	(0.44)
$IMPO_{t-1}$	2.13***	-57.92	-0.02
	(3.93)	(-1.21)	(-0.08)
$IMPO_{t-2}$	1.14***	-40.14	0.11
	(2.59)	(-1.03)	(0.54)
$Constant$	0.12**	21.26	65.43***
	(2.39)	(0.00)	(2.80)
R-squared	0.59	0.34	0.61
Log likelihood		-909.37	
Akaike Information Criterion		71.95	
Schwarz Criterion		73.21	

Notes: Robust z statistics are represented in parenthesis below coefficients, *** denotes significant at 1% level (p≤0.01), ** denotes significant at 5% level (p≤0.05) and * represents at 10% significant level (p≤0.1).

Normality test

The Johansen normalisation restrictions or long-run effects test is presented in Table 6.32. The target variable for the Johansen normalisation restrictions is total employment, which is tested against exports output and imports output. The outcomes reveal that the t-statistics for $EXPO_t$ series is negative and statistically significant at 1 percent level. The signage of the statistically significant normalised co-integrating coefficient is interpreted in reverse order. Therefore, Table 6.32 suggests that in a long-run a 1 percent increase in exports output results in 3.06

percent in total employment. Conversely, in the long-run a 1 percent increase in imports output leads to at least 2.37 decreases in total employment. In a nutshell, the exports output of the avocado industry has a positive long-run effects on the total employment, while imports output has a negative long-run effects on total employment.

Table 6. 32: The normalised co-integrating coefficients for the avocado industry

$Cointegrating\ Equation$:	$CointEq1$
$lnEMPG_t$	1.00
$EXPO_t$	-3.06***
	(-5.15)
$IMPO_t$	2.37***
	(4.19)
Constant	-9.99

Note: *** denotes statistically significant at 1% level, while the sign of the significant coefficient is reversely interpreted and the signs of the insignificant coefficient are interpreted as they appear.

The LM test is applied to assess the existence of autocorrelation depending on the lag order of the estimation. Table 6.33 indicates that the null hypothesis of no auto-correlation cannot be rejected due to the fact that p-values are more than 5 percent level. In a nutshell, the first lag of total employment is free from auto-correlation, which makes the model to be robust.

Table 6. 33: Langrage-multiplier test for the avocado industry

Lag	x^2	$Probability$
1	6.1293	0.72691

Source: Author's own compilation

Table 6.34 presents the assessment for normally distributed errors using the Jarque-Bera. The errors are normally distributed when p-values are above 5 percent, while errors are not normally distributed when the p-values are below 5 percent. Therefore, the results from Table 6.34 show that the errors are normally distributed for the total employment and imports output. Conversely, errors are not normally distributed for the exports output and the whole model.

Table 6. 34: The Jarque-Bera test for the avocado industry

$Equation$	x^2	$Probability$
$DlnEMPG_t$	0.40	0.81997
$DlnEXPO_t$	10.65	0.00486
$DlnIMPO_t$	5.48	0.06469
ALL	16.53	0.01119

Source: Author's own compilation

The results from Table 6.35 reveal the model stability condition of the VECM of avocado industry. Table 6.35 shows that the VECM model for avocado industry possess about two unit moduli, which exists in both eigenvalue and modulus rows. Therefore, the model fulfils the eigenvalue stability condition, since modulus of each eigenvalue is smaller than 1, except two conditions that are equivalent to 1. In a nutshell, the test for stableness reveals that the model is constant.

Table 6. 35: The eigenvalue stability condition for the avocado industry

$Eigenvalue$	$Modulus$
1	1
1	1
0.3948716 + 0.7483875i	0.846172
0.3948716 - 0.7483875i	0.846172
-0.8141914	0.814191
-0.34536 + 0.4626359i	0.577326
-0.34536 - 0.4626359i	0.577326
-0.4146108	0.414611
0.3483021	0.348302

Note: The VECM specification imposes 2 unit moduli.

Granger causality test for avocado regression

The granger causality test is applied to check the causality effects amongst identified variables. Table 6.36 shows the bi-directional causality effects between total employment and exports output, as well as between exports output and imports output. The former bi-directional relationship is attributed to the fact that exports boost business profitability which results into increased employment. The latter bi-directional relationship is ascribed to the fact that South Africa is a net importer of fruit concentrates which are used as intermediate goods for exportable products and employment opportunities are realised from export products, as their p-value are below 0.05. However, there is no existing causality effects between imports output and total employment.

Table 6. 36: Granger causality test for the avocado industry

Null hypothesis	*F − statistic*	*P − value*
EXPO does not Granger-cause LNEMPG	1.62	0.0220
LNEMPG does not Granger-cause EXPO	1.09	0.0355
IMPO does not Granger-cause LNEMPG	1.06	0.3621
LNEMPG does not Granger-cause IMPO	0.42	0.6616
IMPO does not Granger-cause EXPO	6.29	0.0069
EXPO does not Granger-cause IMPO	3.92	0.0350

Note: the relationship with p-values below 0.05 percent signifies the causality effects between the variables, while the relationship with p-value over 0.05 percent denotes no causality between the variables.

❖ The ECM findings for the South African orange industry

The AIC is the chosen optimal lag length selection criterion for Johansen co-integration analysis. Table 6.37 reveals that the third lag length is selected option throughout the orange industry analysis. Mccombie (2011) postulates that the AIC selection criterion picks the best parsimonious estimation since it is linked to the log likelihood function.

Table 6. 37: The lag selection criterion for the orange industry

Lag	*LogL*	*LR*	*FPE*	*AIC*	*HQIC*	*SBIC*
0	-908	NA	1.8	75.89	75.93	76.04*
1	-897	20.92	1.6*	75.77	75.93*	76.36
2	-889	17.33	1.8	75.80	76.07	76.83
3	-867	12.97	1.9	75.52*	76.03	77.44
4	-882	29.62*	2.4	76.01	76.40	77.48

Note: *indicates the selected optimal lag length based on each criterion

The Johansen co-integrating assessment technique was conducted using the non-correlated errors based on adopted optimal lag selection criterion. As presented on ADF test, the identified variables were first differenced, since they all showed to be non-stationary at levels. Notably, the condition to reject the null hypothesis of no co-integration happens when the trace statistics is smaller than 5 percent critical value (Gujarati 2003; Mccombie 2011; Verduzco-Gallo et al. 2014). Alternatively, the null hypothesis of no co-integration cannot be rejected when the trace statistics is bigger than 5 percent critical value.

Table 6.38 indicates that the Johansen co-integration assessment technique was identified to test the existence of a long-run equilibrium interrelation amongst all identified regressors. Therefore, Johansen co-integration assessment technique checks the possibilities of long-run associations that may occur amongst the exports output, imports output and total employment. The results indicate that the trace statistics as shown on Table 6.38 highlights the existence of about two co-integrating equations, since trace statistics are smaller than 5 percent critical value. In a nutshell, the findings highlight the existence of a long-run co-integrating relationship amongst all identified regressors.

Table 6. 38: The estimation of co-integrating vectors for the orange industry

$Hypothesized$ $No. of\ CE(s)$	$Eigenvalue$	$Trace$ $Statistic$	0.05 $Critic\ value$
None	0.40	29.80	21.68
At most 1	0.25	15.49	7.72
At most 2	0.004	0.12	3.84*

Note: the results highlight the presence of two co-integrating equation in this model, *represents the co-integrating equation

As depicted in Table 3.10, all included variables in the orange analysis were found to be stationary after first differencing [*I(1)*]. The VECM results from Table 6.39 indicate that estimation has at least two co-integrating relationships. Furthermore, the VECM reveals the long-run impacts of the endogenous variables to adjust to their long-run equilibrium while allowing an excessive range of short-run dynamics. As revealed in Table 6.39, the ECT coefficient for the total employment has an expected negative signage, which is statistically significant at 10 percent and its speed of adjustment towards equilibrium is about 0.002.

In a short-run, the total employment is converging by 0.002 percent of last year's deviation gap from the equilibrium. The lower value of the ECT coefficient for total employment results in a slower speed of adjustment towards an equilibrium. The other variables included on the total employment regression are two lags of total employment, two lags of exports output and two lags of imports output. Therefore, the results show that in a short-run, the total employment is converging by at least 0.002 percent of last year's deviation from equilibrium.

Table 6.39 reveals that the ECT coefficient of exports output possess a negative expected signage and is statistically significant at 1 percent level. Furthermore, the coefficient of ECT for exports output has about 1.11 percent speed of convergence towards equilibrium. Therefore, the interpretation is that in a short-run exports output is adjusting by at least 1.11 percent of previous year's derogation from equilibrium. In a nutshell, the model is stable and speed of convergence to equilibrium is sluggish.

The ECT's coefficient for imports output carries a negative sign and it is statistically significant at 1 percent level. The outcomes support the stability of the model and smoother adjustment towards equilibrium. Furthermore, the adjustment speed for this equation is faster, due to the bigger ECT value which is equivalent to 25.37. Therefore, the expected signage and statistical significance of all coefficients linked to ECTs of all three equations suggest that the variables affect one another in the long-run.

Table 6.39 shows that the R^2 for three equations are as follows: 0.45, 0.88 and 0.45, respectively. The AIC and SBIC values are both below the log likelihood value, which are 75.62 and 77.33, respectively. The log likelihood value of 910.26 indicates the greater strength of this model. The R^2 value for total employment highlights that at least 45 percent of variations in the total employment model is explained by all regressors. The R^2 value for exports output show that at least 88 percent of variations in the exports output equation are clarified by all independent variables. Table 6.39 reveals that at least 45 percent of variations in the imports output are clarified by all explanatory variables.

Table 6. 39: The VECM estimation results for the orange industry

$Error\ Correction$	$D(lnEMPG)$	$D(EXPO)$	$D(IMPO)$
$EC\ term\ (Speed\ of\ adjustment)$	-0.002*	-1.11***	-25.37***
	(-2.23)	(-3.56)	(-2.71)
$InEMPG_{t-1}$	0.16	-3.90	1.16
	(0.59)	(-0.48)	(0.47)
$InEMPG_{t-2}$	-0.002	-1.51*	1.36
	(-0.01)	(-1.78)	(0.53)
$InEMPG_{t-3}$	-0.07	1.50	1.22
	(-0.26)	(0.17)	(0.47)
$EXPO_{t-1}$	4.19	-0.93***	-0.01
	(0.42)	(-3.01)	(-1.45)
$EXPO_{t-2}$	2.18	-0.29	-0.01*
	(0.26)	(-1.12)	(-1.80)
$EXPO_{t-3}$	-3.40	-0.26	-0.01*
	(-0.42)	(-1.04)	(-1.90)
$IMPO_{t-1}$	-7.39	58.07***	0.61
	(-1.51)	(3.85)	(1.35)
$IMPO_{t-2}$	-3.65	75.95***	0.81
	(-0.62)	(4.15)	(1.46)
$IMPO_{t-3}$	-3.45	54.04	0.71
	(-0.49)	(2.47)	(1.08)
$Constant$	-0.003	94.28	-41.10
	(-0.08)	(0.00)	(-1.15)
R-squared	0.45	0.88	0.45
Log likelihood		-910.26	
Akaike Information Criterion		75.62	
Schwarz Criterion		77.33	

Notes: Robust z statistics are represented in parenthesis below coefficients, *** denotes significant at 1% level (p≤0.01), ** denotes significant at 5% level (p≤0.05) and * represents at 10% significant level (p≤0.1).

Normality test

Table 6.40 shows that Johansen normalisation restrictions test for orange industry. The normalisation restrictions test is based on the target variable (total employment). Table 6.40 indicates that the t-statistics for $IMPO_t$ series is statistically significant and $EXPO_t$ series is statistically insignificant. It is worth noting that the statistically significant normalised co-integrating coefficients are interpreted in reverse format. However, the statistically insignificant of normalised co-integrating coefficients are interpreted as they appear. The findings suggest that a 1 percent increase in exports output results into 2.10 increases in total employment in a long-run. Furthermore, a 1 percent increase in imports output leads to a decrease of 3.05 in total employment in the long-run. Therefore, the decision is that the exports output has a positive long-run effects on total employment, while imports output has a long-run negative effects on the total employment, *ceteris paribus*.

Table 6. 40: The results of co-integration equation for the orange industry

$Co-integrating\ Equation$:	$CointEq1$
$lnEMPG_t$	1.00
$EXPO_t$	-2.10*
	(-0.71)
$IMPO_t$	3.05***
	(4.48)
Constant	-7.36

Note: *** denotes statistically significant at 1% level, *represents statistically significant at 10% level, while the sign of the significant coefficient is reversely interpreted and the signs of the insignificant coefficient are interpreted as they appears.

The Langrage Multiplier technique was applied to assess the presence of auto-correlation on the lag order of the equation. As depicted on Table 6.41, the null hypothesis of no auto-correlation failed to be rejected as all probability values are beyond 5 percent. The implication is that all four lags of orange equation are free from auto-correlation, which makes the model to be robust.

Table 6. 41: Langrage-multiplier test for the orange industry

Lag	x^2	$Probability$
1	19.87	0.08
2	16.20	0.06
3	12.08	0.21
4	9.26	0.41

Source: Author’s own compilation

Table 6.42 presents the test results for normality of distributed errors utilising the Jarque-Bera approach. The deciding factor is that errors are normally distributed when the p-value is over 5 percent, while errors are not normally distributed when the p-values are below 5 percent. The findings indicate that the errors are normally dispersed for the total employment equation, exports output and the whole model. Nonetheless, the errors are not normally distributed only for the imports output, since its p-value is lower than 0.05.

Table 6. 42: The Jarque-Bera test for the orange industry

$Equation$	x^2	$Probability$
$DlnEMPG_t$	1.27	0.52976
$DlnEXPO_t$	0.87	0.64715
$DlnIMPO_t$	44.06	0.00000
ALL	46.20	0.0000

Source: Author's own compilation

Table 6.43 shows the findings for the model stability condition for VECM analytical technique of the orange industry. The findings reveal that the VECM estimation imposes at least two unit moduli, which appears on both eigenvalue and modulus rows. The model meets the eigenvalue stability condition, since modulus of individual eigenvalue is below 1, excluding for only two conditions. Therefore, the results for stability condition show that the model is stable.

Table 6. 43: The eigenvalue stability condition for the orange industry

$Eigenvalue$	$Modulus$
0.7126087 + 0.9002103i	1.14812
0.7126087 - 0.9002103i	1.14812
1.050946	1.05095
1	1
1	1
-0.8356735 + 0.334111i	0.899989
-0.8356735 - 0.334111i	0.899989
-0.4527786 + 0.7138282i	0.845316
-0.4527786 - 0.7138282i	0.845316
0.2255524 + 0.4870533i	0.536745
0.2255524 - 0.4870533i	0.536745
-0.2836746	0.283675

Note: The VECM specification imposes 2 unit moduli.

Granger causality test

The granger causality test is adopted to assess the causality effects amongst the identified variables. Table 6.44 shows an expected bi-directional causality effects between the total employment and exports output, due to the fact that their probability values are smaller than 0.05. The results are ascribed to the fact that exports are instrumental in generating profits for firms which produce oranges, which triggers more employment opportunities. Nonetheless, there is no causality effects amongst imports output and total employment, as well as between exports output and imports output.

Table 6. 44: Granger causality test for the orange industry

$Null\ hypothesis$	$F-statistic$	$P-value$
EXPO does not Granger Cause LNEMPG	5.30	0.0132
LNEMPG does not Granger Cause EXPO	0.39	0.0067
IMPO does not Granger Cause LNEMPG	0.35	0.7105
LNEMPG does not Granger Cause IMPO	0.28	0.7588
IMPO does not Granger Cause EXPO	2.12	0.1438
EXPO does not Granger Cause IMPO	1.61	0.2224

Note: the relationship with p-values below 0.05 percent signifies the causality effects between the variables, while the relationship with p-value over 0.05 percent denotes no causality between the variables.

- ❖ The ECM findings for the South African pear industry

The analysis for the pear industry adopts the AIC criterion to select an optimal lag length under Johansen co-integration technique. Table 6.45 shows that the third lag length has been selected for the entire pear industry analysis. Notably, the AIC criterion selects the most parsimonious model asymptotically as it is grounded on log likelihood function.

Table 6. 45: The lag selection criterion for the pear industry

Lag	$LogL$	LR	FPE	AIC	$HQIC$	$SBIC$
0	-824	NA	1.7	68.89	68.93*	69.03*
	-814	18.91	1.6*	68.85	69.00	69.44
2	-806	16.72	1.8	68.90	69.18	69.93
3	-795	22.41*	1.6	68.72*	69.11	70.19
4	-789	11.78	2.7	68.98	69.49	70.89

Note: *indicates the selected optimal lag length based on each criterion

The estimation of Johansen co-integrating errors based on the optimal lag length selection criterion for pear industry is presented on Table 6.46. As presented in Table 6.46, identified variables in the series are first integrated as there is possibility of an equilibrium connection amongst them. Notably, the rejection rule of the null hypothesis of no co-integration happens when the trace statistics is smaller than 5 percent critical value (Gujarati 2015; Wooldridge 2013). Furthermore, the null hypothesis of no co-integration cannot be rejected when the trace statistics is higher than 5 percent critical value.

In addition, the Johansen co-integration test was applied to check the existence of a long-run equilibrium association amongst the variables. Therefore, Table 6.46 tests the trend of long-run associations that exists amongst the total employment, exports output and imports output. The results show that there is a presence of at least two co-integrating equations from the model as the trace statistics are smaller than 5 percent critical value. The overall results indicate the existence of a long-run co-integrating relationship amongst the total employment, exports output and imports output.

Table 6. 46: The estimation of co-integrating vectors for the pear industry

$Hypothesized$ $No.of\ CE(s)$	$Eigenvalue$	$Trace$ $Statistic$	0.05 $Critic\ value$
None*	0.73	43.96	29.80
At most 1	0.26	28.36	15.49
At most 2	0.003	0.09	3.84

Note: trace indicates 1 co-integrating equation at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level.

After finding that all explanatory variables are stationary after first differencing and Johansen co-integrating test shows that the model has at least two co-integrating relationships. The VECM shows the long-run impacts of the endogenous variables to adjust to their long-run equilibrium while allowing an extensive range of dynamics linked to short-run equilibrium. Table 6.47 reveals the coefficient that is linked to an ECT for the total employment, which carries an expected sign, while it shows to be statistically significant at 5 percent level and its speed of adjustment towards equilibrium is equivalent to 0.06 percent.

The implication is that in the short-run, the total employment is converging by about 0.06 percent of the previous year's deviation from the equilibrium. The larger values associated with the ECT coefficient indicate that equilibrium agents reduce a bigger percentage of disequilibrium relating to each period. However, the smaller coefficient values are linked to the sluggish speed of adjustment to equilibrium. Therefore, the value of 0.06 percent for total employment is associated with sluggish speed of adjustment towards equilibrium. The other included variables on the model are second lags of total employment, second lags of exports output and second lags of imports output. The first lag of total employment is statistically significant at 1 percent level, while the second lag of total employment and first lag imports output are statistically significant at 10 percent level.

The coefficient of ECT associated with exports output possesses a negative sign and it shows to be statistically significant at 5 percent level. The coefficient associated with ECT has at least 1.45 percent speed of convergence to equilibrium. Therefore, the interpretation is that in a short-run exports output is adjusting by at least 1.45 percent of previous year's derogation from equilibrium. This indicates that the model is stable and speed of convergence to equilibrium is sluggish.

The ECT coefficient linked with the imports output carries a negative sign and it shows to be statistically significant at 1 percent level. The outcomes reveal the stability of the model and fast convergence towards equilibrium. Table 6.47 shows that the adjustment towards the equilibrium is quicker since there is high value of ECT coefficient which is equivalent to 55.03. Therefore, the statistical significance associated with all ECTs' coefficients show that the identified variables cause one another in a long-run.

The findings presented in Table 6.47 show that the R^2 for VECMs are as follows: 0.63, 0.58 and 0.64, respectively. Table 6.47 shows that the AIC of about 67.99 and SBIC of 69.25 are lower than the calculated log likelihood. Therefore, the log likelihood value of about 857.88 is higher than both values of AIC and SBIC, which indicates the strong strength of the model. The R^2 value linked to total employment highlights that at least 63 percent of variations in the total employment model are explained by all regressors. The results show that 58 percent of variations in the exports output model are clarified by all the independent variables. Table 6.47 reflects that at least 64 percent of variations in the imports output model are explained by all regressors.

Table 6. 47: The VECM estimation results for the pear industry

$Error\ Correction$	$D(lnEMPG)$	$D(EXPO)$	$D(IMPO)$
$EC\ term\ (Speed\ of\ adjustment)$	-0.06**	-1.45**	-55.03***
	(-2.43)	(-2.41)	(-3.01)
$InEMPG_{t-1}$	-0.96***	4.86	-76.56
	(-4.61)	(0.09)	(-0.49)
$InEMPG_{t-2}$	-0.41*	7.53	-12.29
	(-1.92)	(0.14)	(-0.77)
$EXPO_{t-1}$	7.28	-0.88**	-0.002**
	(0.53)	(-2.55)	(-2.05)
$EXPO_{t-2}$	1.09	-0.45	-0.001
	(0.10)	(-1.70)	(-1.33)
$IMPO_{t-1}$	-7.25*	319.20***	0.55
	(-1.88)	(3.33)	(1.87)
$IMPO_{t-2}$	-4.67	138.44	-0.001
	(-1.23)	(1.47)	(-0.01)
$Constant$	0.10***	10.45	-27.51
	(3.65)	(0.00)	(-1.32)
R-squared	0.63	0.58	0.64
Log likelihood		-857.88	
Akaike Information Criterion		67.99	
Schwarz Criterion		69.25	

Notes: Robust z statistics are represented in parenthesis below coefficients, *** denotes significant at 1% level (p≤0.01), ** denotes significant at 5% level (p≤0.05) and * represents at 10% significant level (p≤0.1).

Normality test

Table 6.48 shows the Johansen normalisation restrictions test for the pear industry, this test is often called long-run co-integration analysis. The normalised restrictions are grounded on the target variable which is the total employment. The findings show that the $EXPO_t$ series is statistically significant at 1 percent level and $IMPO_t$ series also statistically significant at 1 percent level. Therefore, Table 6.48 shows that a 1 percent incline in exports output results in 3.23 long-run increases in total employment. Furthermore, the results indicate that a 1 percent increase in imports output leads to at least 2.36 decreases in total employment. In a nutshell, exports output has a positive effect on total employment in the long-run, while the imports output impacts negatively on the total employment in the long-run, *ceteris paribus*.

Table 6. 48: The results of co-integration equation for the pear industry

$Cointegrating\ Equation$:	$CointEq1$
$lnEMPG_t$	1.00
$EXPO_t$	-3.23***
	(-5.67)
$IMPO_t$	2.36***
	(4.70)
Constant	-9.62

Note: *** denotes statistically significant at 1% level, while the signs of the significant coefficient are reversely interpreted and the signs of the insignificant coefficient are interpreted as they appear.

The LM assessment was applied to test the existence of auto-correlation throughout the lag order of regression. The rule of thumb associated with the LM test is that the null hypothesis for absence of auto-correlation is rejected when the p-value is lower than 5 percent. The alternative hypothesis for no auto-correlation is failed to be rejected when the probability value is more than 5 percent. Therefore, the results from Table 6.49 show that the null hypothesis of no auto-correlation cannot be rejected, as all probability values are more than 5 percent. Therefore, all included lags do not suffer from autocorrelation and this renders the model robust.

Table 6. 49: Langrage-multiplier test for the pear industry

Lag	x^2	$Probability$
1	4.03	0.91
2	12.89	0.17
3	12.82	0.17

Source: Author's own compilation

Table 6.50 presents the assessment for normally distributed errors utilising the Jarque-Bera approach. The deciding principle is that errors are normally distributed when the p-value is over 5 percent, while the errors are not normally distributed when the p-value is less than 5 percent. The findings show that the errors are normally distributed for total employment and for overall model. However, errors are not normally distributed for both exports output and imports output.

Table 6. 50: The Jarque-Bera test for the pear industry

$Equation$	x^2	$Probability$
$DlnEMPG_t$	0.35	0.83778
$DlnEXPO_t$	4.93	0.008493
$DlnIMPO_t$	7.24	0.02675
ALL	12.53	0.05117

Source: Author's own compilation

Table 6.51 highlights the outcomes for the model stableness condition of VECM regression for the pear industry. The findings indicate that the VECM model imposes at least two unit moduli, which are shown on both eigenvalue and modulus rows. The regression meets the eigenvalue stableness condition, based on the fact that majority of modulus and eigenvalue are below 1, excluding only two conditions which are equivalent to 1. Therefore, the assessment for stability condition shows that the model is strong and stable.

Table 6. 51: The eigenvalue stability condition for the pear industry

$Eigenvalue$	$Modulus$
1	1
1	1
-0.103625 + 0.8442874i	0.850623
-0.103625 - 0.8442874i	0.850623
0.6500659	0.650066
-0.444717 + 0.4336413i	0.621142
-0.444717 - 0.4336413i	0.621142
-0.3668067 + 0.2211679i	0.428325
-0.3668067 - 0.2211679i	0.428325

Source: Author's own compilation based on dataset

Granger causality test

The granger causality test is adapted to check for causality effects amongst the identified variables. Table 6.52 highlights the anticipated bi-directional causality effects between the total employment and exports output, since their probability values are less than 0.05. This is ascribed to fact that exports cause profitability to pears-producing firms, which in turn increases their total employment. However, there are no causality effects between imports output and total employment, also between exports output and imports output, due to the fact that their p-values are below 0.05.

Table 6. 52: Granger causality test for the pear industry

$Null\ hypothesis$	$F - statistic$	$P - value$
EXPO does not Granger-cause LNEMPG	3.68	0.005
LNEMPG does not Granger-cause EXPO	5.39	0.001
IMPO does not Granger-cause LNEMPG	0.27	0.762
LNEMPG does not Granger-cause IMPO	1.82	0.192
IMPO does not Granger-cause EXPO	18.02	2.051
EXPO does not Granger-cause IMPO	5.45	0.073

Note: the relationship with p-values below 0.05 percent signifies the causality effects between the variables, while the relationship with p-value over 0.05 percent denotes no causality between the variables.

❖ The ECM findings for the South African table grape industry

Table 6.53 presents the lag selection criterion in order to select an optimal lag length for Johansen co-integration analysis. Therefore, the AIC is chosen as an optimal lag length selection criterion for the table grape industry. As presented in Table 6.53, the first lag is selected as an optimal lag length for an entire analysis of the table grape industry. Notably, the AIC criterion selects the most parsimonious estimation due to its association with a log likelihood function.

Table 6. 53: The lag selection criterion for the table grape industry

Lag	$LogL$	LR	FPE	AIC	$HQIC$	$SBIC$
0	-865	NA	5.4*	72.37*	72.41*	72.52*
1	-857	17.48*	5.6	72.39	72.55	72.98
2	-851	11.45	7.7	72.67	72.94	73.70
3	-845	11.06	1.1	72.96	73.35	74.43
4	-840	11.39	1.9	73.23	73.74	75.15

Note: *indicates the selected optimal lag length based on each criterion

The Johansen co- integration assessment was performed using uncorrelated errors grounded on the optimal lag length selection criterion (Gujarati & Porter 2009; Salvanes & Forre 2003). All variables in the estimation are stationary after first differencing, since there are possibilities of equilibrium connection amongst them. In this regard, the rejection of null hypothesis of co-integration happens when trace statistics is below 5 percent critical value. Therefore, the decision rule is that the null hypothesis of no co-integration failed to be rejected when the trace statistics is higher than 5 percent critical value.

In addition, the Johansen co-integration assessment is used to check the presence of a long-run equilibrium association amongst all identified variables. Table 6.54 checks the long-run association that may exist amongst the total employment, exports output and imports output. It is worth noting that trace statistics as shown on Table 6.54 highlights the existence of at least two co-integrating equations, since their trace statistics are below 5 percent critical value. Notably, the outcomes show the existence of a long-run co-integrating relationship amongst the total employment, exports output and imports output.

Table 6. 54: The estimation of co-integrating vectors for the table grape industry

$Hypothesized$ $No.of\ CE(s)$	$Eigenvalue$	$Trace$ $Statistic$	0.05 $Critic\ value$
None	0.70	42.22	29.80
At most 1	0.30	39.72	15.49
At most 2*	0.004	0.11	3.84

Note: the results highlight the presence of two co-integrating equations in this model, *represents the co-integrating equation

Subsequent to learning that all variables become stationary after first integration and VECM contains about two co-integrating equations throughout their optimum lags, the VECM highlights the long-run effects of the endogenous variables to adjust to their long-run equilibrium while allowing a wide range of short-run dynamics. Table 6.55 indicates that the coefficient for ECT linked to the total employment, which carries an anticipated negative sign, while it shows to be statistically significant at 5 percent level and its adjustment speed towards equilibrium is 0.69 percent.

The implication is that in the short-run, the total employment is converging by at least 0.69 percent of last year's deviation from the equilibrium. The smaller value such as 0.69 is associated with slow speed of adjustment to equilibrium. Therefore, the speed of convergence for the total employment to equilibrium is slower. Other variables included on the total employment estimation include the two lags of total employment, two lags of exports output and two lags of imports output. Both the first as well as second lags of imports output are statistically significant at 1 percent level.

The coefficient of ECT associated with exports output possesses an expected negative signage, while it is statistically significant at 10 percent level. Furthermore, the ECT coefficient linked to exports output has about 1.24 percent speed of adjustment towards equilibrium. The interpretation is that in a short-run, exports output is adjusting by at least 1.24 percent of previous year's derogation from equilibrium. The implication is that the system is constant and the speed of convergence to equilibrium is sluggish.

The ECT coefficient linked to imports output carries a negative signage and it is statistically significant at 1 percent level. The findings indicate the stability of the system and gradual convergence to equilibrium. In addition, the adjustment to equilibrium is slower due the smaller ECT value which is equivalent to 4.03. Notably, the statistical significance of the entire coefficient linked to ECTs suggests that the identified variables cause each other in the long-run.

The findings revealed in Table 6.55 indicate that the VECM's R^2 are as follows: 0.59, 0.34 and 0.61, respectively. The AIC and SBIC values associated with table grape regression are equivalent to 71.95 and 73.21, respectively. The value of log likelihood is equivalent to 909.37 which is more than both AIC and SBIC, which suggests the stronger strength of model. The value of R^2 of the total employment indicates that at least 59 percent of variations in the total employment are clarified by the independent variables. Furthermore, the R^2 value of 34 percent associated with exports output shows that at least 34 percent of variations in the exports output is explained by all regressors. In a nutshell, Table 6.55 highlights that at least 61 percent of variations in the imports output are clarified by all regressors.

Table 6. 55: The estimation results for the table grape industry

$Error\ Correction$	$D(lnEMPG)$	$D(EXPO)$	$D(IMPO)$
$EC\ term\ (Speed\ of\ adjustment)$	-0.69**	-1.24*	-4.03***
	(-2.39)	(-2.09)	(-2.95)
$InEMPG_{t-1}$	0.003	-2.76	1.16
	(0.01)	(-1.08)	(0.84)
$InEMPG_{t-2}$	0.31	-2.65	1.51
	(1.45)	(-1.40)	(1.49)
$EXPO_{t-1}$	-9.47	-0.08	-0.0004
	(-0.36)	(-0.36)	(-0.31)
$EXPO_{t-2}$	-3.09	0.20	0.0006
	(-1.17)	(0.86)	(0.44)
$IMPO_{t-1}$	2.13***	-57.92	-0.02

	(3.93)	(-1.21)	(-0.08)
$IMPO_{t-2}$	1.14***	-40.14	0.11
	(2.59)	(-1.03)	(0.54)
$Constant$	0.12***	21.25	65.43***
	(2.39)	(0.00)	(2.80)
R-squared	0.59	034	0.61
Log likelihood		-909.37	
Akaike Information Criterion		71.95	
Schwarz Criterion		73.21	

Notes: Robust z statistics are represented in parenthesis below coefficients, *** denotes significant at 1% level (p≤0.01), ** denotes significant at 5% level (p≤0.05) and * represents at 10% significant level (p≤0.1).

Normality test

Table 6.56 shows the Johansen normalisation restrictions for table grape industry. The target variable as shown in Table 6.56 is the total employment. The findings show that $EXPO_t$ series is statistically significant at 1 percent level, while the $IMPO_t$ series is statistically significant at 1 percent level. Notably, the signage associated with the statistically significant normalised co-integrating coefficient is interpreted in reverse. Table 6.56 highlights that a 1 percent increase in exports output in long-run results to at least 3.06 increase in total employment. Therefore, a 1 percent rise in imports leads to 2.37 long-run decreases in total employment. In a nutshell, exports output has positive effects in a long-run towards the total employment, while the imports output indicates a negative effect in a long-run towards the total employment.

Table 6. 56: The results of co-integration equation for the table grape industry

$\boldsymbol{Cointegrating\ Equation}$:	$CointEq1$
$lnEMPG_t$	1.00
$EXPO_t$	-3.06***
	(-5.15)
$IMPO_t$	2.37***
	(4.19)
Constant	-9.99

Note: *** denotes statistically significant at 1% level, while the signs of the significant coefficient are reversely interpreted and the signs of the insignificant coefficient are interpreted as they appear.

The Langrage Multiplier assessment is used to test the presence of auto-correlation on lag order of the regression. The deciding factor for LM assessment is that the null hypothesis for the absence of auto-correlation is rejected when the p-value is less than 5 percent. Conversely, the alternative hypothesis for no auto-correlation failed to be rejected when probability value is higher than 5 percent. Table 6.57 highlights that the null hypothesis of no auto-correlation cannot be rejected, since the probability value is above 5 percent. Therefore, the first lag is free from auto-correlation, which makes the model to be robust.

Table 6. 57: Langrage-multiplier test for the table grape industry

Lag	x^2	$Probability$
1	6.1293	0.72691

Source: Author's own compilation

Table 6.58 presents the assessment for normally distributed errors, applying the Jarque-Bera approach. The judgement principle is that the errors are normally distributed when the p-value is above 5 percent, while the errors are not normally dispersed when the probability value is below 5 percent. Table 6.58 suggests that errors are normally dispersed for the total employment and imports output. However, the errors are not normally dispersed for the exports output and for the overall model.

Table 6. 58: The Jarque-Bera test for the table grape industry

$Equation$	x^2	$Probability$
$DlnEMPG_t$	0.40	0.81997
$DlnEXPO_t$	10.65	0.00486
$DlnIMPO_t$	5.48	0.06469
ALL	16.53	0.01119

Source: Author's own compilation

Table 6.59 shows the findings for the stableness condition of VECM estimates for table grape industry. The findings indicate that VECM model has about two unit moduli, which are reflected on both eigenvalue and modulus. The model meets the criteria for eigenvalue stability condition, since the majority of moduli are less than

1, except for the first two conditions. Therefore, the assessment for stability condition suggests that the model's stability is strong.

Table 6. 59: The eigenvalue stability condition for the table grape industry

$Eigenvalue$	$Modulus$
1	1
1	1
0.3948716 + 0.7483875i	0.846172
0.3948716 - 0.7483875i	0.846172
-0.8141914	0.814191
-0.34536 + 0.4626359i	0.577326
-0.34536 + 0.4626359i	0.577326
-0.4146108	0.414611
0.3483021	0.348302

Source: Author's own compilation based on dataset

Granger causality test

The granger causality assessment is adopted to check the causality effects amongst the identified variables. Table 6.60 shows the expected bi-directional causality effects which exists between the total employment and exports output, as their probability values are lower than 0.05. The results are attributed to the fact that exports trigger profits for the exporting firms, which results in an increase in the total employment. Notably, there is no causality effect between imports output and total employment, or between exports output and imports output.

Table 6. 60: Granger causality test for the table grape industry

$Null\ hypothesis$	$F-statistic$	$P-value$
EXPO does not Granger-cause LNEMPG	0.63	0.005
LNEMPG does not Granger-cause EXPO	1.50	0.002
IMPO does not Granger-cause LNEMPG	0.10	0.902
LNEMPG does not Granger-cause IMPO	0.44	0.653
IMPO does not Granger-cause EXPO	2.71	0.091
EXPO does not Granger-cause IMPO	3.81	0.045

Note: the relationship with p-values below 0.05 percent signifies the causality effects between the variables, while the relationship with p-value over 0.05 percent denotes no causality between the variables.

6.4.2 Results of Two-stage least squares (2SLS) regression

The two-staged least squares technique is applicable to handle regression with endogenous independent variables in a linear regression context. Notably, the regressor variable is a variable which correlates with the error term in the econometric model. The utilisation of endogenous variable contravenes the linear regression assumptions. Furthermore, this type of variable could be discovered when variables are measured with an error. The overarching principle of the two-staged least squares method is to include instrumental variables which are not correlating with the error term when estimating the regression. Nonetheless, the instrumental variables need to correlate with the endogenous variables but not the disturbance term of the regression (Felbermayr et al. 2009; Gujarati 2015: 150).

Various economic models contain endogeneity, which is a theoretical relationship that does not fit into the context of y on x estimation. Therefore, the intuition is that the y variable is explained by (but does not collectively explain) x. Based on econometrics ground, this condition sometimes emanates from the omitted variables, errors in variables and measurement error in the x variables. When faced with any of the three circumstances, ordinary least squares (OLS) is not suitable to deliver consistent and reliable parameter estimates. The overall concept suitable is the instrumental variables estimator, which is referred as the two-stage least squares (Bulagi et al. 2016; Wooldridge 2013).

❖ The discussion for the 2SLS results for the apple industry

The apple estimation consists of one dependent and seven independent variables which were identified to analyse the effect of international trade on wages in the apple industry of South Africa. The dependent variable is wages output of the apple industry which is represented by $lnWAGO_t$ in the regression. When it comes to the seven independent variables, the apple regression considered the following on the basis of theoretical and empirical literature (Bulagi et al. 2016; Mashabela 2007; Sandrey & Vink 2007). The seven selected independent variables are as follows:

the first lag of previous year's total employment in the apple industry ($lnEMPG_{t-1}$), the first lag of the exports output ($lnEXPO_{t-1}$), the total gross value of production for the apple industry ($lnTGVP_t$), the first lag of wage output ($lnWAGO_{t-1}$), the total employment in the apple industry ($lnEMPG_t$), the previous year's production volumes of the apples ($lnPRODT_{t-1}$) and imports output in the apple industry ($lnIMPO_t$).

The coefficient for the model constant is negative and statistically significant at 1 percent level. The value of apple coefficient is equivalent to -40.75. The results imply that when everything is held constant, the wages in the apple industry decrease by 40.75 percent. This is attributed to the fact that South Africa is a net importer of downstream products such as apple concentrates, while wages from this industry are remunerated to the employees in the exporting countries. Furthermore, South Africa has a pool of unemployed people, which undermines the negotiation for better wages since employees are easily replaced by the reserve unemployed pool (Bowens et al. 2013; Burawoy 2011; DAFF 2018a; Lubinga & Phaleng 2018; Tinel 2009).

The first lag of total employment

The slope coefficient of β_1 represents the $lnEMPG_{t-1}$ which is positive and significant at 1 percent level. There is a clear indication that there is positive interrelation between the wages and the first lag of total employment in the apple industry of South Africa. The coefficient value of $lnEMPG_{t-1}$ is equivalent to 2.68, which implies that a unit increase in the first lag of total employment results in wages increase by an additional 2.68 percent per annum. This is attributed to fact that the current year's employment numbers as well as wages are based on the previous year's employment and wage trends. Furthermore, the wages output of the apple industry depends on the performance of the employees from the previous production cycle (DAFF 2018a; Mashabela 2007; Ortmann 2005).

The first lag of exports output of the apple industry

The coefficient value for the first lag of exports output ($lnEXPO_{t-1}$) of the apple industry is positive and statistically significant at 1 percent level, since its p-value is less than 0.05 and the z-statistics is 5.65. The coefficient value associated with $lnEXPO_{t-1}$ is equivalent to 0.35, which indicates that when holding other variables constant, *ceteris paribus*, the first lag of exports output increases by one unit and the wages output of the apple industry increases by 0.35 percent. The results are attributed to the fact that the first lag of exports output is instrumental in determination of current year's wage output. The previous year's exports output increases profits of the production firms, which triggers a spike in wages output and employment opportunities in the apple industry (DAFF 2018a; Kalaba & Henneberry 2001; Sandrey & Vink 2007).

The total gross value of production

The slope coefficient of β_3 represents the total gross value of production ($lnTGVP_t$), which shows to be positive and statistically significant at 1 percent level. Furthermore, the p-value is below 0.05 and z-statistics is equivalent to 4.11. Table 6.61 indicates the positive interrelationship between the total gross value of production and wages output of the apple industry. The coefficient value of $lnTGVP_t$ is equivalent to 0.22, which implies that when holding all other regressors constant, a one unit spike in the total gross value of production leads to 0.22 percent increase in the wages output of the apple industry. This is ascribed to the fact that total gross production value determines the wages, employment and other production expenditure. Total gross value of production in the apple industry showed an increasing trend during the period under review which is attributed to the fact that the industry is export-oriented and the biggest contributor to the South African agricultural gross value of production (DAFF 2018a; Bulagi 2014; Kalaba & Henneberry 2001).

The first lag of wage output

The coefficient of the first lag of wages is positive and statistically significant at 1 percent level. The value of coefficient is 0.0004, with p-value of less than 0.05 and z-statistics of 13.03. The implication is that a one-unit increase in the previous year's wages output leads to 0.0004 percent increase in current year's wages output. This makes economic sense, since the current wages output is based on the previous year's wages output. The minimum wage legislation and unionised bargaining power in the fruit industry are main drivers for an increase in the wages output for both previous and current year (BFAP & NAMC 2016; Lubinga & Phaleng 2018; Ntombela & Moobi 2013; Ntshangase et al. 2016; Phaleng 2017).

The total employment of the apple industry

The slope coefficient of β_5 denotes the total employment of the apple industry, which is positive and significant at 1 percent level. There is a positive inter-relation between the total employment ($lnEMPG_t$) and the wages output in the apple industry ($lnWAGO_t$). The coefficient value for $lnEMPG_t$ is equivalent to 4.22, z-statistics is 10.27 and p-value of less than 0.05. The implication is that when holding all explanatory variables constant, *ceteris paribus*, a one-unit increase in the total employment leads to 4.22 percent increase in wages output in the apple industry. This is attributed to the fact that all producers and firm owners are obliged to comply with the new minimum wage of R18 or more per hour, therefore, when producers increase total employment, then the wages output is prone to rise (DAFF 2018a; Kalaba & Henneberry 2001; Mashabela 2007; SEDA 2012).

The first lag of production volumes

The coefficient of the first lag of production volumes ($lnPRODT_{t-1}$) is negative and statistically significant at 5 percent level as shown on Table 6.61. There is a negative relationship between the previous year's production volumes and wage output of the apple industry. The slope coefficient value of β_6 is equivalent to -3.41, which implies that when other explanatory variables are constant, *ceteris paribus*, a one-unit increase in the previous year's production volumes results in 3.41 decline in the wages output. This is attributed to the fact that when previous year's yield is low, the markets are under supplied and that affects the producers' prices, which negatively affects the wages as well as employment opportunities (Bulagi 2014; Bulagi et al. 2015; DAFF 2018a; Kalaba & Henneberry 2001; Mashabela 2007).

The imports output for the apple industry

The imports output ($lnIMPO_t$) as shown on Table 6.61 is positive and statistically significant at 1 percent level. The slope coefficient value of $lnIMPO_t$ is 0.20, z-statistics of 6.27 and p-value is below 0.05. The effect of imports output on the wage output is positive. The results indicate that when imports output incline by one unit, ceteris paribus, the wages output rises by at least 0.20. This is attributed to the fact that South Africa is a net importer of downstream apple products such as apple concentrates, which are used in the manufacturing process of apple products, more specifically non-alcoholic beverages (DAFF 2018a; Greenaway et al. 1999; Phaleng 2017; Phaleng & Ntombela 2018; Ronquest-Ross et al. 1994).

Diagnostic tests for the 2SLS apple regression

The initial process is to check for endogeneity by performing the Durbin and Wu-Hausman test, with the judgement rule specifying that the variables are endogenous when the probability values of Durbin and Wu-Hausman test are less than 0.05. Furthermore, the variables are regarded as exogenous when the probability values are above 0.05. The chi-square associated with apple regression is 11.66 and its p-value is equivalent to 0.0006. The implication posed by Durbin test is that the variables are endogenous.

The Wu-Hausman test was applied to complement the Durbin results for the apple regression. The null hypothesis states that the variables are exogenous when the probability value is above 0.05. The chi-square for Wu-Hausman test in equivalent to 24.94 and its probability value is equivalent to 0.0041. The implication is that the null hypothesis of exogenous variables is rejected and the conclusion is that the variables are endogenous. Therefore, the conclusion remarks based on Durbin and Wu-Hausman assessments is that the variables are endogenous.

The first stage regression for apple was performed to assess the strength of the instruments. The decision rule is that the F-statistics needs to be above critical values at 5 and 10 percent, respectively for strong instruments. Conversely, the F-statistics needs to be less than critical values at 5 and 10 percent, respectively for weak instruments. The F-statistic for apple regression is about 23.84, which is above critical values at 5 and 10 percent. In addition, the probability value associated with apple regression is equivalent to 0.0028, which completes the results from F-statistics for strong instruments.

The tests adopted for assessment of over-identification restrictions of instruments were Sargan and Basmann techniques. The null hypothesis is that the model is correctly specified and valid, when its probability values associated with Sargan and Basmann tests are more than 0.05. As presented in Table 6.61, the probability value associated with apple regression is about 0.54, which is over 0.05. Therefore, the findings of over-identification restrictions for identified instruments indicate that the model is clearly specified and valid.

❖ The discussion for the 2SLS results for the apricot industry

The apricot estimation used one dependent variable which is a wages output ($lnWAGO_t$) to determine the effect of international trade on wages. The six adopted explanatory variables are as follows: the first lag of total employment ($lnEMPG_{t-1}$), the first lag of exports output ($lnEXPO_{t-1}$), the imports output ($lnIMPO_t$), average exchange rate ($lnAEXRT_t$), total employment ($lnEMPG_t$) and the local sales ($lnLOCS_t$). Table 6.61 shows that the concept term is positive and significant at 1 percent level. The coefficient value of concept term is equivalent to

23.89, with a z-statistics equivalent to 14.35 and p-value less than 0.05. The implication for the period under review (1990 until 2018) is that when all variables are constant, *ceteris paribus*, and the estimated wages output of the apricot industry is equivalent to R23.89 per hour. The results are attributed to the fact that apricot producers are adhering to the minimum wage of R18 per hour, prescribed by the government while some of the producers are exceeding the minimum wage (DAFF 2018b; Mashabela 2007; Muchopa 2019; Ntombela & Moobi 2013).

The first lag of total employment

The slope coefficient of β_1 denotes the first lag of total employment ($lnEMPG_{t-1}$) which is negative and statistically significant at 1 percent level. The coefficient value of $lnEMPG_{t-1}$ is equivalent to -1.20, with the z-statistics of -5.95 and p-value of less than 0.05. The implication is that when keeping everything constant, *ceteris paribus*, one-unit increase in the previous year's total employment results in a 1.20 decrease in wage output. The reason behind is that producers are not adding new employers on a yearly basis. The firms in the apricot industry mostly hire casual employees during peak season, but permanent employees are only required when there is a vacancy. More employees affect the wages negatively, while more employees are necessary to enhance productivity and export base. The producers are mandated to remunerate employees using a minimum wage legislature (DAFF 2018b; OECD 2006; Ortmann 2005; SEDA 2012).

The first lag of exports output

The results shows that the first lag of exports output ($lnEXPO_{t-1}$) is equivalent to -0.03, z-statistics of -0.19, negatively insignificant and the implication is that $lnWAGO_t$ is negatively affected by the first lag of exports output. The results are attributed to the fact that the apricot industry is export-oriented and wages output are highly linked to the $lnEXPO_{t-1}$. If the previous year's exports output are smaller, the wages output would decrease. The lower value of previous year's exports output negatively affects the current year's wages output and employment opportunities (DAFF 2018b; Muchopa 2019; Ortmann 2005; Van-Dyk and Maspero 2004).

The imports output

Table 6.61 shows that β_3 denotes the imports output ($lnIMPO_t$) which is negative but statistically insignificant with a p-value of over 0.1. The slope coefficient value of the imports output is equivalent to -0.02 with a z-statistics of -1.67, and the results indicate a negative expected sign during the period under review, as supported by the economic literature (Mandel & Carew 2012; Mukhtar & Rasheed 2010; Sertic et al. 2017; Shaikh 2007). It seems there is a definite negative interrelationship between the imports output and wages output during period starting from 1990 to 2018. The implication is that imports cause wages and employment opportunities to shrink since wages remuneration is received by employees in the exporting countries (Alvarez & Opazo 2011; DAFF 2018b; Kemeny et al. 2015; Mashabela 2007; Pacheco-López and Thirlwall 2011).

Average exchange rate

The slope coefficient of β_4 signifies the average exchange rate ($lnAEXRT_t$) which is positive and statistically significant at 1 percent level. The coefficient value of the average exchange rate is 1.01, with z-statistics of 3.11 and p-value of less than 0.05. There is a positive interrelation between the average interest rate and the wage output. The results show that when suppressing all other regressors, *ceteris paribus*, a one-unit increase on the average exchange rate would lead to 1.01 percent increase in the wages output. When the exchange rate is higher, the wages output is also higher and makes the employees to have more disposable income (Brunner 1978; DAFF 2018b; Huang et al. 2014; Johnson 1982; Peter 2017).

The total employment

Table 6.61 shows that the total employment ($lnEMPG_t$) is negative and statistically significant at 1 percent level. The results affirm the negative interrelation between the wage output and the total employment. The coefficient value of $lnEMPG_t$ is equivalent to -2.34, z-statistics of -9.75 and p-value below 0.05. The interpretation on $lnEMPG_t$ is that when holding all regressors constant, ceteris paribus, a one-unit increase in the total employment leads to 2.34 percentage decline in the wages output. This makes economic sense due to the fact that when a farmer increases employment, the wages tend to shrink or remain stagnant. South Africa is characterised by a huge number of unemployed people, which allows apricot farmers to have reserve labour force (Phaleng & Ntombela 2018; Pollin 2008; Shaikh 2007). For instance, the producers continue to employ casual workers during a peak season who are only compensated using a minimum wage of R18 per hour. The wage is still considered to be insufficient to sustain a normal living standard (DAFF 2018b).

The local sales

The slope coefficient of β_6 denotes local sales of the apricot industry which is positive and statistically significant at 5 percent level. The coefficient value of apricot regression is 0.15, with the z-statistics and p-value of less than 0.05. The results show that when all explanatory variables are stable, *ceteris paribus*, a one -unit increase in the local sales causes the wages output in the apricot industry to rise by at least 0.15 percent, which makes an economic sense based on literature (Flam & Helpman, 1996; Melitz, 2003; Shaikh 2007). Furthermore, local sales are driven by increased domestic demand which supports both the wages output for the apricot industry and the total employment. This is attributed to fact that the government of South Africa has developed the local content legislature which is embedded in the Preferential Public Procurement Act of 2011 (DAFF 2018b; Ntombela & Moobi 2013; OECD 2006).

Diagnostic test for the 2SLS apricot regression

The Durbin and Wu-Hausmann were adopted to assess for endogeneity amongst the identified variables. The chi-square associated with Durbin assessment of apricot regression is 15.11 and its probability value is equivalent to 0.0001. Therefore, the results show that the included variables are endogenous, since its p-value is lower than 0.05.

The Durbin test was complemented by Wu-Hausmann assessment, in order to verify whether the variables are endogenous or not. The chi-square linked with apricot regression is 135.74 and its probability value is 0.0001. Nonetheless, the null hypothesis of exogenous variables is rejected due to the fact that its probability value is lower than 0.05. Therefore, both the Durbin and Wu-Hausmann tests highlight that the variables suffer from endogeneity.

The strength of the instruments included in the apricot regression was tested using the first stage regression. The F-statistic for apricot is about 22.58, which is over the critical values at 5 and 10 percent. The associated probability value is equivalent to 0.005, which supports the findings of strong instruments as suggested by the F-statistic. Therefore, the instruments included in the apricot regression are strong.

The assessments for over-identification restrictions of instruments were applied utilising the Sargan and Basmann tests. The null hypothesis associated with both Sargan and Basmann tests is that the model is well specified and valid if the probability values are more than 0.05. Table 6.61 highlights that the probability value linked with Sargan test for apricot is about 0.67, while the probability value associated with Basmann test is equivalent to 0.76. The indication is that both values for Sargan and Basmann are lower than 0.05. Therefore, the findings for over-identification restrictions for instruments show that the model is well specified and strong.

❖ The discussion for the 2SLS results for the avocado industry

It should be noticed that two out of four explanatory variables from the avocado regression are positive and statistically significant. The regressand for the avocado regression is the wages output. The four adopted explanatory variables are as follows: the first lag of total number of people employed ($lnEMPG_{t-1}$), the first lag of exports output ($lnEXPO_{t-1}$), total gross value of production ($lnTGVP_t$), total number of employment ($lnEMPG_t$) and exports output ($lnEXPO_t$). The intercept coefficient is negative and statistically significant at 1 percent level, since its p-value is practically zero. The intercept value of about -1.48 suggests that, on average, if all the explanatory variables are kept constant, then the wages output depreciates by at least 1.48 percent. This makes an economic sense, as wages output is normally lower as compared to the living expenses. The producers are often reluctant to increase the wages, unless legislation such minimum wage in South Africa and unionisation are strictly enforced, which push employers to increase wages on an annual basis (Bulagi et al. 2016; DAFF 2018c; Lubinga & Phaleng 2018; Ortmann 2005; Rahmanian 2015).

The first lag of total employment

The slope coefficient of β_1 represents the first lag of total employment ($lnEMPG_{t-1}$), which is positive and statistically insignificant. The coefficient value of $lnEMPG_{t-1}$ is equivalent to 0.03, with the p-value above 0.05. The positive sign implies that the previous year's total employment is positively related to the wages output of the current year. In a nutshell, when the first lag of total employment increases by one percent, *ceteris paribus*, wages output rises by at least 0.03 percent. This makes an economic sense, since the production costs of the current year are calculated based on previous year's information (DAFF 2018c; Mashabela 2007; SEDA 2012).

The total gross value of production

The results for total gross value of production ($lnTGVP_t$) from the avocado regression shows that it is positively related with the wages output. The coefficient value of $lnTGVP_t$ is 2.50, with the p-value greater than 0.05. The results imply that when the total gross value of production increases, then the wages output increases as both local sales and exports improve the profitability of the production firms which in turn reward employees through improved wage structures (Bulagi et al. 2015; DAFF 2018c).

The total employment

The variable total employment ($lnEMPG_t$) is positive and statistically significant at 1 percent level. The coefficient value of $lnEMPG_t$ is equivalent to 0.93, with the p-value closer to zero and z-statistic equated to 3.79. The results for $lnEMPG_t$ implies that when holding all regressors constant, *ceteris paribus*, one-unit increase in the total employment results in 0.93 percent increase in wages output. The overall indication is when an avocado-producing firm increases its work force, this leads to an increase in the wages output. The seniors and long serving employees tend to receive improved remuneration, which is attributed to minimum wage legislation and bargaining power linked to unionisation (DAFF 2018c; Van-Dyk & Maspero 2004).

The exports output

The slope coefficient of β_4 represents the exports output ($lnEXPO_t$), which is statistically significant at 1 percent. The coefficient value is equivalent to 6.41 and z-statistic of 2.96. The implication is that when all independent variables are kept constant, *ceteris paribus*, one-unit increase in exports output results in 6.41 percent increase in wages output. The results are attributed to the fact that when exports go up, producers of avocados earn foreign currencies, which in turn enhances profitability and employees are rewarded wages increase or sometimes even bonuses (Bulagi 2014; DAFF 2018c; Lubinga & Phaleng 2018; Sibulali 2018).

Diagnostic test for the 2SLS avocado regression

The initial phase is to conduct an assessment for endogeneity by applying the Durbin and Wu-Hausman test. The decision rule is that the variables are endogenous when the probability value of Durbin test is lower than 0.05. However, the variables are exogenous when the probability values are greater than 0.05. Notably, the chi-square associated with Durbin test for avocado regression is 7.93. The probability value linked with Durbin test for avocado estimation is equivalent to 0.0049. Therefore, the findings for Durbin test indicate that the variables are endogenous.

The Wu-Hausman test was applied to supplement the Durbin test of the avocado regression. The chi-square of Wu-Hausman test for avocado regression is 0.86. The probability value from Wu-Hausman test linked to avocado estimation is equivalent to 0.02. Nonetheless, the null hypothesis of exogenous variable is failed to be rejected and the conclusion is that the variables are endogenous. Therefore, both the results of Durbin and Wu-Hausman tests show that the variables are endogenous.

The strength of the instruments for the avocado estimation was tested by using the first stage regression. The F-statistic for avocado is about 25.67, which is larger than the critical values of 5 and 10 percent, respectively. Furthermore, the findings of the F-statistic for avocado regression are complemented by the probability value of the first stage estimation, which is equivalent to 0.0004. The implication is that the instruments for avocado regression are strong.

The Sargan and Basmann approaches were adopted to test for over-identification restrictions of instruments. The null hypothesis associated with the test is that the model is clearly specified and valid if the p-values for both the Sargan and

Basmann tests are greater than 0.05. Table 6.61 indicates that the probability values for avocado estimation associated with Sargan test is about 0.94, while p-value linked with Basmann test is equivalent to 0.97. Notably, the findings of over-identification restrictions for instruments indicate that the model is well specified and valid.

Table 6. 61: 2SLS results for 6 fruit industries

Model	$2SLS$					
Equation	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Apple	*Apricot*	*Avocado*	*Orange*	*Pear*	*Table grape*
Variables	$lnWAGO_t$	$lnWAGO_t$	$lnWAGO_t$	$lnWAGO_t$	$lnWAGO_t$	$lnWAGO_t$
$CONSTANT_t$	-40.87*** (-11.70)	23.89*** (14.35)	-1.48*** (-0.68)	-12.47*** (-6.18)	17.97*** (10.82)	17.27*** (4.89)
$lnEMPG_{t-1}$	2.68*** (5.95)	-1.20*** (-5.95)	0.03 (0.22)	1.75*** (9.38)	-1.43 (-8.10)	-0.67** (-2.34)
$lnEXPO_{t-1}$	0.35*** (5.65)	-0.03 (-0.19)				
$lnTGVP_t$	0.22*** (4.11)		2.50 (0.97)			
$lnWAGO_{t-1}$	0.0004*** (13.03)					
$lnEMPG_t$	4.22*** (10.27)	-2.34*** (-9.75)	0.93*** (3.79)			
$lnPRODT_{t-1}$	-3.41** (-2.13)					
$lnIMPO_t$	0.20*** (6.27)	-0.02 (-1.67)			-1.46*** (-10.02)	0.42*** (2.78)
$lnAEXRT_t$		1.01*** (3.11)				
$lnLOCS_t$		0.15*** (2.48)		9.81*** (6.88)	0.00005*** (4.65)	0.00008*** (-7.94)
$lnEXPO_t$			6.41*** (2.96)	5.49*** (2.61)	6.30*** (7.96)	0.32 (1.38)
$lnIMPO_{t-1}$				-0.03**		

				(-2.38)		
$AVRP_t$				0.0009**		
				(6.08)		
$dlnAEXRT_{t-1}$				-0.68***		
				(6.31)		
$dlnPCONS_{t-1}$				-0.13***		
				(-2.62)		
$NETR_t$				-0.0001**	0.00003	
				(-3.44)	(2.18)	
FDI_t					1.28**	
					(2.22)	
$dlnDCONS_{t-1}$						1.01***
						(6.16)
$AEXRT_t$						0.12***
						(8.61)
$AREAP_t$						-8.43***
						(-3.22)
Endogeneity test (Durbin)	11.66	15.11	7.93	12.05	8.98	9.71
Durbin (p-value)	0.0006	0.0001	0.0049	0.0005	0.0027	0.0018
Endogeneity test (Wu-Hausman)	24.94	135.74	0.86	18.31	491.89	11.32
Wu-Hausman (p-value)	0.0041	0.0001	0.02	0.0052	0.0287	0.0200
First-stage (F-statistic)	23.84	22.58	25.67	53.99	3215.74	38.95
P-value of first stage	0.0028	0.0005	0.0004	0.0001	0.0125	0.0252
Over-identification (Sargan)	0.38	0.18	0.12	0.02	0.02	4.23
Sargan (p-value)	0.5369	0.6713	0.9415	0.8974	0.8925	0.3760
Basmann	0.139983	0.09	0.05	0.06	0.002	0.87
Basmann (p-value)	0.7083	0.7628	0.9738	0.9370	0.9640	0.9295

Note: Robust z statistics are represented in parenthesis below coefficients, *** denotes significant at 1% level ($p \leq 0.01$), ** denotes significant at 5% level ($p \leq 0.05$) and * represents at 10% significant level ($p \leq 0.1$).

- The discussion for the 2SLS results for the orange industry

Table 6.61 shows that the orange regression consists of one dependent variable, which is wages output ($lnWAGO_t$), while there are eight independent variables. The identified independent variables are as follows: the first lag of total employment ($lnEMPG_{t-1}$), the first lag of imports output ($lnIMPO_{t-1}$), average price ($AVRP_t$), first lag of average exchange rate ($dlnAEXRT_{t-1}$), the exports output ($EXPO_t$), the first lag of per capita consumption ($dlnPCONS_{t-1}$), net realisation from orange exports ($NETR_t$) and local sales of oranges ($LOCS_t$). All eight explanatory variables are positively responding to the change in wages output, except for three variables with a negative response which are: the first lag of imports output, the first lag of per capita consumption and net realisation from orange exports. The intercept value of about -12.47 suggests that if all regressors remain constant, the wages output in the orange industry would decline by at least 12.47 percent. This is attributed to the fact that South African orange exports have access issues into traditional markets such as EU due to citrus black spot. The wages output is mostly affected by other socio-economic factors such as climate change, exchange rates, uncoordinated government support and legislation (Dlikilili, 2018; Mashabela, 2007; Ndou, 2012; Nyhodo *et al.*, 2009; Peter, 2017; Sandrey and Vink, 2007).

The first lag of total employment

The slope coefficient of β_1 denotes the first lag of total employment which is positively responding to the changes in wages output and statistically significant at 1 percent level. The coefficient value of about 1.75, implies that on average, one-unit increase in previous year's total employment would result in 1.75 percent wages output. The results are attributed to the fact that an increase in employment in the previous year would result in a higher wage bill for the orange producers in the following year, as producers are mandated by the government to remunerate the employees based on minimum wage of at least R18 per hour. The employees, irrespective of contract details, are expected to be compensated for their labour based on the employment guidelines issued and amended regularly by the national Department of Employment and Labour (DAFF, 2018d; Dlikilili, 2018; Ndou, 2012; Sinngu, 2014).

The first lag of imports output

Table 6.61 shows that the first lag of imports output ($lnIMPO_{t-1}$) is responding negatively to the changes in wages output and is statistically significant at 5 percent level, with z-statistic of -2.38. The coefficient value of about -0.03 highlights that when all explanatory variables are kept constant, *ceteris paribus*, one-unit increase in previous year's imports output results in 0.03 less wages output. This makes economic sense, as imports reduce the wages output and employment in most sectors of the economy (Francois & Roland-Holst, 1996; Kemeny *et al.*, 2015; Mukhtar & Rasheed, 2010; Pomfret, 1992). The results are attributed to the fact that oranges from Southern Africa Development Community (SADC) member states are exported to South Africa, while sometimes those countries are using South African ports to export to their destine markets. Furthermore, South Africa is importing fruit concentrates which have been produced in developed countries and wages output as well as employment opportunities are created by these fruit concentrates in the exporting countries (DAFF, 2018d; Dlikilili, 2018; Ndou, 2012; Shaikh, 2007; Sinngu 2014).

Average price

The slope coefficient of average price ($AVRP_t$) is statistically significant at 5 percent level, while positively responding to the changes in wages output. Table 6.56 shows that the coefficient value of average price is equivalent to 0.0009, with z-statistic of 6.08. The interpretation of the results is that when all variables are held constant, a one-unit increase in average price for the oranges would lead to a 0.0009 percent increase in wages output. The results make economic sense as price increases improve profitability of the orange producers, which then reward employees through improved wages output (Capuano & Hans-Jorg, 2015;

Dlikilili, 2018 Egger & Etzel, 2012; Peter, 2017; Tinel, 2009). This is attributed to the fact that orange industry is export-oriented and is among the largest contributor to the gross value of the citrus industry as well as the entire agriculture sector (Bulagi *et al*., 2016; DAFF, 2018d; Lubinga & Phaleng, 2018; Ndou, 2012; Sinngu, 2014).

The first lag of average exchange rate

Table 6.61 shows that the first lag of average exchange rate is positively responding to a change in wages output and statistically significant at 1 percent level. The coefficient value of the first lag of average exchange rate is about 0.68 and z-statistic equivalent to 6.31. The results show that when all regressors are held stable, *ceteris paribus*, a one-unit increase in the first lag of average exchange rate ($lnAEXRT_{t-1}$) would result in 0.68 percent increase in wages output. This is attributed to the fact that the South African rand is fluctuating against the currencies of the importing countries, which are mostly the developed countries. The wages output increases when the rand is weaker, since producers are exporting more due to a higher demand which results in a surge in employments and wages in the citrus industry (DAFF, 2018d; Hayward-Butt & Ortmann, 2010; Ndou, 2012; Ntombela et al*.* 2018).

The exports output

The slope coefficient of β_5 represents the exports output, which is positive and statistically significant at 1 percent level. The coefficient value of the exports output is equivalent to 5.49 and the z-statistic is about 2.61. The interpretation for the results is that when all independent variables are constant, *ceteris paribus*, a one-unit increase in the exports output would lead to 5.49 percent increase in the wages output. This is attributed to the fact that the orange industry is export-oriented and earnings from the international markets enhance wages output and put the industry on the centre of creating employment opportunities on casual and permanent basis (Hartzenberg 2006; Kapuya et al. 2014; Lubinga & Phaleng 2018; Sinngu 2014; Vink 2012).

The first lag of per capita consumption

The slope coefficient of the first lag of per capita consumption is negative and statistically significant at 1 percent level. The coefficient value is about -0.13 and z-statistic of -2.62. The implication for the results is that when all regressors are held constant, *ceteris paribus*, a one-unit increase in the first lag of per capita consumption leads to 0.13 decrease in wages output. This is attributed to the fact that per capita consumption of the previous year determines the wages output of the current year and the economic circumstances supress the per capita consumption of fruits in South Africa which push people to spend their monies on the staple food products (Badurally-Adam & Darroch 2010; Ronquest-Ross et al. 1994; UNCTAD 2009; van der Merwe & Otto 2010).

Net realisation from orange exports

The variable net realisation from orange exports as denoted by $NETR_t$ on Table 6.61 shows to be negative and statistically significant at 5 percent level. The coefficient value is about 0.0001 and the z-statistic is equivalent to -3.44. The interpretation of the results is that when all variables are kept constant, *ceteris paribus*, a one unit increase in the net realisation from orange exports would result in a 0.0001 decline in wages output. This is attributed to the fact that the net realisation from exports boost the cash flow and profits of the producers, which trigger producers to raise their production capacity through increased employment as well as wages output (Dlikilili 2018; Ndou 2012; Ortmann 2005: 136; Sinngu 2014).

Local sales of oranges

The slope coefficient of β_8 represents the local sales of oranges ($LOCS_t$) which positively relates to the wages output in the orange industry. Table 6.61 shows that the variable is statistically significant at 1 percent level. The coefficient value of $LOCS_t$ is equivalent to 9.81, with the z-statistics of 6.88. The interpretation is that when all independent variables are kept constant, a one-unit increase in the local sales would result in a 9.81 percent escalation in the wages output. This is attributed to the fact that oranges are sold both locally and internationally. The local markets vary from fresh produce markets located across the country, wholesalers, retailers and street vendors (DAFF 2018d; Dlikilili 2018; Hayward-Butt & Ortmann 2010; Peter 2017; Van-Dyk & Maspero 2004).

Diagnostic test for the 2SLS orange regression

The initial stage is to assess for endogeneity by applying the Durbin and Wu-Hausman test. Wooldridge (2013) suggests that the variables are endogenous when probability values of both Durbin and Wu-Hausman techniques are lower than 0.05. Conversely, the variables are considered to be exogenous when the probability values are more than 0.05. The value of chi-square associated with Durbin test for orange estimation is equivalent to 12.05. The probability value of Durbin test associated with orange estimation is equivalent to 0.0005. Notably, the results from Durbin assessment indicate that the included variables are endogenous.

The findings from the Durbin test were complemented by the Wu-Hausman technique. The chi-square associated with Wu-Hausman test for orange estimation is about 18.31. The probability value of Wu-Hausman test linked to orange estimation is equivalent to 0.0052. In this case, the null hypothesis of exogenous variables is rejected and concludes that the included variables are endogenous.

The strength of the variables was tested by using the first stage regression of the orange estimation. The F-statistic value for orange regression is about 53.99, which is greater than the critical value at 5 and 10 percent. Notably, the findings of the F-statistic for orange are supported by the probability value of the first stage regression, which is almost zero (0.0001). Therefore, all the included instruments are strong.

The assessments for over-identification restrictions of instruments were applied using the Sargan and Basmann tests. The decision rule is that the model is valid and well specified when the probability value Sargan and Basmann tests are greater than 0.05. Table 6.61 reveals that the probability value of Sargan assessment for orange estimation is about 0.90, while the probability value of Basmann test is equivalent to 0.94. The probability values for both Sargan and Basmann tests are over 0.05. Therefore, the findings of over-identification restrictions for instruments highlight that the model is valid and correctly specified.

❖ The discussion for the 2SLS results for the pear industry

As illustrated in Table 6.61, the pear regression consists of one dependent variable which is wages output as well as six independent variables which are as follows: the first lag of total employment, the exports output, net realisation from pear exports, the local sales of pears, the imports output and foreign direct investment. The regression results show that at least four independent variables ($EXPO_t$, $LOCS_t$, $lnIMPO_t$ and FDI_t) are statistically significant at 1 and 5 percent, respectively. Furthermore, out of four regressors which are statistically significant only imports output ($lnIMPO_t$) carries a negative sign while the other three are positive. The two independent variables which are insignificant are the first lag of total employment ($lnEMPG_{t-1}$) and net realisation from pear exports ($NETR_t$).

The intercept for pear regression is positive and statistically significant at 1 percent level. The coefficient value of intercept is about 17.97 with the z-statistics of 10.82. The interpretation is that when all regressors are constant, on average, the wages output in the pear industry would increase by at least 17.97 percent. This is attributed to the fact that wages output cost of living are gradually increasing on an annual basis, which translates into escalation in the wages output (DAFF 2018e; Mashabela 2007; Valenciano et al. 2017).

The first lag of total employment

The slope coefficient of β_1 represents the first lag of total employment which is negative and statistically insignificant. This means that the previous year's total employment responds negatively to the changes in wages output. The coefficient value of the first lag of total employment is equivalent to -1.43 and z-statistics of -8.10 are attesting to the insignificant level of the variable. Nonetheless, the results are attributed to the fact that the previous year's total employment drives the wages of the following year, since the current year's budget is based on one from the previous year (Alford et al. 2017; DAFF 2018e; Haouas & Yagoubib 2008; Selwyn 2011; Selwyn 2013).

The exports output

The coefficient of the exports output is positively responding to the changes in wages output and the variable shows to be statistically significant at 1 percent level, with p-value which is practically zero. The slope coefficient of $EXPO_t$ is equivalent to 6.30, with the z-statistics of about 7.96. It can be inferred that when everything is stable, a one-unit incline in the exports output would result in at least 6.3 spike in wages output. This is attributed to the fact that exports output contributes to profitability of pear farms, which triggers producers to continue compensating the employees while enhancing production capacity by employing more permanent as well as casual employees (Mashabela 2007; Phaleng 2017; Ramirez 2016; Steenkamp & Kirsten 2010).

Net realisation from pear exports

Table 6.61 illustrates that the net realisation from pear exports is positive and statistically insignificant. The slope coefficient value of β_3 is equivalent to 0.00003, which is practically zero with z-statistics of about 2.18. This illustrates that the participation of producers in the international markets does not automatically translate into better or reduced wages output. The producers are sometimes faced with other transaction costs and repayment of debts that are expected to be covered by the realisation from exports output. Therefore, the relationship of wages output, employment and net realisation are not visible in the pear industry, since the industry is export-oriented but still employees are remunerated like others within the agricultural industry (DAFF 2018e; Muchopa et al. 2019; Ortmann 2005).

The local sales of pears

The slope coefficient of β_4 denotes the local sales of pears, which is positively responding to the changes in wages output. The variable is statistically significant at 1 percent level, with a p-value close to zero. The coefficient value of $LOCS_t$ is about 0.00005, which basically is zero and z-statistics equivalent to 4.65. This suggests that when all explanatory variables are kept constant, a one-unit increase in local sales of pears would result in approximately 0.00005 increase in wages output. This is attributed to the fact that local sales increase due to surge in middle class who prioritise health living comprising of fruits and vegetables. The increasing urbanisation accompanied by improved affordability triggers people to consume more pears, which translates into improved wages output and employment opportunities across pear supply chain (DAFF 2018e; Lubinga & Phaleng 2018; Mbatha 2011; Valenciano et al. 2017).

The imports output

As depicted in Table 6.61, the imports output is negative and statistically significant at 1 percent level. The estimation shows that wages output responds negatively towards an increase in the imports output. The coefficient value is equivalent to -1.46 and z-statistics of -10.02. This means that when all independent variables are constant, *ceteris paribus*, and one-unit incline in the imports output would lead to at least 1.46 decreases in wages output. This is attributed to the fact that imports output generates employment opportunities and improves wages output in the countries of origin, while causing injury in the importing countries especially if the producers were subsidised (Bulagi 2014; Fear 2006; Malefane & Odhiambo 2018; Poonyth et al. 2010; Ratombo 2019).

Foreign Direct Investment

The slope coefficient of foreign direct investment (FDI_t) is positively responding to the changes in wages output and is statistically significant at 5 percent level. The coefficient value associated with foreign direct investment is equivalent to 1.28 and z-statistics of about 2.22. These results show that when other regressors are kept constant, *ceteris paribus*, a one-unit increase in foreign direct investment results in an increase in wages output. This emanates from the fact that foreign direct investment stimulates economic growth which translates into enhancement in wages output and employment opportunities. The foreign direct investment stimulates the pear industry's production activities, while improving quality which results in the South African produce meeting the phytosanitary standards (DAFF 2018e; Gebrehiwet et al. 2010; Rahmanian 2015; Valenciano et al. 2017).

Diagnostic test for the 2SLS pear regression

The first diagnostic step is to conduct a test for endogeneity using the Durbin and Wu-Hausman test, with the null hypothesis stating that the variables are endogenous when the probability values of both Durbin and Wu-Hausman tests are smaller than 0.05. Alternatively, the variables are assumed to be exogenous when the p-values are greater than 0.05. The chi-square for Durbin test of pear estimation is equivalent to 8.98 and p-value of Durbin test for pear regression is about 0.0027. Therefore, the findings for Durbin test show that the identified variables are endogenous.

The Wu-Hausman assessment technique was used to complement the findings from Durbin test of the pear regression. The chi-square of Wu-Hausman test of pear estimation is equivalent to 491.89 and its probability value is equivalent to 0.029. Therefore, the null hypothesis of exogenous variables is rejected and makes a conclusion that the variables included in the regression are endogenous.

The first stage regression for pear was conducted to assess whether the instruments are strong or weak. The F-statistic value for pear is about 3215.74, which is far greater than the critical values at both 5 and 10 percent, respectively. The probability value associated with the first stage regression of pear estimation is equivalent to 0.013. Therefore, the instruments are strong since the F-statistic value is greater than both critical values.

The statistical assessment for over-identification restrictions of instruments were conducted through the use of the Sargan and Basmann tests. The null hypothesis indicates that the model is valid and correctly specified when the probability values for both the Sargan and Basmann tests are greater than 0.05. As depicted in Table 6.61, the probability value of Sargan test for pear estimation is equivalent to 0.89, while the p-value of Basmann test for pear regression is about 0.96. Therefore, the results of over-identification restrictions for both Sargan and Basmann tests highlight that the model is valid and well-specified.

❖ The discussion for the 2SLS results for the table grape industry

The estimation equation for table grape industry consists of one regressand which is wages output ($lnWAGO_t$), while there are approximately seven regressors. The regressors are as follows: the first lag of total employment, the exports output, the local sales of table grapes, the imports output, domestic consumption, average exchange rate and area planted with table grapes. Overall, there are six variables that are statistically significant at 1 and 5 percent, respectively. The only regressor which is not statistically significant is exports output, which was found to be positively responding to the changes in wages output.

The first lag of total employment

The slope coefficient of β_1 represents the first lag of total employment ($lnEMPG_{t-1}$), which is positive and statistically significant at 5 percent level. The coefficient value of $lnEMPG_{t-1}$ is about -0.67 and z-statistics is equivalent to -2.34. The estimation results show that when holding everything constant, a one-unit incline in the first lag of total employment would lead to at least 0.67 decrease in the wages output. It can be inferred that wages output of the current year relies on the total employment of the previous year, since the budgetary decisions are made based on expenditures and incomes of the previous year. If many people were employed in the table grape industry during a specific year, then the wages output of the following year would decline (Almeida & Faria 2014; Bella & Quintieri 2000; Neumark & Wascher 1995).

The exports output

As shown in Table 6.61, the variable exports output is positive and statistically insignificant. The coefficient value of $EXPO_t$ is equivalent to 0.32, with the p-value over 0.1 and z-statistics of about 1.38. Nonetheless, the literature shows that exports output supports the wages and employment (Chant et al. 2010; Hisali

2011; Itskhoki 2009; Otsuki et al. 2001; Ramirez 2016). However, the inference of the table grape industry shows that exports output has no impact on wages output, since the industry is export-oriented but the wages output does not differ from the rest of agricultural sector (DAFF 2019; Ntombela & Kleynhans 2011; Reynolds 2010; Vink et al. 2010).

The local sales of table grapes

As depicted in Table 6.61, the local sales of table grapes are responding negatively to the changes in wages output. The regressor shows to be statistically significant at 1 percent level, with a p-value which is practically zero and z-statistics of about -7.94. The coefficient value is equivalent to -0.00008, which implies that when holding all regressors constant, a one-unit increase in the local sales of table grape would lead to at least 0.00008 percent decrease in wages output. This is attributed to the fact that table grape is export-oriented, that more than 50 percent of its produce is exported and that local sales contribute insignificantly to wages output while contributing significantly to the employment opportunities throughout its value chain (BFAP 2019; DAFF 2019; Lubinga & Phaleng 2018; Ntombela & Kleynhans 2011; Ntombela & Moobi 2013; Reynolds 2010).

The imports output

The slope coefficient of β_4 represents the imports output ($lnIMPO_t$) which is positive and statistically significant at 1 percent level. The coefficient value of imports output is about 0.42, with z-statistics equivalent to 2.78 and p-value which is practically zero. The interpretation is that when keeping all explanatory variables constant, *ceteris paribus*, a one-unit increase in imports output results in 0.42 increase in the wages output. This is attributed to the fact that oranges from SADC member states are exported to South Africa for further processing and also the producers of oranges are using South African harbours to export their produce to the global markets. South Africa has harbour infrastructure which meets the international standards and also the capacity to handle huge consignments on a daily basis (Adriaen et al. 2010; Lesofe & Nontombana 1998; Ortmann 2005; Phaleng 2017; van der Merwe & Otto 2010).

Domestic consumption

The domestic consumption is positively responding to the changes in wages output and it shows to be statistically significant at 1 percent level. The slope coefficient is equivalent to 1.01, with z-statistics of about 6.16 and p-value below 0.01. The interpretation is that when all explanatory variables are stable except for domestic consumption, *ceteris paribus*, a one-unit increase in domestic consumption would result in 1.01 percent increase in the wages output. This is attributed to the fact that domestic consumption drives revenues of the industry and generates the much needed employment opportunities as well as wages output tabled in the National Development Plan (NDP) vision 2030 (Banda et al. 2015; Burger 2014; DAFF 2019; Ntombela & Kleynhans 2011; Reynolds 2010; Sigwele 2007).

Average exchange rate

The slope coefficient of β_6 denotes the average exchange rate ($AEXRT_t$) which is positive and statistically significant at 1 percent level. The coefficient value of the average exchange rate is about 0.12, with z-statistics equivalent to 8.61 and p-value which is practically zero. The implication is that when holding all the independent variables constant, a one-unit increase in the average exchange rate leads to at least 0.12 rise in the wages output. This is ascribed to the fact that an increase in average exchange rate improves net realisation from the exports. The South African rand is among the currencies that are strong against the currency such as United States of America (USA) dollar, United Kingdom's pound sterling and European Union's Euro (Jensen et al. 2013; Huang et al. 2014; Peter 2017; Schröder 2013; Siudek & Zawojska 2014).

Area planted with table grapes

The area planted with table a grape is negatively responding to the changes in wages output and is statistically significant at 1 percent level. The coefficient value of area planted with table grapes is equivalent to -8.43, with z-statistics of about -3.22. This implies that when holding all regressors constant, *ceteris paribus*, a one-unit increase area planted with table grapes results in at least 8.43 decrease in the wages output. This is attributed to the fact that when more hectares are planted with table grapes, there is over-supply to both domestic and international markets, which results in lower prices for the produce. The lower producer price minimises the income for the farming enterprises and the wages output is negatively affected if producer prices are low (DAFF 2019; Fadeyi et al. 2015; Francis & Yeats 1999; Helpman & Itskhoki 2017; Idsardi & Cloete 2013; Nyhodo et al. 2010).

Diagnostic test for the 2SLS table grape regression

The diagnostic test is started by assessing the endogeneity variables by applying the Durbin and Wu-Hausman test. The decision principle is that the variables are endogenous when both the probability values of Durbin and Wu-Hausman assessments are less than 0.05. Notably, the variables are considered to be exogenous when the probability values are above 0.05. The chi-square for Durbin test associated with the table grape estimation is equivalent to 9.71. The probability value for Durbin test associated with the table grape regression is about 0.001, which is below 0.05. Therefore, the findings of Durbin test for the table grape estimation show that the included variables are endogenous.

The Wu-Hausman test was applied to verify the outcomes of Durbin test for table grape estimation. The chi-square of Wu-Hausman assessment for table grape is equivalent to 11.32. The probability value of Wu-Hausman test associated with table grape is equivalent to 0.02, which is below 0.05. Therefore, the null hypothesis of exogenous variables is rejected and the findings are that the included variables are endogenous.

The first stage estimation for table grape was adopted to check the strength of the instruments. The deciding factor is that the F-statistics should be greater than the critical values at 5 and 10 percent for strong instruments and smaller than the critical values at 5 and 10 percent for weak instruments. The F-statistic associated with table grape estimation is 38.95, which is greater than the critical values at 5 and 10 percent, respectively. Furthermore, the findings of the F-statistic for table grape are completed by the probability value of the first stage regression, which is close to zero (0.03).

The assessments for over-identification restrictions were done using the Sargan and Basmann tests. The null hypothesis associated with both Sargan and Basmann tests is that the model is valid and well-specified if the probability is greater than 0.05. Table 6.61 indicates that the probability value for Sargan test of table grape is about 0.38, while the p-value for Basmann test of table grape is equivalent to 0.93. Therefore, the findings of over-identification restrictions for instruments associated with the table grape regression highlight that the model is valid and correctly specified.

6.4.3 Ordinary Least Squares (OLS) model

The interrelationship amongst several variables makes the process of econometric modelling more difficult. One of the critical steps in modelling a specific socio-economic relationship amongst variables is to estimate an econometric model. The correct specification of the method depends on the purpose of the study and assessment of data availability (Jaupllari & Zoto, 2013). The results of this section are intended to address the fourth objective regarding the impact of South African exports to the EU on employment and wages in the selected six fruit industries of South Africa. The OLS model is consistently applied on several studies on estimating the effects of international trade on employment and wages in both developed and developing countries (Foster *et al.*, 2011; Kalaba and Henneberry, 2001).

Chumni (2001) posits that OLS is an analytical technique that estimates an equation that is best suited to most secondary dataset due to its potential to reduce the sum of squared errors between each observation and the fitted line. The underlying intuition is that when the assumptions of standard linear regression model are satisfied, the OLS technique produces the best linear unbiased parameters. Notably, the best linear unbiased estimator denotes minimum variance, while unbiased estimator indicates that the envisaged values of estimates are identical to their parameters. However, OLS technique mostly suffers from the existence of serial correlation and multicollinearity, which infringes assumptions underlying the standard linear regression model (Abbas *et al*., 2017). The results of OLS estimation technique are necessary to examine the significance and trend of co-movement amongst South African exports of selected six fruits into the EU market and other identified variables such as employment, wages, etcetera.

Table 6. 62: OLS results for 6 fruits

Model	OLS					
Equation	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Apple	*Apricot*	*Avocado*	*Orange*	*Pear*	*Table grape*
Variables	$lnVOSAXEU_t$	$lnVOSAXEU_t$	$lnVOSAXEU_t$	$lnVOSAXEU_t$	$lnVOSAXEU_t$	$lnVOSAXEU_t$
$CONSTANT_t$	4.10	291.78**	11.17***	11.47***	-0.13*	7.27
	(1.13)	(2.86)	(9.31)	(22.66)	(-2.86)	(1.83)
$lnWAGO_t$	- 0.49***	1.57	1.18***	0.17**	0.77*	0.004
	(-7.57)	(1.63)	(3.30)	(2.43)	(2.55)	(0.08)
$lnAREAP_t$	1.11***					
	(3.06)					
FDI_t	3.42**	6.95***	2.05	2.95**		4.58
	(2.66)	(3.84)	(0.32)	(2.18)		(0.67)
$lnGRVF_t$		0.08				
		(0.26)				
$lnPOPU_t$		-17.23**				
		(- 2.78)				
$lnNETR_t$		0.62**				
		(2.28)				
$lnPROCV_t$		0.24				
		(0.96)				
$lnPRODT_t$					0.58	
					(0.82)	
$lnEMPG_t$						0.58*
						(2.08)
$lnDRDV_t$						0.35***
						(3.24)
$lnDCONS_t$						-0.46
						(-1.43)

R-squared	0.84	0.90	0.68	0.56	0.82	0.74
F-statistics	21.26***	12.98***	8.56***	8.34***	6.64*	5.67***
Durbin-Watson	2.06	2.39	2.98	2.54	2.32	1.96
Breusch-Godfrey (p-value)	0.7642	0.2903	0.06	0.4450	0.1541	0.5873
Breusch-Pagan-Godfrey (p-value)	0.2734	0.3349	0.42	0.2827	0.3796	0.5570

Notes: t-statistics are represented in parenthesis below coefficients, *** denotes significant at 1% level ($p \leq 0.01$), ** denotes significant at 5% level ($p \leq 0.05$) and * represents at 10% significant level ($p \leq 0.1$).

Table 6.62 presents the OLS results for apple, apricot and avocado industries as from 1990 until 2018. The dependent variable ($lnVOSAXEU_t$) for all equations is the South African exports of apple, apricots and avocado to the EU markets. The independent variables differ per industry due to different dynamics of each industry and that the selection of independent variables was also influenced by the literature concerning the international trade, employment and wages (Foster *et al.*, 2011; Fugazza, 2014; Gaston, 1998; Gaston and Trefler, 1994; Shell, 1995; Tuhin, 2015).

❖ Interpretation of OLS results for the apple industry

Table 6.62 shows that the apple industry has one regressand which is a logarithm of the South African exports of apples to the EU markets ($lnVOSAXEU_t$) and three regressors which are as follows: a logarithm of the wages output ($lnWAGO_t$), a logarithm of the total area planted with apples ($lnAREAP_t$) and foreign direct investment (FDI_t). The estimation results indicate that the two regressors ($lnAREAP_t$ and FDI_t) are positive and statistically significant at 1 and 5 percent, respectively. However, the wages output ($lnWAGO_t$) displays an expected negative sign and significant at 1% (Bazen & Cardebat, 2001; Du-Caju *et al.*, 2012; Ma & Wooster, 2009)

The South African exports of apples to the EU markets ($lnVOSAXEU_t$) regression given in Table 6.62, shows the intercept value of 4.80, which implies that on average, the value of South African apple exports to EU markets is estimated to be R4.8 billion when all regressors in the equation are equivalent to zero. This is attributed to fact that EU is the traditional market for the South African apples. Furthermore, South Africa is based on the southern hemisphere which acts as a suitable supplier of apples in EU during their off-season (Lubinga & Phaleng, 2018; Ntombela & Moobi, 2013).

Wages output for the South African apple industry

The wages output's ($lnWAGO_t$) coefficient of -0.49 implies that when holding all variables constant, a one unit increase in wage output leads to a 49 percent decrease in South African exports of apples to the EU markets ($lnVOSAXEU_t$). The variable is positively significant with a p-value of below 0.01 and t-statistics of -7.57. This is attributed to the fact that South African government has introduced a minimum wage legislation which obliges producers to compensate labourers at least a minimum of wage of R3 500 per month. The increase in wages makes firms to be less competitive in the global markets, in which most markets are distorted as firms received the bulk of subsidies from their governments (Lin & Chang, 2009). The results coincides with the theory of imperfect competition, which emphasises that trade gains such as wages and employment opportunities are realised by developed countries since they provide support instruments to their firms and most their firms are multinationals (Helpman, 1990; Krugman, 1979; Pomfret, 1992).

Total area planted with apples

The coefficient of total area planted with apples ($lnAREAP_t$) is equivalent to 1.11 which reflects a positive expected sign and is statistically significant at 1% level. When holding all other variables constant, *ceteris paribus*, a one unit increase in total area planted with apples results in 1.11 percent increase in South African exports of apples to the EU markets ($lnVOSAXEU_t$). The results are attributed to the fact that EU is the biggest and traditional market for South African apples, due to seasonality differences and ability of the SA apples to meet the phytosanitary standards required by the Europeans (Chitiga *et al*., 2008; Grandin & Pletschke, 2015; Lubinga & Phaleng, 2018)

Foreign Direct Investment

There is a positive relationship between the South African exports of apples to the EU markets ($lnVOSAXEU_t$) and the Foreign Direct Investment (FDI_t), since the variable is positive and statistically significant at 5 percent level. The Foreign

Direct Investment's coefficient of ≈ 3.42 indicates a one unit increase in FDI_t leading to a 3.42 percent incline in South African exports of apples to the EU markets. The results are attributed to the fact that FDI increases the competitive advantage of apple exports in the global markets. The investors are partnering with apple producers in adopting the latest technology, while investing in research and development to enhance productivity (Bulagi, 2014; Mashabela, 2007).

Test of the overall significance and goodness of fit for the apple regression

The hypothesis underlying the overall significance is that when the calculated F-statistic value is smaller than the table F-statistic, then the null hypothesis of regressors affecting the regressand is rejected. Alternatively, when the calculated F-statistic value is greater than the table F-statistic, then the null hypothesis of regressors affecting the regressand is rejected. The calculated F-statistic is equivalent to 12.26, which is far greater than F-value from statistics table ($F_{(\propto,k,n-k-1}$) which is 3.01, which implies that the null hypothesis is rejected and concludes that all the regressors affect the South African apple exports to the EU markets. Furthermore, the p-value of the calculated F-statistic is significant at one percent level, which implies the overall significance of the apple regression. The apple regression R^2 is equivalent to 0.84, which shows that the 84 percent of the variations in the South African apple exports to the EU markets are explained by the regressors. On the basis of coefficient of determination value, the conclusion is that the apple model offers an excellent fit.

Diagnostic test for the apple regression

The diagnostic tests performed for the apple regression included the Breusch-Godfrey (Lagrange Multiplier) LM test for serial correlation, Breusch-Pagan-Godfrey for Heteroscedasticity and model stability through cumulative sum of recursive residuals (CUSUM). The result of the Breusch-Godfrey serial correlation test shows a p-value of 0.76, which confirms absence of serial correlation. The underlying rule is that when p-value is ≥ 0.05 then the null hypothesis of the existence of serial correlation is rejected and concludes that the model is free from serial correlation (Gujarati, 2003; Gujarati & Porter, 2009; Gujarati, 2015; Wooldridge, 2013).

The results of the heteroscedasticity test indicate that the model is homoscedastic, since the p-value of 0.27 is greater than 0.05, which implies that the disturbance term is similar across all values of the regressors. These results confirm that the standard errors are not biased and the regression is not spurious. Therefore, the impact of regressors on the South African apple exports to EU markets is correctly specified by the apple regression.

The results of model stability tests for the apple regression are shown in Figure 6.1, which indicates that the residuals are normally distributed. Furthermore, all necessary variables are incorporated in the predictor set. Recursive residuals have been widely adopted as a statistical technique to test for stability of the model (Galpin & Hawkins, 1984). Figure 6.1 shows that the recursive residuals are more linear in nature, since they are identical and independently distributed. The specified apple regression satisfies all performed diagnostic tests, which indicates that OLS is the best suited model to estimate the impact of regressors on the South African apple exports to the EU markets.

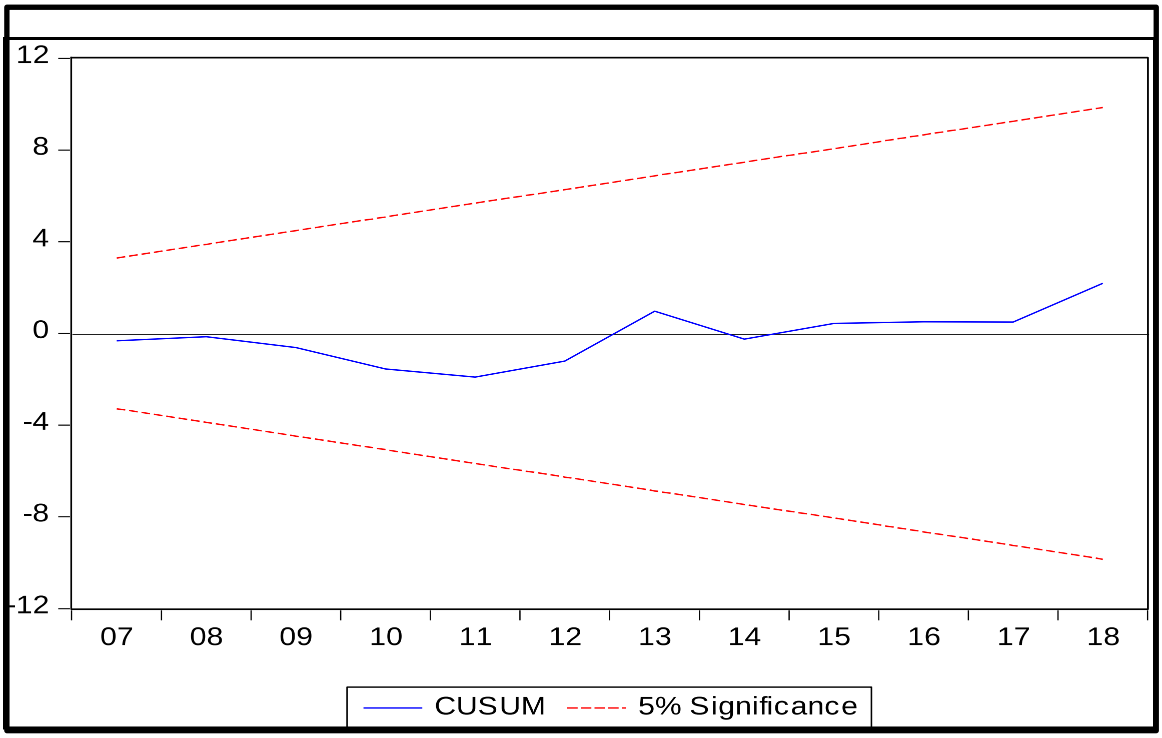

Figure 6. 1: The model stability test for the apple industry
Source: Author's computation

❖ The interpretation of OLS results for the apricot industry

The regressand for the apricot regression is a logarithm of the South African apricot exports to the EU markets ($lnVOSAXEU_t$), while the regressors are as follows: a logarithm of wage output of the apricot industry ($lnWAGO_t$), Foreign Direct Investment (FDI_t), gross value of fresh apricots ($lnGRVF_t$), South African population ($lnPOPU_t$), net realisation from apricot exports ($lnNETR_t$) and processing volume of the apricot industry ($lnPROCV_t$). All variables except FDI are transformed into logarithm form, for normalisation of the dataset. Theoretically, the estimation needs to produce smallest error as possible, while taking into cognisance that overfitting the model is avoided (Wooldridge 2013; Zaman *et al*., 2001).

The coefficient of a concept is 291.78, which is positive and significant at 5 percent level. The intercept value shows that when all variables are constant, the South African apricot exports to the EU markets are equivalent to R292 million per annum. The results are attributed to the fact that more than 50 percent of apricots are destined to the markets through fresh, processed and canned products (Phaleng, 2017). Furthermore, the apricots produced in South Africa are meeting the standards required in the EU markets and the difference in production seasonal between northern as well as southern hemisphere puts South Africa as a preferred supplier together with fellow southern hemisphere producers such as Argentina, Brazil, Chile and New Zealand (Lubinga & Phaleng 2018; Phaleng & Ntombela 2018).

Wage output for the South African apricot industry

The slope coefficient of wage output $(lnWAGO_t)$, is positively associated with the South African apricot exports to the EU markets. However, the variable is not statistically significant. The results show that other socio-economic variables might contribute significantly to the regressand ($lnVOSAXEU_t$). Furthermore, when South Africa exports its apricot products to EU markets, employment opportunities are generated and wages are paid to the employees involved in the production chain.

Foreign direct investment

The Foreign Direct Investment (FDI_t) is positive and statistically significant at 1 percent level. The coefficient value of FDI_t is 6.95, which indicates that when holding all variables constant, a one-unit increase in FDI_t would result in 6.95 increase in South African apricot exports to the EU markets. This is attributed to the fact that apricot production is a capital-intensive business which requires continuous domestic and international investment. The yield of apricot is destined to local and international markets, while some portion is absorbed by the downstream activities such as canning, drying and etcetera (Phaleng 2017).

Gross value of fresh apricots

The gross value of fresh apricots $(lnGRVF_t)$ shows a positive relationship with the South African apricot exports to the EU markets $(lnVOSAXEU_t)$. The variable is not statistically significant since its p-value is greater than 0.1 and t-statistics is less than 2. As postulated by DAFF (2018b), an increase in gross value of fresh apricots triggers growth in exports of both fresh and processed apricot products. The multiplier effects of gross value incentivise growth in employment and wages (SEDA, 2012; Van-Dyk and Maspero, 2004).

Total population of South Africa

The slope coefficient β_4 (total population) is negative and statistically significant at 5 percent level, which represents the total population in South Africa. The coefficient value of population is -17.23, which shows that there is a negative linkage between the total population of South Africa and the South African apricot exports to the EU markets. On average, when holding all other regressors, a one -unit increase in the total South African population would cause the South African apricot exports to the EU markets to decrease by 17.23 percent. The decline in exports is associated with fact that an increase in population triggers a domestic demand of apricots. Furthermore, the middle income segment and urbanisation is increasing in South Africa, which propels the growing demand of the fruits (Ortmann, 2005; Mashabela, 2007).

Net realisation from apricot exports

The net realisation from apricot exports $(lnNETR_t)$ is positive and statistically significant at 5 percent level. The slope coefficient of β_4 is 0.62, which implies that when other independent variables are constant, *ceteris paribus*, a one-unit increase in the net realisation from apricot exports leads to at least 62% increase in the South African apricot exports to the EU markets. This is attributed to the fact that an incline in net realisation encourages producers to increase production and exports. The EU countries are regarded as lucrative traditional markets, while the trade development and cooperation agreement (TDCA) has been a vehicle to smoothen trade between two regions. The newly ratified agreement between SADC and EU called Economic Partnership Agreement (EPA) has deepened and broadened the trade relations between the SADC and EU (Chitiga *et al*., 2008; Muchopa, 2019).

Processing volume of apricots

The slope coefficient of β_6 represents the processing volume of apricots and is positive, but statistically insignificant. The coefficient value of processing volume of apricots $(lnPROCV_t)$ is 0.24, which indicates that when processing volume of apricots increase by one unit, *ceteris paribus*, the South African apricot exports to the EU markets rise by approximately 24 percent. The results are linked with the fact that South Africa diversifies apricot products into fresh, processing, canned and compost. The industry is export-oriented and contributes significantly to employment creation in South Africa (DAFF, 2018b; Grandin & Pletschke, 2015) (Mashabela, 2007).

Test of the overall significance and goodness of fit for the apricot regression

The calculated F-statistics value is equivalent to 12.98 which is greater than the table F-statistics of 2.57 and that signifies the overall significance of the apricot regression. Furthermore, the p-value of the calculated F-statistics is statistically significant at 1 percent level, since it is below 0.05 and this also confirms the overall significance of the apricot regression. The R^2 value of the apricot regression is 0.90, which indicates that 90 percent of the variations in the South African apricot exports to the EU markets are clarified by the regressors. Based on a coefficient of the determination value, the decision is that the apricot regression renders an excellent fit.

Diagnostic test for the apricot regression

Several diagnostic tests were performed to validate the apricot model, namely: Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation, Breusch-Pagan-Godfrey for Heteroscedasticity and model stability using the cumulative sum of recursive residuals (CUSUM). The outcomes of Breusch-Godfrey LM test for serial correlation depict a p-value of 0.29, which rejects the null hypothesis of serial correlation and concludes that the model does not suffer from serial correlation (Gujarati, 2015; Wooldridge, 2013).

The outcomes of the Breusch-Pagan-Godfrey test show that the apricot model does not suffer from heteroscedasticity. The p-value is 0.33, which is higher than 0.05 indicates that error term is ordinarily dispersed across all the regressors. The outcomes highlight that the regression is not spurious and the results are not misleading. Therefore, the effect of regressors on the South African apricot exports to EU markets is appropriately defined by the apricot regression.

The outcomes of CUSUM test for stability as depicted on Figure 6.2 highlights that the residuals from apricot regression are normally distributed. Moreover, all required variables are correctly included in the regression. The recursive residuals have been identified as a technique to test the model stability. As illustrated in Figure 6.2, the recursive residuals are linear, due to the fact that they are identical and independently dispersed. Therefore, the apricot regression is correctly specified, as it fulfils all performed diagnostic checks. The conclusion is that the OLS model is a paramount suited model to examine the impact of regressors on the South African apricot exports to the EU markets.

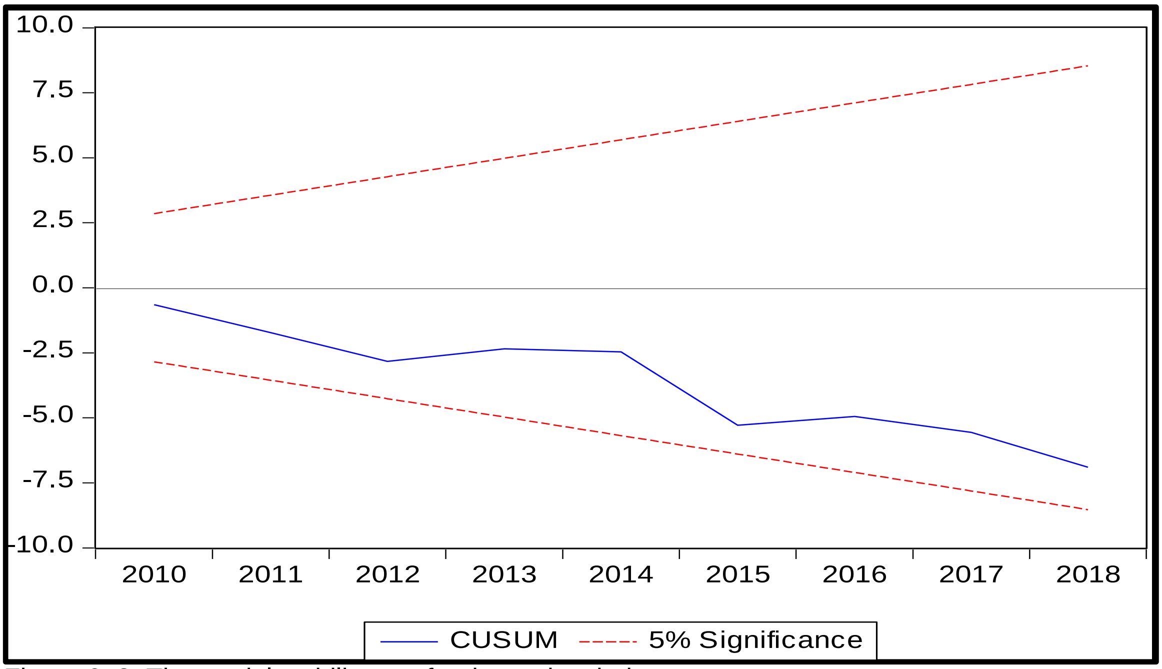

Figure 6. 2: The model stability test for the apricot industry
Source: Author's computation

❖ The discussion for the OLS results for the avocado industry

The results from the avocado regression as shown in Table 6.62 highlights that a model consists of one regressand which is a logarithm of the South African avocado exports to the EU markets ($lnVOSAXEU_t$). There are two included regressors which are a logarithm of the wages output ($lnWAGO_t$) and foreign direct investment (FDI_t).

Wage output for the South African avocado industry

Table 6.62 shows that both the regressors carry a positive sign, but only a logarithm of the wages output is statistically significant at 1 percent level, since its p-value is below 0.05 and t-statistics is equivalent to 3.30, respectively. Notably, the coefficient value of $lnWAGO_t$ is 1.18, which implies that a one-unit increase in wages output leads to at least 1.18 increase in the South African avocado exports to the EU markets. The results are attributed to fact that when exports of fresh avocadoes increase results into employment opportunities and increased wages, the producers uses wages output and bonuses to encourage employees to maximise profitability of the firms. Furthermore, the unionisation of employees assists in pushing wages higher and the recent legislation on minimum wages for employees in South Africa contributed to an increase in wages for employees (DAFF, 2018c; Phaleng, 2017; Rahmanian, 2015).

Foreign direct investment

The slope coefficient of β_2 on the avocado regression as shown in Table 6.62, denotes the foreign direct investment (FDI_t).The variable is positive, but statistically insignificant, since its p-value is above 0.1 and t-statistics is 0.32, respectively. The positive sign indicates that foreign direct investment and the South African avocado exports to the EU markets have a positive relationship. The results are attributed to the fact that when foreign direct investment intensifies the production increases, which result in growth in exports into the lucrative markets (Bulagi, 2014; DAFF, 2018c; Lubinga & Phaleng, 2018).

Testing for the overall significance and goodness of fit for the avocado regression

The avocado model meets overall significance assumptions, since the calculated F-statistic value is equivalent to 8.56 which is more than the table F-statistics of 3.39, which confirms the overall significance of the avocado regression. Notably, Table 6.62 shows that the p-value of the calculated F-statistics is statistically significant at 1 percent level, hence it is under 0.05 and that supports the overall significance of the avocado regression. The value of the R^2 is equivalent to 0.68, which signifies that 68 percent of the variations in the South African avocado exports to the EU markets are explained by the independent variables. The coefficient of the determination value shows that the avocado regression provides an excellent fit (Wooldridge, 2013).

Diagnostic test for the avocado regression

According to Davidson and Mackinnon (1999), there are various diagnostic tests required to validate the specified avocado model, which are as follows: Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation, Breusch-Pagan-Godfrey for Heteroscedasticity and model stability using the cumulative sum of recursive residuals (CUSUM). The results of Breusch-Godfrey LM test show that the specified model does not suffer from serial correlation, since its p-value is 0.06 (Gujarati & Porter, 2009).

As depicted in Table 6.62, the Breusch-Pagan-Godfrey test indicates that the avocado regression does not suffer from heteroscedasticity. Furthermore, Table 6.62 shows that the p-value of the Breusch-Pagan-Godfrey test is 0.42 which is more than 0.05, the implication is that the disturbance term is normally distributed across all the independent variables. The results show that the specified regression is not spurious and the findings are not misrepresentative. Notably, the impact of the independent variables on the South African avocado exports to the EU markets is correctly defined by the avocado regression.

Figure 6.3 highlights the results of the cumulative sum of recursive residuals (CUSUM) which show that the residuals from avocado regression are usually dispersed. The results indicate that all necessary regressors are properly included in the set of independent variables. The CUSUM has been identified as an econometric technique to test the stability of the model. Figure 6.3 illustrates that the recursive residuals are linear, within the boundaries and are normally distributed. Notably, the avocado model is normally specified, as it meets all the performed diagnostic tests. In conclusion, the OLS model is correctly specified to assess the impact of the independent variables on the South African avocado exports to the EU markets.

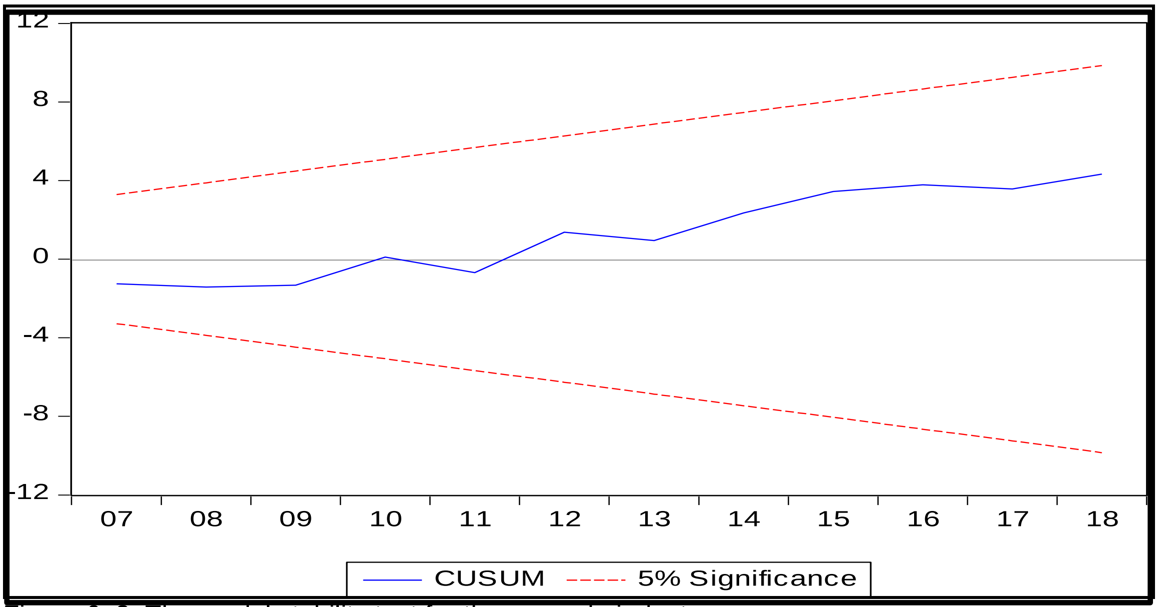

Figure 6. 3: The model stability test for the avocado industry
Source: Author's computation

Table 6.62 shows the OLS regression results for orange, pear and table grape industries. All three regressions used the South African exports to the EU markets as the dependent variable $(lnVOSAXEU_t)$, while regressors vary per fruit industry. Three regressions were performed separately using different independent variables in order to establish how the variations in regressor are explained by the independent variables of selected fruit industries.

❖ The discussion for the OLS results for the orange industry

The regression for the orange industry has two independent variables which are a logarithm of wage output $(lnWAGO_t)$ and foreign direct investment (FDI_t). The coefficient of intercept for the orange is positive and statistically significant at 1 percent level. Table 6.62 indicates that for the orange industry, the value of intercept's coefficient is 11.47, which implies that when all variables are held constant, *ceteris paribus*, the South African orange exports to the EU markets are estimated at R11.47 million per annum. This is attributed to the fact that EU is amongst the most traditional lucrative market for the South African oranges. However, the orange exports are heavily affected by the Citrus Black Spot (CBS), which is one of the barriers to access the EU markets (Dlikilili, 2018; Ndou, 2012; Sinngu, 2014).

Wage output for the South African orange industry

The slope coefficient of β_1 represents a logarithm of wage output $(lnWAGO_t)$ which is positive and statistically significant at 5 percent level. The coefficient value of $lnWAGO_t$ is 0.17, which signifies that a one-unit increase in wages output leads to at least 17 percent increase of the South African orange exports to the EU markets. The results are attributed to the fact that an increase in wages is associated with increased productivity and that encourages the employees to deliver more products which are serving both the local and export markets (Hansson *et al.,* 2004; Ndou, 2012).

Foreign direct investment

The coefficient of the foreign direct investment (FDI_t) is positive and statistically insignificant. The implication is that there is a positive interrelationship between foreign direct investment and the South African orange exports to the EU. The coefficient value of FDI_t is 2.95, with a p-value of more than 0.1 and t-statistics of less than 2. However, the empirical literature posits that an increase in foreign direct investment results in an increase in export growth, employment and wages. Therefore, foreign direct investment is an enabler for the growth of the South African orange exports to the EU markets, since the market requires top quality grades and puts stringent standards which require more resources (Lo et al. 2016; Phaleng, 2017; Žiković et al. 2014).

Testing for the overall significance and *goodness of fit for the orange regression*

Table 6.62 shows that orange regression satisfies overall significance assumptions, the calculated F-statistic value is 8.34, which is greater than F-statistic from the statistical table, which is 3.39. Furthermore, p-value of the calculated F-statistics is below 0.05, which implies statistical significance at one percent level. Secondly, the value of R^2 of the orange regression is 0.56 as depicted by Table 6.62. The implication is that 56 percent of the variations in the South African orange exports to the EU markets are clarified by the identified explanatory variables. The coefficient of the deterministic value highlights that the orange model renders a perfect goodness of fit (Baltar, 2011; Block, 2014; Holzner, 2010).

Diagnostic test *for the orange regression*

There are several diagnostic tests identified to validate the orange regression, namely: Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation, Breusch-Pagan-Godfrey for Heteroscedasticity and model stability using the cumulative sum of recursive residuals (CUSUM). Notably, the outcome of the Breusch-Godfrey LM test indicates that the orange regression is free from serial correlation due to the fact that its p-value is 0.45, which over 0.05.

Table 6.62 shows the results of Breusch-Pagan-Godfrey test, which reveals that the orange regression is homoscedastic. The p-value of the Breusch-Pagan-Godfrey test is 0.28, which is greater than 0.05, this implies that the error term is normally distributed over all the observations. In a nutshell, the orange regression does not show to be spurious and the results are not misleading. Therefore, the impact of regressors on the South African orange exports to the EU market is significantly expressed by the orange regression.

The results of the cumulative sum of recursive residuals (CUSUM) as depicted in Figure 6.4 indicate that the residuals from orange model are normally distributed. The outcomes show that all the independent variables are accurately incorporated in the set of regressors. Gujarati and Porter (2009) acknowledge CUSUM as the econometric technique to assess the stability level of the estimation. As depicted in Figure 6.3, the recursive residuals are linear, clearly fitted within the confines and are normally dispersed. Therefore, the outcomes of three diagnostic tests show that orange regression is correctly specified, since it satisfies the assumptions for all tests. Therefore, the ordinary least square is the best suited econometric technique to examine the impact of the regressors on the regressand ($lnVOSAXEU_t$).

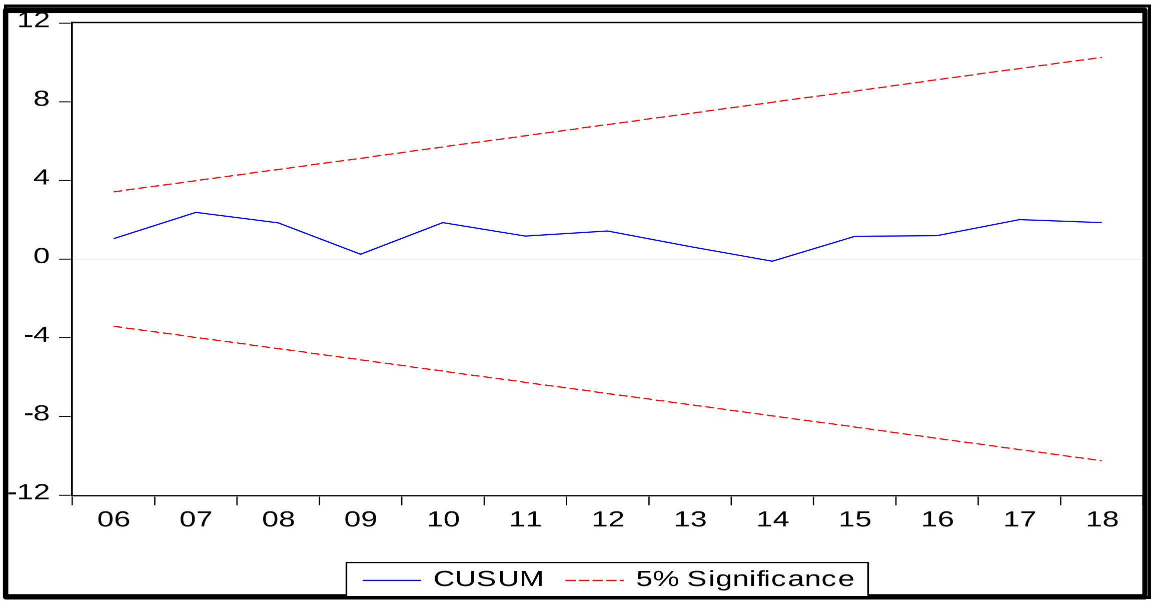

Figure 6. 4: The model stability test for the orange industry
Source: Author's computation

❖ The discussion for the OLS results for the pear industry

Table 6.62 shows that the pear regression outcomes, which consists of one dependent variable ($lnVOSAXEU_t$), while the two independent variables are the logarithm of wage output ($lnWAGO_t$) and a logarithm of production volumes of the pear industry ($lnPRODT_t$). The independent variables are positively interrelated with the South African exports of pear to the EU markets ($lnVOSAXEU_t$). The coefficient of intercept is negative and statistically significant at 10 percent level. The value of intercept's coefficient is -0.13, which indicates that when holding everything constant, *ceteris paribus*, the South Africa pear exports to the EU markets would depreciate by 13 percent. This is attributed to the fact that South African pears compete with products from other countries, more particularly from top producers in the southern hemisphere such as

Argentina, Brazil, Chile and New Zealand (Kalaba & Henneberry, 2001; Lubinga & Phaleng, 2018).

Wages output for the South African pear industry

The coefficient of $lnWAGO_t$ is positive and significant at 10 percent level. The variable's coefficient value is 0.77, which signifies that when keeping all the independent variables constant, a one-unit increase in wage output results in a 77 percent increase on the South African pear exports to the EU markets. This is attributed to the fact an increase in wage output provides incentives for employees to produce more, which translates into sufficient products to satisfy the domestic and international markets. South Africa has signed to law the minimum wage legislation which guarantees the low-skill workers a minimum wage of R3 500 per month (Bulagi *et al*., 2016; Muchopa, 2019; Ndou, 2012).

Production volumes of the pear industry

The slope coefficient of β_2 represents a logarithm of production volumes of the pear industry ($lnPRODT_t$) which is positive and statistical insignificant. The $lnPRODT_t$ variable's coefficient value is 0.58 with the t-statistics equivalent to 0.82 and p-value greater than 0.1. The results make an economic sense as higher production yields contribute significantly to the export growth, employment and wages (DAFF 2018e). The South African pear industry is export-oriented in nature, due to suitable climatic and soil conditions in South Africa (BFAP and NAMC 2016).

Testing for the overall significance and goodness of fit for the pear regression

The pear regression is compatible with overall significance assumptions, due to the fact that its calculated F-statistics value is 6.64 and this tends to be greater than the table F-statistics of 3.39, which makes the pear regression to be overall significant. Additionally, Table 6.62 indicates that p-value of the calculated F-statistics is below 0.05, statistically significant at 1 percent level and conforms to the overall significance assumption. The pear regression's R^2 value is 0.82, which implies that 82 percent of the variations in the South African pear exports to the EU markets are explained by the regressors. Therefore, the pear regression renders an excellent fit due to the coefficient of the deterministic value (Gujarati & Porter 2009; Holland & Welsch 1977; Wooldridge 2013).

Diagnostic test for the pear regression

The pear regression is validated by using three diagnostic techniques, namely: Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation, Breusch-Pagan-Godfrey for Heteroscedasticity and model stability using the cumulative sum of recursive residuals (CUSUM). Table 6.62 shows the results of the Breusch-Godfrey LM test which highlights that the pear regression does not suffer from serial correlation since its p-value is 0.15, which is greater than 0.05 (Cetin 2016; Gujarati 2015; Zheng et al. 2020).

The outcomes of Breusch-Pagan-Godfrey test for the pear industry as reflected in Table 6.62, which indicates that the pear regression does not suffer from heteroscedasticity. Furthermore, the p-value of Breusch-Pagan-Godfrey test is 0.38, which highlights that the disturbance term is perfectly distributed across all the observations. Notably, the pear regression is not spurious and the findings are not misleading. Nonetheless, the impact of explanatory variables on the South African pear exports to the EU markets is explained by the pear regression.

Figure 6.5 presents the results of the cumulative sum of recursive residuals (CUSUM), which specifies that the residuals from pear regression are normally dispersed. The results indicate that the explanatory variables are best fitted in the specified pear model. As outlined by Gujarati and Porter (2009), CUSUM is the best identified econometric technique to examine the model stability. As illustrated on Figure 6.5, the residuals are linear, perfectly aligned within the boundaries and normally distributed. Nonetheless, the results of all identified tests reveal that pear industry model is perfectly specified as it meets the assumptions for all identified diagnostic tests. Notably, the OLS is the perfectly suited technique to determine the impact of the explanatory variables on the dependent variable $(lnVOSAXEU_t)$.

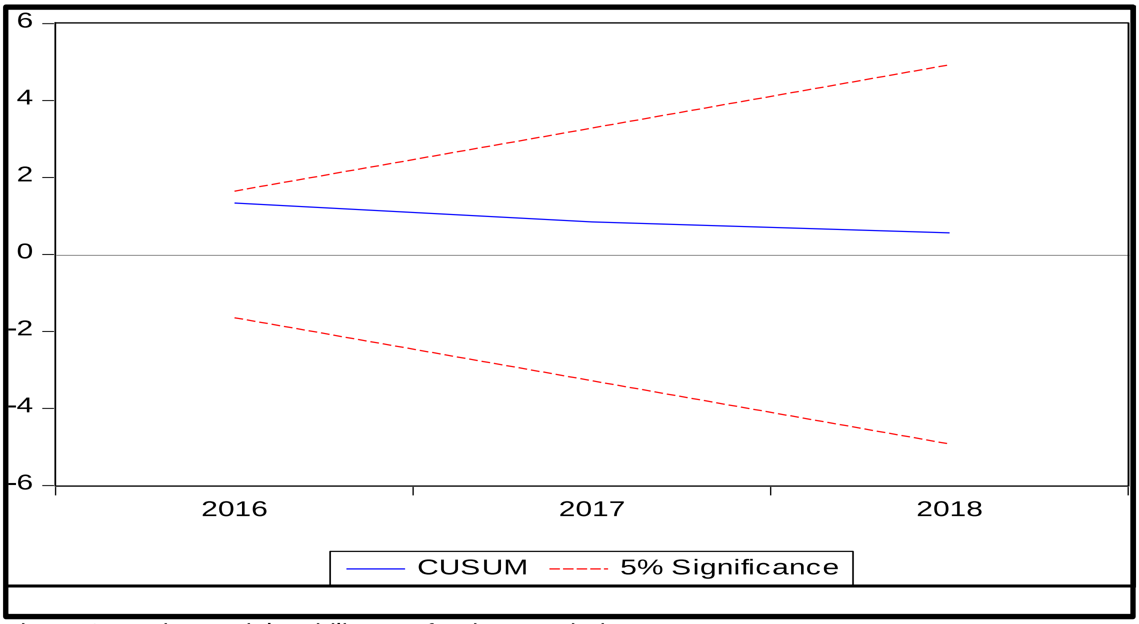

Figure 6. 5: The model stability test for the pear industry
Source: Author's computation

❖ The interpretation of OLS results for the table grape industry

As shown by Table 6.62, the table grape regression consists of one dependent variable, which is the South African table grape exports to the EU markets $(lnVOSAXEU_t)$, while the explanatory variables are as follows: wage output $(lnWAGO_t)$, Foreign Direct Investment (FDI_t), total employment in the table grape industry $(lnEMPG_t)$, dried volumes for the table grapes $(lnDRDV_t)$ and domestic consumption of table grapes $(lnDCONS_t)$. Nonetheless, all identified explanatory variables are converted into logarithm format for normalisation of the dataset (Zaman et al. 2001). The results show that only two explanatory variables $(lnEMPG_t)$ and $(lnDRDV_t)$ are statistically significant, while the remaining four are insignificant.

Table 6.62 shows that the coefficient of a concept term is 7.27, which is positive, but statistically insignificant. The results imply that when all explanatory variables are constant, the South African table grape exports to the EU markets are valued at R7 million per annum. Notably, the table grape industry is export-oriented, while it contributes significantly to the gross value of agricultural products, employment and wages. The exports to the EU markets are dominated by fresh produce, whose majority exports come from the Western Cape Province (DAFF 2019; Ortmann 2005; Sandrey & Vink 2007).

Wage output for the South African table grape industry

The slope coefficient of β_1 represents the wage output for the table grape industry ($lnWAGO_t$) which is positive and statistically insignificant. The coefficient value of $lnWAGO_t$ is 0.004, with a t-statistic value of 0.08. The results make an economic sense since an increase in wages incentivises the employees to work even harder to increases the outputs. The EU is the traditional market for the table grape industry, while the seasonality difference provides a competitive edge to South African table grape exporters (Kalaba & Henneberry 2001; Mashabela 2007; Muchopa 2019).

Foreign direct investment

The coefficient of Foreign Direct Investment (FDI_t) is positive, but statistically insignificant. The coefficient value of FDI_t is equivalent to 4.58, while its t-statistics is 0.67. This is attributed to the fact that Foreign Direct Investment stimulates the production capacity and allows the South African table grapes industry to comply with norms as well as the standards required by the EU markets. The inflow of Foreign Direct Investment offers an opportunity for the table grapes producers to develop and adopt new technologies that gives them a competitive edge over their competitors (Ortmann 2005; Lubinga & Phaleng 2018; Van-Dyk & Maspero 2004).

The total employment in the table grape industry

The total employment in the table grape industry ($lnEMPG_t$) is positive and statistically significant at 10 percent level. The coefficient value of $lnEMPG_t$ is equivalent to 0.58, which shows that when all explanatory variables are constant, *ceteris paribus*, a one-unit incline in total employment in the table grape industry results into at least 58 percent increase in the South African table grape exports to the EU markets. The results are attributed to the fact that table grapes production generates more employment opportunities through on-farm and post-harvest activities. The positive interrelation between $lnEMPG_t$ and regressand suggests that the EU markets are contributing to socio-economic growth for the industry (Mashabela 2007; Phaleng & Ntombela 2018; Rahmanian 2015).

Dried volumes for the table grapes

The slope coefficient of β_4 represents the dried volumes ($lnDRDV_t$) of the table grapes, the variable is positive and statistically significant at one percent level. The coefficient value is equivalent to 0.35 with a t-statistics of 3.24 and p-value of less than 0.05. There is a positive response of the South African table grape exports to the EU markets on the changes in dried volumes for the table grapes. The implication is that when holding everything constant, a one-unit increase in dried volumes for the table grape results into 35 percent increase in the South African table grapes exports to the EU markets. These is attributed to the fact that dried volumes diversify exports of table grape products to the EU markets, while generating the much need employment, as postulated by the National Development Plan (NDP) and Industrial Policy Action Plan (IPAP). The downstream industry creates additional employment opportunities in the supporting industries such as logistics, packing houses, packaging, etcetera (DAFF 2019; Grandin & Pletschke 2015; Kalaba & Henneberry 2001; Mashabela 2007).

Domestic consumption of table grapes

The slope coefficient of β_5 signifies the domestic consumption $(lnDCONS_t)$ of table grapes as depicted in Table 6.62. The variable shows to be negative, but statistically insignificant, since its p-value is over 0.1 and the value of t-statistics is -1.43. The coefficient value of $lnDCONS_t$ is -0.46, which makes an economic sense because as the domestic consumption increases, the exports decline. Supplying the domestic markets saves producers from incurring other transactional costs and also allows the small micro and medium enterprises (SMMEs) with experience of the international markets to participate effectively (Ntshangase et al. 2016; Rahmanian 2015).

Testing for the overall significance and goodness of fit for the table grape regression

The table grape regression shows to be meeting the assumptions of overall significance, since the value of calculated F-statistics is equivalent to 5.67, which is greater than the table F-statistics of 2.66. The implication is that table grape regression meets the assumptions of overall significance. Furthermore, Table 6.62 shows that p-value for the calculated F-statistics is almost zero, which is statistically significant at 1 percent level and that makes the regression to comply with the overall significance assumptions. The R^2 value of the table grape regression is equivalent to 0.74, which indicates that 74 percent of the variations in the South African table grape exports to the EU markets are clarified by the explanatory variables. It is evident that the table grape regression offers an excellent fit due to the coefficient of the deterministic value (Gujarati & Porter 2009; Wooldridge 2013).

Diagnostic test for the table grape regression

The three diagnostic techniques adopted to validate the table grape regression are as follows: Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation, Breusch-Pagan-Godfrey for Heteroscedasticity and model stability using the cumulative sum of recursive residuals (CUSUM). As illustrated by Table 6.62, the Breusch-Godfrey LM test shows that the table grape estimation does not suffer from serial correlation due to the fact that its p-value is 0.59, which is beyond 0.05 (Gujarati 2015; Zheng et al. 2020).

The Breusch-Pagan-Godfrey test as shown on Table 6.62 validates the table grape estimation from heteroscedasticity. Notably, the Breusch-Pagan-Godfrey test for the table grape regression produced the p-value equivalent to 0.56, which indicates that the error term is normally distributed throughout the observations. Therefore, the implication is that the table grape regression is not considered to be spurious and its findings are not misleading. The validity of table grape regression shows that the effect of independent variables on the South Africa table grape exports to the EU markets is clarified by the table grape regression.

The outcomes of the cumulative sum of recursive residuals (CUSUM) for the table grape regression are presented in Figure 6.6, which indicates that the recursive residuals of the table grape estimation are normally distributed. Therefore, the outcome shows that the independent variables are well fitted in the table grape regression. The econometrics literature shows that the cumulative sum of recursive residuals is the best technique to assess the regression stability (Gujarati & Porter, 2009; Wooldridge, 2013). As displayed in Figure 6.6, the residuals show to be distributed within the boundaries, linear and normally dispersed. Nonetheless, the results of all identified diagnostic tests show that table grape regression is correctly specified as it complies with the requirements for robust estimation. It should be concluded that the Ordinary Least Square is the best suited analytical technique to examine the impact of the regressors on the regressands.

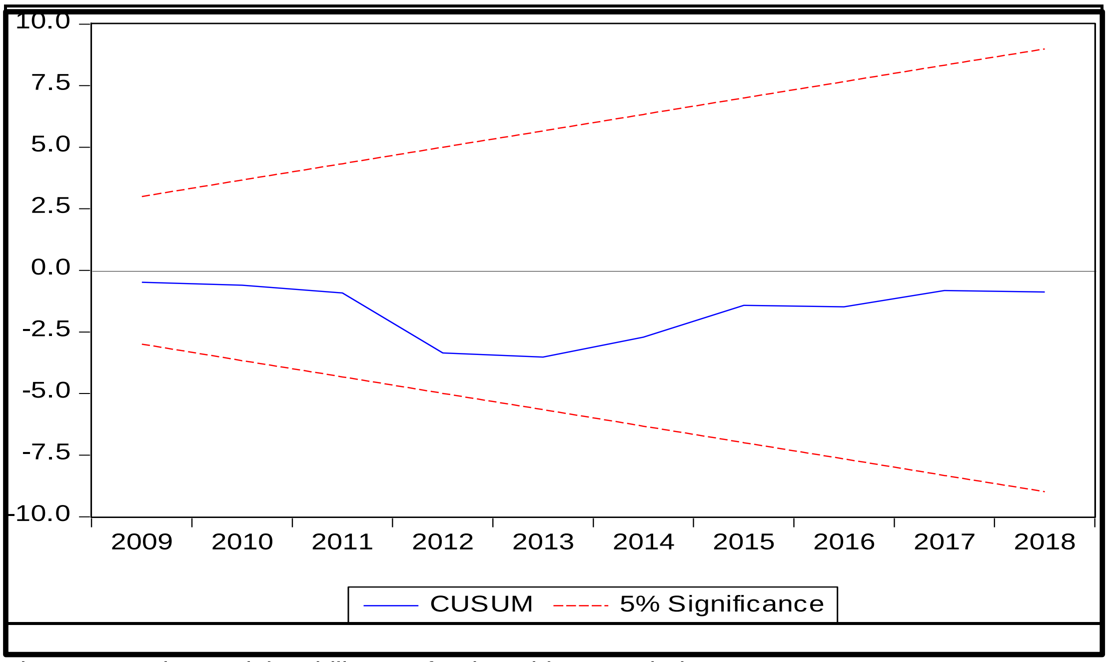

Figure 6. 6: The model stability test for the table grape industry
Source: Author's computation

6.5 Chapter Summary

The concluding remarks in Chapter 6 are based on the findings from the analytical technique such as error correction model, granger causality test, two-staged least squares and ordinary least squares. The findings from the error correction model shows that the variables affect each other in a long-run, since exports output affect the total employment, while imports output affects total employment negatively. The findings emanating from the two-staged least squares show that wages are impacted positively by the exports output. However, there are other factors that impact wages positively such as net realisation from exports, local sales, total gross value of production and foreign direct investment. The wages are negatively affected by imports output, average exchange rate and average prices. The ordinary least squares for all estimated fruit industries show that the volumes of exports to the European Union market affect the wages positively, while other variables that are positively affected by the exports to EU market include amongst others the production volumes, productivity, total area planted and foreign direct investment. However, the volumes of exports to the European

Union market negatively affect the processing volumes of the fruit industries in South Africa, domestic consumption per capita and average prices.

CHAPTER 7
SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This chapter provides detailed summary, conclusion and recommendations of the effects of international trade on employment and wages within the six selected fruit industries of South Africa. The overarching aim of the study is to analyse the impact of international trade on employment and wages in the South African fruit industry between the period of 1990 and 2018. The selection of fruit industry is informed by the intuition that the fruit industry is amongst the top contributor of employment opportunities, supplier of minimum wages to employees and increases the South African export base. The study focused on only six fruit industries, which was prioritised based on their economic and social significance in the entire fruit industry. It has also analysed the performance of those six selected fruit industries in terms of international trade, employment and wages output.

The South African fruits industry shows positive signs of benefiting from international trade than other commodities within the agricultural space. Economics of scale propel the industry to continue benefiting from local and international trade, while generating the much needed employment opportunities and remunerates employees based on the minimum wage. The findings show that the orange industry, which is under citrus group is the biggest contributor towards employment and wages amongst other five prioritised fruits. The study comprised of seven chapters, in which the first three chapters painted a detailed picture about the fruit sector, as well as background information on international trade, labour markets which includes employment and wages.

The second chapter which is the literature review explored the theoretical framework connecting to the study called the Krugman's theory of imperfect competition. The findings captured from the theory are that trade of same products amongst developed and developing countries tends to work in favour of developed countries. This is based on the following arguments: developing countries focus on exporting primary goods such fresh fruits, while developed countries exports beneficiated products like fruit concentrates. Furthermore, it was found that the firms in developed countries are horizontally and vertically integrated with a higher market share. The developed countries utilise primary commodities received from developing countries to produce intermediate and final products. The findings from literature show that there is existence of market distortions in the developed countries, due to the fact that production is subsidised and import duties for primary goods are set low in order to stimulate the beneficiation process. Conversely, the developing countries focus mostly on the production of primary goods with minimal government support.

7.2 Summary and conclusion

This study adopted an in-depth industries analysis for each selected fruit, which was complemented by descriptive statistics. The in-depth industries analysis and descriptive statistics were addressing the first objective regarding profiling of the six selected fruit industries. The results from the in-depth industries analysis show that all six fruits are of high economic importance in terms of key dependent variables such as total employment, international trade earnings and wages. For instance, the South African fruit industry contributes significantly to direct employment during production, value addition, processing and marketing. Most indirect employment opportunities are generated at the ancillary and support industries such as bottling, logistics, cartooning, cold chain management, wholesaling and retailing.

The second objective was aimed at analysing the impact of international trade flow on employment and wages in the selected six South African fruit industries. The objective was achieved by adopting the error-correction model since the variables were endogenous and co-integrated. The error correction model measured the long-run relationship amongst total employment, wages and international trade. The model also caters for the short-term variations amongst the variables. The error correction terms for total employment, exports output and imports output are negative and statistically significant. The results for an apple regression show that in a short-run, the system is stable and adjustment speed to equilibrium is very slow. The conclusion for the apple regression is that exports output lead to an increase in total employment in a long-run, while imports output lead to a decrease in total employment in a long-run. Furthermore, the statistical significance of all ECT's coefficients shows that the selected variables cause one another in the long-run.

The short-run findings for apricot estimation highlight that the system for total employment is constant and the speed of adjustment towards equilibrium is sluggish. However, the estimation indicates that the system for exports output and imports output are fluctuating while the adjustment speed to equilibrium is faster. The concluding remarks for apricot estimation is that in a long-run exports output results into a surge in total employment in a long-run, while imports output leads to a decline in total employment. Therefore, the statistical significance of the entire ECT's coefficients indicates that the selected variables cause one another in the long-run.

The results for avocado analysis show that the steadiness agents for total employment eliminate a higher percentage of disequilibrium associated with each specific period. Ultimately, the findings for avocado estimation shows that in the long-run exports output leads to an increase in total employment, while imports output results in a decline in total employment. The similar trends are observed for orange, pear and table grape regressions, where the speed of convergence towards equilibrium is either slow or fast. However, the exports output results in an increase in total employment, while imports output leads to a decline in total employment.

Furthermore, the study endeavoured to determine the causality effects amongst employment, wages and exports in the six selected fruits within the South African fruit industry. This objective was successfully realised by using the granger causality test, which focuses on the causality effects amongst total employment, exports output and imports output. The findings from apple, apricot; avocado; orange; pear and table grape regressions show the existence of bi-directional relationship between total employment and exports output. However, the results highlight that there are no relationships amongst total employment and imports output as well as between exports output and imports output. Therefore, there is a bi-directional causality effects between total employment and exports output. In conclusion, there are no causality effects between total employment and imports output no causality effects between exports output and imports output.

The study also intended to determine the response of total employment, exports output and imports output on variations in wages within the selected six South African fruit industries. The objective was successfully attained by using the two-staged least squares, which is best suited to address endogeneity amongst variables. The findings of the apple estimation highlight that the previous year's total employment affects a decision on wages of the current year. The exports output of the previous year affects wages output positively, which implies that when exports output are high, then the wages are spiking due to the returns received from export earnings. Nonetheless, when total gross value of production increases, it triggers the wages in the apple industry to also increase. The wages from the previous production cycle have a positive impact on the wages of the current production cycle. The collective bargaining process advocates for costs of leaving adjust or wage increases on an annual basis in order to allow employees to catch up with the cost of leaving. Furthermore, wages are positively affected by the total employment, more especially if those employed people are productive and knowledgeable about technical aspects of producing such fruits. The imports output also tends to affect the wages positively, since other countries within the SADC region transit their fruits through the South African harbours and some further processing are conducted within the South African borders, which translates into more employment and wage opportunities. However, lower production volumes from the previous year affect the wages negatively in the apple industry, since the net realisation is lower and not enough to cover wage increase and other capital expenditures. Conclusively, wages in the apple regression depends on various variables.

The 2SLS findings for apricot regression indicate that wages are positively affected by the average exchange rate and local sales. However, the set of variables that negatively affect the wages in the apricot regression are higher total employment from the previous year, lower exports output of the previous year, imports output and higher total employment in the current production cycle. In summary, results for avocado estimation show that wages output is positively associated with total employment of the previous year, total gross value of production, total employment within the current production cycle and exports output.

The results for orange regression reveal that wages are positively affected by the total employment from last production cycle, average price, average exchange rate of the previous calendar year, exports output and local sales. However, the variables that shows to be negatively associated with wages are imports output of the previous cycle, lower per capita consumption and net realisation.

The 2SLS findings for pear regression shows that wages are positively associated with exports output; net realisation; local sales and foreign direct investment. However, there are variables that negatively affect wages in the pear industry, which include among others: the lower total employment from the previous year and imports output. The concluding remarks for table grape estimation highlights that wages are positively affected by last year's total employment , exports output; imports output; domestic consumption and average exchange rate. However, wages from table grape industry are negatively affected by the following: inconsistent local sales and reduced area planted.

Lastly, the study aimed at determining the effect of European Union's Trade Development and Cooperation Agreement on wages in the South African fruit industry. The objective was successfully realised by applying the Ordinary Least Squares. The OLS findings from apple regression show that the wages are positively affected by the European Union's Trade Development Cooperation Agreement. The other variables in the apple regression which were positively affected by the European Union's Trade Development Cooperation Agreement are total area planted and foreign direct investment.

The OLS results from apricot estimation indicate that wages were positively affected by the European Union's Trade Development Cooperation Agreement. Additionally, other variables in apricot estimation which were positively affected by the European Union's Trade Development Cooperation Agreement include foreign direct investment; gross value of fresh apricot; net realisation. However, the only variable in the apricot regression which is negatively affected by the European Union's Trade Development Cooperation Agreement is total population.

The OLS results drawn from the avocado regression is that wages are positively affected by the European Union's Trade Development Cooperation Agreement. Another variable in the avocado industry which is positively impacted by the European Union's Trade Development Cooperation Agreement is the foreign direct investment. The OLS findings from the orange estimation are that wages are positively impacted by the European Union's Trade Development Cooperation Agreement. It is evident that foreign direct investment is also affected positively by the European Union's Trade Development Cooperation Agreement in the orange industry.

The concluding remarks from the pear estimation are that wages are positively impacted by the European Union's Trade Development Cooperation Agreement. The only variable which is affected positively by the European Union's Trade Development Cooperation Agreement is production volumes. The OLS findings for the table grape regression is that wages are positively affected by the European Union's Trade Development Cooperation Agreement. Additional variables which are positively affected by the European Union's Trade Development Cooperation Agreement are foreign direct investment, total employment and dried volumes. In conclusion, the only variable that is negatively affected by the European Union's Trade Development Cooperation Agreement is domestic consumption.

7.3 Recommendations

The following recommendations are based on the critical analysis of the theory, empirical literature review, performance of the fruit industry in South Africa, methodological approach and the empirical findings. The recommendations from this study are put into three categories, which are focused on fruit producers, policy recommendations and recommendations for further research.

7.3.1 Recommendations to producers

Based on empirical results from the analysis for fruit industry performance, producers should accelerate productivity in the six fruit commodities. The international trade of apple, apricot, avocado, orange, pear and table grape show to be important contributors to total employment and wages output. Therefore, producers need to deepen and broaden the export base, while working closely with government to diversify the export markets. The diversification of markets coupled with beneficiation of those commodities render a great opportunity to assist government in addressing a challenge of high unemployment.

In light of findings from empirical analysis, it is recommended that producers, with support from government institutions responsible for trade promotions, should strengthen trade cooperation with various trading blogs, more particularly with the European Union, United Kingdom, countries in Asia, Middle East and African states. This exercise will highly enhance the capacity of South African fruit producers to exploit the untapped international trade opportunities from different markets.

Based on labour market analysis through two-staged least squares, it is prudent to recommend that government should continue to regulate the labour market so that employees could benefit from net realisation from international trade. This will probably reduce the instances of unfair labour practices such as lower wages, child labourers, abnormal working hours and overall poor working conditions.

7.3.2 Recommendations to policy makers

In light of the developed set of international trade proxies based on employment and wages, it is recommended that trade negotiators of agricultural products, such as the Department of Trade, Industry and Competition and the Department of Agriculture, Land Reform and Rural Development should lobby and advocate for putting into perspective other measures for quantifying the effects of international trade in labour markets, rather than relying on measures based on the World Trade Organisation. The lobbying and advocating for such important considerations should be brought forward at the international trade negotiations forums where agricultural specialists are represented. International trade measures based on World Trade Organisation practices are more appropriate and applicable for developed countries. Therefore, the consideration of labour markets in the developing countries will more likely trigger employment opportunities and innovations in the labour market, like upskilling employees on recent technology while matching the changing production methods within the agricultural sector.

Based on the positive findings relating to European Union's Trade Development Cooperation Agreement's effects on wages, it is recommended that South Africa should continue to design and implement policies as well as programmes which support international trade between South Africa, European Union as well as the United Kingdom. Owing to the importance of the horticultural sector towards labour market, the government should collaborate with the industry and academic and research institutions to design, coordinate and implement pro-growth policies that stimulate the sustainability of the fruit industry, as well as continuous compliance to the market standards.

South African government in collaboration with the fruit industry should undertake more investments aimed at boosting productivity of the fruit industry. The recommended investments may include agricultural research and development. Through adoption of science and technology-based innovations, like breeding improved fruit cultivars that tolerate different climatic conditions and improving orchards management methods, the investment on research and development will make the industry to be a sustainable supplier of quality fruits in domestic and various international markets. This translates into a long-run competiveness of the South African industry. Furthermore, the country should also invest in physical and market infrastructure such as water, electricity, harbours, rail and road networks.

7.3.3 Recommendations for further research

It is recommended that further study be undertaken to establish the effects of international trade on labour markets in the fruit industry within the member states of the South African Customs Union, since South Africa is now negotiating trade agreements and cooperation with these countries. Therefore, further research needs to be comparative in nature in order to create more beneficiaries to international trade of fruits.

The current study is analysing the impact of the European Union's Economic Partnership Agreement to South Africa with relation to the labour market, focusing on the selected fruit industries. However, given that the agreement is focusing on various regions of the world, it is recommended that the ranking approach be adopted to assess the regions and fruit commodities that are enjoying bigger margins from the treaty.

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APPENDICES: DATASET

APPENDIX A1: DATASET FOR APPLES

$OBSERVATIONS$	$EMPG\ (COUNT)$	$WAGO\ (ZAR)$	$VOSAXEU\ (TONS)$	$EXPO\ (ZAR)$	$IMPO\ (ZAR)$	$EXPOLAG\ (ZAR)$
1990	23165	0	0	201579130.3	7761.9	
1991	23956	0	0	348313143.3	0	201579130.3
1992	24521	0	0	444073512	4135400	348313143.3
1993	26894	0	0	408570334.1	0	444073512
1994	25425	0	0	263188846.8	10652.4	408570334.1
1995	23730	0	0	419862214.7	0	263188846.8
1996	25990	0	0	393574132	4299.3	419862214.7
1997	23730	0	0	472491295	0	393574132
1998	24860	0	0	693108263	9921623	472491295
1999	27120	0	0	595506296	1050	693108263
2000	24320	0	0	469061227	2295	595506296
2001	24268	0	0	603124735	0	469061227
2002	23961	0	148371	879897765	22260	603124735
2003	28068	800.00	182983	1074249876	355898	879897765
2004	26747	871.58	180297	1156860532	13629	1074249876
2005	28540	949.58	156868	981289951	0	1156860532
2006	25878	994.00	151838	1069365871	153256	981289951
2007	25744	1041.00	158647	1495164435	863001	1069365871
2008	26007	1090.00	171177	1977977030	714309	1495164435
2009	26464	1231.70	144896	1957447679	1611966	1977977030
2010	27033	1316.69	112848	1980246991	2912162	1957447679

2011	27493	1375.94	110512	2249429670	1293701	1980246991
2012	27801	1503.90	120041	2736940107	15912	2249429670
2013	28220	2274.22	152711	4281868737	1674749	2736940107
2014	26823	2420.41	84418	3838091729	252447	4281868737
2015	26697	2606.78	105687	4861206698	2655347	3838091729
2016	27526	2778.83	97617	5274814924	3703913	4861206698
2017	27297	3001.13	91250	4980727913	6493959	5274814924
2018	27319	3169.19	108983	5106108854	5446080	4980727913

Sources: HORTGRO, BFAP AND GTA[6]

Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

[6] All abbreviations are detailed on page xiv until xvi.

APPENDIX A2: DATASET FOR APPLES

$OBSERVATIONS$	$TGVP\ (ZAR)$	$WAGOLAG\ (ZAR)$	$EMPGLAG\ (ZAR)$	$PRODTLAG\ (ZAR)$	$AREAP\ (HECTARES)$
1990	504 160 000				20500
1991	561 093 000	0	23165	40 344	21200
1992	574 182 000	0	23956	515 074	21700
1993	389 464 000	0	24521	518 492	23800
1994	678 486 000	0	26894	589 037	22500
1995	599 898 000	0	25425	563 473	21000
1996	837 856 000	0	23730	518 268	23000
1997	687 324 000	0	25990	608 408	21000
1998	865 649 000	0	23730	535 126	22000
1999	595 235 000	0	24860	586 346	24000
2000	755 729 000	0	27120	565 718	21522
2001	880 654 000	0	24320	593 173	21476
2002	1317 476 000	0	24268	608 079	21204
2003	1602 545 000	0	23961	626 125	27126
2004	1862 290 000	800.00	28068	792 678	24845
2005	1595 385 000	871.58	26747	822 047	21326
2006	1606 498 000	949.58	28540	698 710	20633
2007	2007 786 000	994.00	25878	627 091	22000
2008	2746 037 000	1041.00	25744	710 172	23000
2009	2883 711 000	1090.00	26007	757 680	21000
2010	2691 142 000	1231.70	26464	800 803	20449
2011	3146 817 000	1316.69	27033	753 167	21919
2012	3411 501 000	1375.94	27493	768 125	22900
2013	4848 737 000	1503.90	27801	790 562	24819
2014	4839 553 000	2274.22	28220	883 826	20759
2015	5738 566 000	2420.41	26823	799 524	24518

2016	6126 672 000	2606.78	26697	914 037	23838
2017	5501 300 000	2778.83	27526	900 611	23823
2018	6117097000	3001.13	27297	952 695	20963

Sources: Abstract statistics from DALRRD, BFAP and HORTGRO.
Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX B1: DATASET FOR APRICOTS

$OBSERVATIONS$	$EMPG\ (COUNT)$	$WAGO\ (ZAR)$	$VOSAXEU\ (TONS)$	$EXPO\ (ZAR)$	$IMPO\ (ZAR)$	$EXPOLAG\ (ZAR)$
1990	23165	0	0	201579130.3	7761.9	
1991	23956	0	0	348313143.3	0	348313143.3
1992	24521	0	0	444073512	4135400	444073512
1993	26894	0	0	408570334.1	0	408570334.1
1994	25425	0	0	263188846.8	10652.4	263188846.8
1995	23730	0	0	419862214.7	0	419862214.7
1996	25990	0	0	393574132	4299.3	393574132
1997	23730	0	0	472491295	0	472491295
1998	24860	0	0	693108263	9921623	693108263
1999	27120	0	0	595506296	1050	595506296
2000	24320	0	0	469061227	2295	469061227
2001	24268	0	0	603124735	0	603124735
2002	23961	0	148371	879897765	22260	879897765
2003	28068	800.00	182983	1074249876	355898	1074249876
2004	26747	871.58	180297	1156860532	13629	1156860532
2005	28540	949.58	156868	981289951	0	981289951
2006	25878	994.00	151838	1069365871	153256	1069365871
2007	25744	1041.00	158647	1495164435	863001	1495164435
2008	26007	1090.00	171177	1977977030	714309	1977977030
2009	26464	1231.70	144896	1957447679	1611966	1957447679
2010	27033	1316.69	112848	1980246991	2912162	1980246991
2011	27493	1375.94	110512	2249429670	1293701	2249429670
2012	27801	1503.90	120041	2736940107	15912	2736940107
2013	28220	2274.22	152711	4281868737	1674749	4281868737

2014	26823	2420.41	84418	3838091729	252447	3838091729
2015	26697	2606.78	105687	4861206698	2655347	4861206698
2016	27526	2778.83	97617	5274814924	3703913	5274814924
2017	27297	3001.13	91250	4980727913	6493959	4980727913
2018	27319	3169.19	108983	5106108854	5446080	5106108854

Sources: BFAP, GTA and HORTGRO.
Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX B2: DATASET FOR APRICOTS

$OBSERVATIONS$	$AEXRT\ (PERCENT)$	$LOCS\ (TONS)$	$GRVF\ (ZAR)$	$POPU\ (COUNT)$	$NETR\ (ZAR)$	$PROCV\ (ZAR)$	$FDI\ (ZAR)$
1990	2.5873	3 413	22 721 000	29 908 000	3 739.69	35 794	0
1991	2.7613	3 471	20 604 000	30575000	3 990.32	34 803	684995691
1992	2.852	3 291	30 921 000	36199000	3 078.48	42 726	10010520
1993	3.2677	3 634	30 822 000	36992000	4 274.52	39 058	33003770
1994	3.5508	4 591	25 689 000	37802000	2 693.08	36 203	1347990204
1995	3.6271	4 038	33 303 000	38631000	4 325.72	40 037	4502029062
1996	4.2993	4 208	46 306 000	39477000	6 758.19	53 568	3514978701
1997	4.608	3 104	67 353 000	40584000	5 459.54	80 670	17587169280
1998	5.5283	2 605	45 969 000	41227000	5 908.23	49 887	3104029884
1999	6.1095	2 986	68 041 000	42131000	6 903.48	50 121	9184044780
2000	6.9398	2 148	64 235 000	43054000	10 898.90	45 872	6157962132
2001	8.6092	2 415	90 075 000	43686000	10 183.92	45 982	58404124064
2002	10.5407	1 817	62 220 000	44561000	5 418.25	42 602	16540044812
2003	7.5647	1 652	75 409 000	45454000	7 032.99	35 129	5549993449
2004	6.4597	2 066	130 108 000	46429000	5 699.49	80 002	5155034391
2005	6.3593	1 248	63 170 000	46586000	7 185.67	31 923	42269821949
2006	6.7715	1 922	107 213 000	46889000	7 276.75	68 641	2108983675
2007	7.0454	1 116	52 227 000	47391000	4 033.51	31 749	46063247924
2008	8.2612	1 797	93 736 000	47850000	6 520.85	49 076	76078795204
2009	8.4737	1 121	115 605 000	48686000	10 050.09	36 932	63570205822
2010	7.3212	1 487	117 368 000	49321000	10 392.78	39 981	26616954720
2011	7.2611	1 535	103 028 000	49991000	12 209.92	37 747	30807903357
2012	8.21	2 352	198 431 000	50587000	12 952.15	48 792	37428158500

2013	9.6551	2 075	145 143 000	52982000	12 648.77	44 370	80138295510
2014	10.8527	1 428	143 057 000	54002000	16 279.96	35 058	62627241782
2015	12.7589	1 390	192 275 000	54957000	19 725.47	43 468	22064986482
2016	14.7096	1 453	195 245 000	55909000	23 503.80	28 630	32875956000
2017	13.3338	1 102	176 409 000	56522000	21 303.38	20 645	26759069868
2018	13.2409	1003	173 968 000	57726000	21807.17	26 039	70626960600

Sources: Abstract statistics from DALRRD, BFAP, HORTGRO, SARB and StatsSA.

Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX C1: DATASET FOR AVOCADOES

$OBSERVATIONS$	$EMPG\ (COUNT)$	$WAGO\ (ZAR)$	$VOSAXEU\ (TONS)$	$EXPO\ (ZAR)$	$IMPO\ (ZAR)$
1990	3540	0	0	44449814	111254
1991	4123	0	0	51158605	57987
1992	3298	0	0	45235572	208196
1993	3122	0	0	46185672	369250
1994	5301	0	0	52566043	10652
1995	5124	0	0	70695806	754437
1996	4123	0	0	71796579	690519
1997	3534	0	0	56902056	926680
1998	6355	0	0	143841897	582607
1999	6744	0	0	93238895	385415
2000	7292	0	0	122767373	1016352
2001	6479	0	0	99112562	1770867
2002	7628	0	41660	185927600	869430
2003	7657	800.00	36441	177658767	3528802
2004	7510	871.58	29900	136316381	9021374
2005	8246	949.58	47018	222364873	13108384
2006	7363	994.00	35863	128838099	16419167
2007	7657	1041.00	37972	196458688	25047723
2008	9424	1090.00	50591	259033572	24683655
2009	8541	1231.70	38391	208535934	29126583
2010	8835	1316.69	47322	325476225	31944094
2011	8128	1375.94	26897	230342385	41458859
2012	9719	1503.90	48441	507811441	29683964
2013	9424	2274.22	44073	745790970	40560958
2014	11780	2420.41	56854	978867677	39985073
2015	9701	2606.78	49568	901840782	51293441

2016	10018	2778.83	52441	1061684414	67897388
2017	6958	3001.13	41608	854414271	95266191
2018	14137	3169.19	83478	1529348122	84091795

Sources: Abstract statistics from DALRRD, BFAP and HORTGRO.
Note: The first column represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX C2: DATASET FOR AVOCADOES

$OBSERVATIONS$	$AEXRT\ (PERCENT)$	$TGRVP\ (ZAR)$	$PRODTVT\ (PERCENT)$	$FDI\ (ZAR)$
1990	2.5873	67724 000	19132	0
1991	2.7613	68328 000	16572	684995691
1992	2.852	71593 000	21705	10010520
1993	3.2677	66222 000	21213	33003770
1994	3.5508	77152 000	14554	1347990204
1995	3.6271	92154 000	17984	4502029062
1996	4.2993	114740 000	27829	3514978701
1997	4.608	106514 000	30140	17587169280
1998	5.5283	137463 000	21630	3104029884
1999	6.1095	181937 000	26977	9184044780
2000	6.9398	160682 000	22036	6157962132
2001	8.6092	169529 000	26166	58404124064
2002	10.5407	195015 000	25567	16540044812
2003	7.5647	264587 000	34555	5549993449
2004	6.4597	236442 000	31485	5155034391
2005	6.3593	277755 000	33684	42269821949
2006	6.7715	226276 000	30734	2108983675
2007	7.0454	297534 000	38858	46063247924
2008	8.2612	344464 000	36552	76078795204
2009	8.4737	409112 000	47903	63570205822
2010	7.3212	365082 000	41322	26616954720
2011	7.2611	486388 000	59840	30807903357
2012	8.21	592557 000	60972	37428158500
2013	9.6551	788243 000	83642	80138295510
2014	10.8527	1078 944 000	91591	62627241782
2015	12.7589	1097 854 000	113164	22064986482

2016	14.7096	1083 028 000	108111	32875956000
2017	13.3338	1036 570 000	148978	26759069868
2018	13.2409	1244 721 000	88046	70626960600

Sources: Abstract statistics from DALRRD, BFAP, HORTGRO and SARB.
Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX D1: DATASET FOR ORANGES

$OBSERVATIONS$	$EMPG\ (COUNT)$	$WAGO\ (ZAR)$	$VOSAXEU\ (TONS)$	$EXPO\ (ZAR)$	$IMPO\ (ZAR)$	$IMPOLAG\ (ZAR)$
1990	16226	0	0	245705532	395857	
1991	14850	0	0	333611982	361730	395857
1992	15300	0	0	400660368	262384	361730
1993	16650	0	0	394087888	1222120	262384
1994	17100	0	0	422488387	95872	1222120
1995	15750	0	0	588986634	794335	95872
1996	18585	0	0	498670356	1109853	794335
1997	19017	0	0	674045588	1304009	1109853
1998	19593	0	0	878653879	1724285	1304009
1999	21150	0	0	1186946644	3591761	1724285
2000	21542	0	0	955478552	2137223	3591761
2001	23850	0	0	1160965147	1598651	2137223
2002	21891	0	298782	1461975017	1245918	1598651
2003	22500	800	314752	1629365473	4408112	1245918
2004	20250	872	261594	1754937341	1104821	4408112
2005	18450	950	343095	1754550504	1455139	1104821
2006	16936	994	295569	2246765054	5086147	1455139
2007	18000	1041	452167	2778266309	4737942	5086147
2008	19350	1090	456089	3695899158	15439047	4737942
2009	18450	1232	335310	3365032813	4932456	15439047
2010	18765	1317	415933	4444008600	2030626	4932456
2011	18405	1376	340467	4305916880	2375973	2030626
2012	19690	1504	396015	4795108514	10626898	2375973
2013	21160	2274	433932	5695034878	20440413	10626898

2014	20649	2420	380233	6561043806	19450846	20440413
2015	20160	2607	428491	7633462264	50892430	19450846
2016	15439	2779	402977	8836018435	33782158	50892430
2017	16253	3001	450921	10028381609	22517934	33782158
2018	19481	3169	464659	10758239638	16786342	22517934

Sources: Abstract statistics from DALRRD, BFAP, GTA and HORTGRO.
Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX D2: DATASET FOR ORANGES

$OBSERVATIONS$	$FDI\ (ZAR)$	$AVRP\ (ZAR)$	$AEXRT\ (PERCENT)$	$PCONSLAG\ (RATIO)$	$NETR\ (ZAR)$	$LOCS\ (TONS)$
1990	0	542	2.5873		709.64	71 769
1991	684995691	513	2.7613	16.51	850.27	97 713
1992	10010520	553	2.852	13.76	987.96	103 730
1993	33003770	605	3.2677	12.17	894.94	112 816
1994	1347990204	544	3.5508	14.96	1 192.68	135 291
1995	4502029062	599	3.6271	15.35	1 120.18	124 496
1996	3514978701	774	4.2993	13.61	1 647.82	98 652
1997	17587169280	706	4.608	20.59	1 501.45	118 543
1998	3104029884	619	5.5283	17.19	1 409.31	145 519
1999	9184044780	835	6.1095	14.39	1 828.76	115 602
2000	6157962132	765	6.9398	17.87	1 964.09	137 056
2001	58404124064	714	8.6092	21.01	1 202.21	145 354
2002	16540044812	768	10.5407	19.69	2 126.66	136 980
2003	5549993449	925	7.5647	18.79	2 058.61	117 782
2004	5155034391	1 056	6.4597	20.01	2 265.30	114 978
2005	42269821949	1 084	6.3593	15.39	2 425.13	114 719
2006	2108983675	1 113	6.7715	14.14	1 580.13	125 619
2007	46063247924	1 026	7.0454	9.28	1 843.43	149 667
2008	76078795204	1 283	8.2612	13.84	2 832.05	122 280
2009	63570205822	1 435	8.4737	15.03	3 443.58	132 938
2010	26616954720	1 479	7.3212	9.86	3 235.38	132 649
2011	30807903357	1 608	7.2611	11.73	4 043.18	134 872
2012	37428158500	1 763	8.21	16.51	4 691.29	137 964
2013	80138295510	1 912	9.6551	15.49	4 442.85	129 244

2014	62627241782	2 075	10.8527	18.48	4 975.40	126 370
2015	22064986482	2 233	12.7589	19.49	5 799.69	120 310
2016	32875956000	2 549	14.7096	17.44	6 627.68	114 108
2017	26759069868	3 651	13.3338	10.52	8 570.28	89 100
2018	70626960600	3 606	13.2409	9.80	8 655.92	88 360

Sources: Abstract statistics from DALRRD, BFAP, HORTGRO and SARB.
Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX E1: DATASET FOR PEARS

$OBSERVATIONS$	$EMPG\ (COUNT)$	$WAGO\ (ZAR)$	$VOSAXEU\ (TONS)$	$EXPO\ (ZAR)$
1990	9735	0	0	132976871
1991	10335	0	0	153282524
1992	9826	0	0	152313912
1993	12068	0	0	233830077
1994	10936	0	0	157843712
1995	12282	0	0	135863912
1996	11372	0	0	141554453
1997	13884	0	0	257241600
1998	12816	0	0	238341598
1999	13884	0	0	291478136
2000	14952	0	0	238999772
2001	12816	0	0	226972949
2002	15256	0	0	373815385
2003	16140	800.00	0	366547539
2004	15322	871.58	0	514360072
2005	14921	949.58	0	563128734
2006	14588	994.00	0	464518129
2007	14402	1041.00	0	832688781
2008	14432	1090.00	0	926757938
2009	14445	1231.70	0	1177462984
2010	14315	1316.69	0	1169305458
2011	14604	1375.94	0	1227089595
2012	14780	1503.90	87090	1328661997
2013	15202	2274.22	110852	1853334795

2014	12822	2420.41	100190	2064636858
2015	13586	2606.78	91556	2062176805
2016	13283	2778.83	97212	2792323382
2017	13124	3001.13	88684	2661724633
2018	13181	3169.19	76542	2548441151

Sources: Abstract statistics from DALRRD, BFAP, GTA and HORTGRO.
Note: The first rows represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX E2: DATASET FOR PEARS

$OBSERVATIONS$	$IMPO\ (ZAR)$	$FDI\ (ZAR)$	$PRODT\ (TONS)$	$NETR\ (ZAR)$	$LOCS\ (TONS)$
1990	0	0	195237	1 790.80	25967
1991	0	684995691	208900	1 688.37	24886
1992	0	10010520	212901	2 064.54	23177
1993	0	33003770	247460	1 113.20	37794
1994	0	1347990204	222589	1 881.70	39867
1995	0	4502029062	225489	2 218.61	32420
1996	0	3514978701	228705	2 783.85	37517
1997	0	17587169280	296979	1 663.55	48149
1998	138208	3104029884	264842	2 532.91	47798
1999	0	9184044780	283943	2 438.13	46982
2000	0	6157962132	307249	2 863.14	60153
2001	0	58404124064	271241	2 965.23	55777
2002	0	16540044812	337329	3 226.84	53782
2003	0	5549993449	325274	3 187.20	51980
2004	0	5155034391	328538	4 059.10	45152
2005	0	42269821949	315244	3 861.49	48545
2006	162516	2108983675	323777	3 785.82	49254
2007	0	46063247924	346403	4 680.14	48334
2008	1668762	76078795204	345276	5 704.29	41165
2009	1050739	63570205822	348383	6 336.06	38976
2010	1024968	26616954720	373722	6 143.64	44357
2011	1241648	30807903357	359851	6 612.30	45453
2012	1292920	37428158500	346642	6 802.77	44987
2013	541351	80138295510	379546	8 834.90	42580

2014	565199	62627241782	413147	9 900.37	41698
2015	2541392	22064986482	414672	10 036.39	45038
2016	4060744	32875956000	431066	11 174.32	42101
2017	2298517	26759069868	432590	10 094.53	40302
2018	2252015	70626960600	401525	11 375.22	40253

Sources: Abstract statistics from DALRRD, BFAP, GTA and HORTGRO.
Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX F1: DATASET FOR TABLE GRAPES

$OBSERVATIONS$	$EMPG\ (COUNT)$	$WAGO\ (ZAR)$	$VOSAXEU\ (TONS)$	$EXPO\ (ZAR)$	$IMPO\ (ZAR)$	$FDI\ (ZAR)$
1990	219597	0	0	154091826	2587	0
1991	219479	0	0	172462514	27613	684995691
1992	221159	0	0	194292500	128340	10010520
1993	223639	0	0	304886213	130708	33003770
1994	225775	0	0	436137662	305369	1347990204
1995	227315	0	0	421167971	1737381	4502029062
1996	232338	0	0	449394378	2873124	3514978701
1997	238588	0	0	568502080	2856849	17587169280
1998	244809	0	0	784072753	4006437	3104029884
1999	229194	0	0	1049472089	695171	9184044780
2000	238522	0	0	1102035513	1320739	6157962132
2001	245678	0	0	1156703212	723131	58404124064
2002	256760	0	168177	1341403767	5882520	16540044812
2003	242440	800.00	158206	1381709239	6885111	5549993449
2004	245518	871.58	173115	1821990978	6752897	5155034391
2005	247696	949.58	171816	1881008273	10102874	42269821949
2006	247977	994.00	188516	1732542493	19450574	2108983675
2007	253000	1041.00	181663	2201326450	23269815	46063247924
2008	264000	1090.00	183299	2584921665	25237600	76078795204
2009	253000	1231.70	181891	3021501644	33218428	63570205822
2010	230382	1316.69	174795	3069937178	47217984	26616954720
2011	227742	1375.94	151215	3124769812	58691522	30807903357
2012	276439	1503.90	161183	3555764528	74379318	37428158500
2013	226002	2274.22	174842	4260114526	94246540	80138295510
2014	272446	2420.41	182852	5392196423	104133987	62627241782

2015	271473	2606.78	205909	6126448184	123031385	22064986482
2016	265049	2778.83	191647	6408262552	150725473	32875956000
2017	262198	3001.13	210236	7208820625	172360253	26759069868
2018	244882	3169.19	204578	7126768316	217278800	70626960600

Sources: Abstract statistics from DALRRD, BFAP and HORTGRO.
Note: The first row represents the number of observations, while other row represents the variable names and units of measurement are included in brackets still on the first row.

APPENDIX F2: DATASET FOR TABLE GRAPES

$OBSERVATIONS$	$AREAP$ ($HECTARES$)	$AEXRT$ ($PERCENT$)	$DCONS$ ($TONS$)	$DRDV$ ($TONS$)	$LOCS$ ($TONS$)
1990	99817	2.5873	1253370	148301	22 845
1991	99763	2.7613	1252147	136392	22 172
1992	100527	2.852	1329448	174660	22 632
1993	101654	3.2677	1181713	119093	21 472
1994	102625	3.5508	1198280	139422	21 964
1995	103325	3.6271	1264241	158629	23 088
1996	105608	4.2993	1309112	120309	22 229
1997	108449	4.608	1328995	167942	20 972
1998	111277	5.5283	1192194	113339	21 659
1999	104179	6.1095	1388004	170376	23 826
2000	108419	6.9398	1292485	152568	22 910
2001	111672	8.6092	1158317	139372	23 566
2002	116709	10.5407	1297753	169420	26 980
2003	110200	7.5647	1432816	146908	29 978
2004	111599	6.4597	1522991	158064	29 920
2005	112589	6.3593	1338665	121664	25 743
2006	112717	6.7715	1518176	164916	29 110
2007	115000	7.0454	1576652	176128	26 974

2008	120000	8.2612	1641911	169760	25 663
2009	115000	8.4737	1522521	130876	23 835
2010	104719	7.3212	1507309	202512	23 499
2011	103519	7.2611	1461469	114800	23 215
2012	125654	8.21	1613226	151628	24 118
2013	102728	9.6551	1764581	223156	21 473
2014	123839	10.8527	1744022	184204	19 397
2015	123397	12.7589	1759338	242148	20 403
2016	120477	14.7096	1666980	218516	21 304
2017	119181	13.3338	1711022	262356	20 713
2018	111310	13.2409	1523041	242764	19 023

Sources: Abstract statistics from DALRRD, BFAP and HORTGRO.
Note: The first row represents the number of observations, while other rows represents the variable names and units of measurement are included in brackets still on the first row.