

**IMPACT OF AGRICULTURAL EXPORTS ON ECONOMIC GROWTH OF
MALAWI: AN ECONOMETRIC ANALYSIS OF TOBACCO, TEA, AND
SUGAR**

WILLIAM HENDERSON HARAWA

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DECLARATION

DECLARATION AND APPROVAL

I, William Henderson Harawa declare that this thesis is my original work and has not been presented for the award of a degree in any other University or for any other award

Signature  Date 30th October, 2024

William H. Harawa (A142E/CTV/PT/39810/2016)
Department of Agricultural Economics

We, the undersigned confirm that the work reported in this thesis was carried out by the candidate under our supervision and has been submitted with our approval as University supervisors

Signature  Date 31st October, 2024

Dr. Eric Kiprotich Bett
Department of Agricultural Economics
Kenyatta University

Signature  Date 
Dr. Lucy Wangare Ngare
Department of Cooperatives and Agribusiness, The Cooperative University of Kenya

DEDICATION

Rebbie, my darling wife, and Joel and Jolene, my dear children; your prayers energize my spirit.

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ACRONYMS AND ABBREVIATION

ARDL	:	Auto-Regressive Distributed Lag
ARIMA	:	Auto-Regression Integrated Moving Average
CVs	:	Critical Values
DCs	:	Developing Countries
ECM	:	Error Correction Method
ELG	:	Export Led Growth
ELGH	:	Export Led Growth Hypothesis
EP	:	Export Promotion
FAO	:	Food Agriculture Organisation
GDP	:	Gross Domestic Product
ILG	:	Import Led Growth
IS	;	Import substitution
ITC	:	International Trade Centre
LDCs	:	Least developing Countries
MGDS	:	Malawi Growth and Development Strategy
MoFEPD	:	Ministry of Finance Economic Planning and Development
MSMEs	:	Micro Small Medium Enterprises
NES	:	National Export Strategy
NSP	:	Nation Adaptation Strategy
RBM	:	Reserve Bank of Malawi
SSA	:	Sub Saharan Africa
SVAR	:	Structural Vector Auto-Regression
VAR	:	vector Auto-Regression
VECM	:	Vector Error Correction Method
WB	:	World Bank
WTO	:	World Trade Organisation

ABSTRACT

Malawi's economy has historically relied exclusively on agricultural export earnings, which account for more than 80% of foreign earnings, with tobacco accounting for almost 50% of total exports. Agriculture employs over 65 percent of people in official employment and contributes at least one-third of Malawi's Gross Domestic Product (GDP). Tobacco, Tea, and Sugar are Malawi's primary export commodities. Over the past five decades, the country has been implementing export expansion strategies to broaden and increase the foreign sector's contribution to GDP. Despite these reforms, Malawi's economic growth has been slow and volatile by regional standards, and poverty levels have risen over time. As a result, this study aimed at evaluating the dynamic impact of disaggregated agricultural crops (Tobacco, Tea, and Sugar) exports on the economic growth of Malawi, as measured by Real GDP; assessing the cyclical correlations in the trends of Tobacco, Tea, and Sugar export value series linked to Real GDP series; and determining the presence of causality between the export commodities and the Real GDP. The short and long-run impact of the export commodities on real GDP was evaluated by estimating Autoregressive Distributed Lag (ARDL) model on time series data spanning 1969-2019; and the validity of causality was determined by the Toda Yamamoto granger causality test; whereas determination of trends and cyclical correlations was done by using The Hodrick-Prescott (HP) filter. The ADF and PP Unit root tests and the ARDL co-integration tests were performed before estimating the Error Correction Model for short-term dynamics and Toda Yamamoto Granger causality. The ARDL Co-integration tests revealed a long-run relationship between agricultural exports and economic growth. The study findings also revealed that only sugar export has a positive and significant impact on economic growth both in the short and long-run, with a 1% increase in sugar exports resulting in a 0.19% increase in Malawi's GDP on average, *ceteris paribus*. Tobacco exports revealed a significant short-run effect on real GDP, whereas Tea export was not significant both in the long and short run. In terms of cyclicity, Tobacco and Tea exports were procyclical with real GDP, which exacerbated economic vulnerabilities. Sugar exports were discovered to be acyclical, with an absence of correlations with economic cycles, boosting economic resilience and stability by assisting in mitigating risk spanning economic cycles. However, the study established a bi-directional causal association between sugar exports and economic growth but no causal relationship between economic growth and tea or tobacco exports. To mitigate the risks of commodity procyclicality, export diversification initiatives aimed at enhancing sugar and tea productivity, such as exporting highly valued goods, should be recommended. By divesting from tobacco and expanding sugar production, the government could additionally mitigate the structural risks of over-reliance on a crop that has no short- or long-term impact on the real GDP. Promoting value-added activities in the tea industry must be recommended as it can lead to more stable revenue streams.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The rationale for open trade and its investment opportunities are crucial to developing countries' (DCs) economic growth (Chaudhary et al., 2007). During the last half-century, we have witnessed an extensive dialogue over the appropriateness of external trade policy regimes that would spur nations' economic development. The evolution of trade policy has transitioned from a focus on import substitution to one centred on export promotion. From 1950 to 1959, most developing economies implemented import substitution (IS) policies to stimulate economic growth. Proponents of this approach highlighted the importance of establishing a distinct economic development strategy that would ultimately enable them to manage the dynamism of domestic economic progress. In the mid-1970s, Malawi, like many developing nations, transitioned its trade strategy from import substitution (IS) to export promotion (EP). The rationale behind this policy shift would have been to fundamentally change the economy's productive capacity to promote sustained economic growth (Ohenewaa, 2021). This approach to trade is conceptually referred to as the 'Export-Led Growth' (ELG) strategy, which posits that exports serve as catalysts for economic growth (Eravwoke & Imide, 2013).

Following the economic progress of recently industrialized countries (the Four Tigers), a consensus on Export-Led Growth (ELG) emerged among neoclassical economists who vehemently contended that the Four Tigers were effective in realizing

rapid economic growth in the 1960s due to a paradigm shift in trade orientation—outward orientation—which was characterized by a dramatic increase in the trade openness of these economies, and this resulted in the rapid growth of exports (Chow, 2010). The success of the four Tigers' export-push strategy appeared to offer tremendous promise for some developing nations, particularly many in Sub-Saharan Africa (SSA), which were persuaded to adopt export promotion as a viable policy instrument for rapid economic growth (Lall, 2000). Despite adopting the EP strategy, DCs have had mixed outcomes, with some experiencing higher economic growth and others experiencing declining output, as well as diverse outcomes in their poverty alleviation strategies, resulting in some scepticism on whether ELG can boost growth in DCs.

An assessment of economic development publications increasingly reveals that sustained economic growth is quintessential to reducing poverty (Zhu et al., 2022). The government of Malawi adopted this stance in light of the growing recognition of Open Trade's impact on economic growth. Following independence, Malawi initiated the diversification of its economic base from agriculture to industry by employing import substitution policies and a restricted export-oriented strategy for attaining rapid economic growth. Later, the nation had a 4% increase in the manufacturing-GDP share from 1964 to 1979 (Chirwa, 2002). Nonetheless, the economic progress was disrupted by a series of significant external shocks in the late 1970s, encompassing declining terms of trade, an energy crisis, and an international transit embargo resulting from the civil conflict in Mozambique.

In response to the economic slump, the Malawi government adopted (IMF-World Bank) Structural Adjustment Policies (SAPs), a neoliberal economic policy aimed at stimulating exports and economic growth, which were primarily centred on increased deregulation, privatization, trade, and financial liberalization, fiscal restructuring, and economic stabilization (Malawi Government, 1999). Subsequently, this allowed Malawi to correct economic imbalances by reorienting her Import Substitution (IS) industrialization approach to Export promotion. Though Malawi implemented structural adjustment reforms, the program's general performance evoked diverse opinions depending on the sector of the economy being evaluated. However, overall, the economic growth under SAPs was unsatisfactory and very dismal, to the extent that the economy sustained episodic recessions, the export base continued undiversified, and external aid remained the feasible lifeline of the economy (Chirwa, 2002)

Since its independence, the base of the economy has been predominantly agriculture; the country gains export earnings by trading tobacco, tea, sugar, and cotton externally (Luka, 2010). The reality is that the export performance of these agricultural commodities has generally been volatile annually due to Malawi's reliance on a climate-sensitive sector—agriculture—which increases her vulnerability to climate change, resulting in perennially dismal agricultural outputs. This event has a direct adverse impact on Malawi's economic growth, which is already constrained by debt and recurring deficits. Accordingly, agricultural output expansion is intrinsically linked to economic growth, implying that bad agricultural performance harms the entire economy.

For the last four decades, Malawi's economy has been plagued by one declining manufacturing sector and deteriorating terms of trade aggravated by volatile exchange rates, including rising interest and inflation rates, which have disincentivized trade performance (UNCTAD, 2006). Despite the poor performance of the agricultural trade policy, Malawi pursues an agricultural-led industrialization economic policy through the implementation of the Malawi Growth and Development Strategy (MDGS III) along with the National Export Strategy (NES: 2013-18) (GoM, 2012). NES aimed to identify ways of increasing the external sector through export diversification (MoTI, 2012). The country's trade deficit is declining despite the implementation of export expansion strategies under the MGDSs and NES. At the strategy launch in 2012, Malawi's exports were worth \$1.47 billion while imports were at \$2.59 billion, representing a Trade Deficit of \$1.1 billion. At the expiration of the strategy in 2018, the merchandise trade deficit was at \$1 billion, a repeat of 2012. The exports in 2018 were projected at \$1.1 billion, much less than the 2012 exports of \$1.47 billion. Despite an insignificant decline in trade deficits during the reform period, NES represented a lost half-decade that was ineffectual in generating expected outcomes.

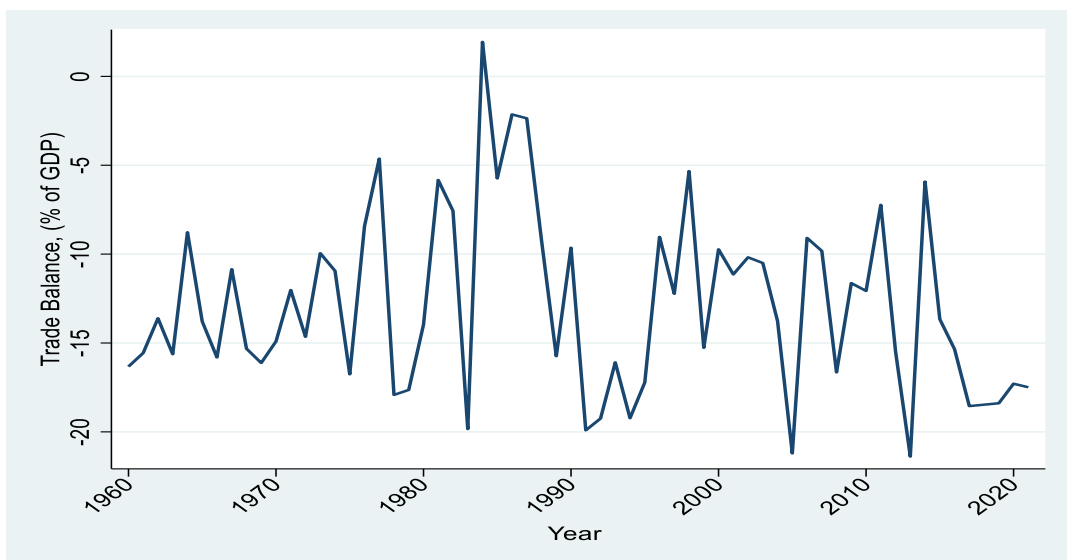
1.1.1 Overview of Malawi's agricultural exports performance and economic growth

Malawi's economy is chiefly Agriculture, which contributes over 33% of (GDP), making up 80% of export earnings and engaging nearly 65% of the labour force. Amongst the principal export crops cultivated are Tobacco, Tea, sugar, and Cotton. In 2015, tobacco accounted for more than half of all exports, 11% of GDP, and 60% of foreign exchange earnings (IMF, 2015), while tea and sugar accounted for 8% and

7%, respectively, of total exports. Agriculture's contribution to foreign trade is critical to maximizing GDP growth in a landlocked economy, even when the economy relies on a narrow range of agricultural exports, making it more vulnerable to exogenous shocks (Persaud & Meade, 2009).

Malawi is relatively open to international trade even though its long-term trade performance is concerning, as the country's trade balance has been structurally and chronically in deficit since independence—the country imports about twice as many commodities as it exports. Without export growth, sustained trade deficits have created severe fragility in Malawi's trade bill, risking the economy into financial distress. Figure 1.0 exhibits trade balance performance for the past five decades; trade balance as a percentage of GDP ranged from -21.39% in 2013 to 1.94% in 1984 — the only time the economy registered a trade surplus; the average was -12.9 %. Moreover 2017, it was -7 percent, while the world average in the same year was -5.72 percent.

Figure 1.1: Malawi Trade Balance, as percent of GDP for 1960-2017 period



Source: Computed by author (2022) with data sourced from the World Bank

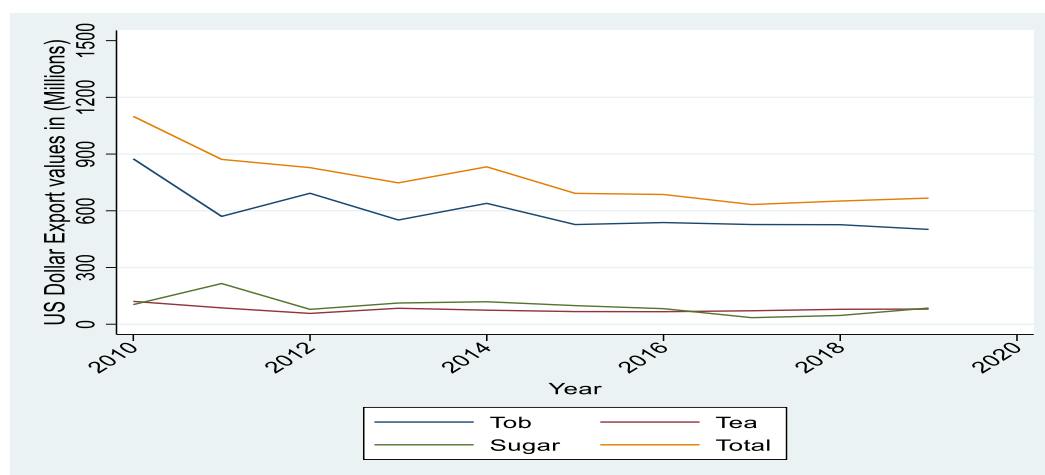
Over the past 15 years, the performance of major traditional exports, such as Tobacco, Sugar, and Tea, was dismal, followed by solid growth in imports, creating a complete trade imbalance (ITC, 2018). The nations' trading activities are concentrated in fewer markets and products; without product diversification, it is challenging to capitalize on global trade opportunities (Persuad & Meade, 2009). As a result, Malawi devised a strategy via NES to expand and diversify exports, as opposed to the long-standing tradition of exporting Tobacco, whose global demand is plummeting amidst concerns about health risks. Malawi's economy has historically been heavily reliant on the performance of tobacco export earnings, which account for more than half of total export volumes. Malawi is one of the top ten tobacco producers in the world (FAOSTAT, 2022). Burley tobacco is still the most widely grown Tobacco in Malawi, regardless of farm size (FAO, 2014). Smallholder farmers currently grow virtually 90% of the tobacco crop, implying that the crop remains a source of their livelihood.

Malawi's second largest export earner is Tea, which is predominantly grown commercially by large estates. Globally, Malawi ranks 13th largest tea exporter (FAO, 2015) and second in Africa behind Kenya. Traditionally, Tea is a forex-earner; in 2017, the total export value of Tea rose to \$90.8 Million from \$ 73.14 million in 2012, representing an increase of 24 percent in five years (Figure 1.2). In 2017, tea production rose to 45.6 from 43 million kilograms, representing a 6 per cent increase from the preceding year. According to IFPRI (2017), the sector is grappling with challenges that adversely affect crop profitability. Some challenges include substandard quality in production and processing, increased low pricing of the product

at the international market, seasonality, and transportation costs due to the landlockedness of Malawi as Teas must be hauled long distances to Mombasa Auction.

After Tobacco and Tea, Sugar is Malawi's third most important export product. The sugar sector employs over 100,000 people along the value chain, making up 10% of the GDP and nearly 12% of export earnings. Malawi exports refined and specialized sugar to segmented global markets. Due to the growth of cultivated areas and processing units, the crop's performance has improved significantly over the last two decades, and it has now surpassed Tea by 2%. Sugar is considered a highly prioritized crop for export expansion under the National Export Strategy, and its recent performance has been linked to competitiveness and maximization of regional markets (Nyirenda et al.,2017). The overall performance of (Tobacco, Tea, and Sugar) exports during the period when NES was operationalized has been remarkably sluggish, with exports fluctuating from year to year owing to commodity price risk and yield fluctuations compounded by the vagaries of weather.

Figure 1.2: Total export value for Tobacco, Tea, and Sugar in US\$ in (Millions) (2010-2019)



Source: Study data (2022)

1.2 Statement of the problem

A sustainable GDP growth rate is crucial for developing countries like Malawi to ensure a better standard of living in the face of a rapidly booming population. Expansion of exports is one strategy for achieving such growth, a point of view that trade policy experts are increasingly promoting to enhance economic growth sustainably. Malawi's export sector is predominantly agro-export commodity dependent, highly concentrated, and has a low complexity index, with highly fluctuating export earnings owing to the market's price volatility. The detrimental impact of commodity dependence is openness to exogenous shocks that run through the economy, exacerbating macroeconomic vulnerability and impairing long-term economic growth (World Bank, 2020). In contrast to import substitution, Malawi has integrated export expansion trade strategy as an economic growth strategy into overall development policy and macroeconomic planning during the past four decades. The exact impact of this method is unclear, as limited research on Malawi's ELG has yielded inconsistent results, including examples of a unidirectional relationship, a bidirectional link, and no relationship at all. Furthermore, an attempt is yet to be made to estimate the impact of disaggregated agricultural export items on Malawi's GDP.

While most empirical data endorse Export-Led Growth, a consensus is lacking due to the seemingly contradictory outcomes observed in developing and developed countries. Study findings could vary between nations due to varied economic dynamics and the application of diverse econometric methodologies, leading to conclusions that lack generalizability. Secondly, a significant portion of the studies analyzed focused only on total exports as the primary driver for economic growth, without isolating the impact of agricultural exports on economic

growth. Furthermore, much research on agriculture-led growth has focused on the impacts of aggregated agricultural commodities rather than the impact of individual major exportable crops on real GDP. Estimating total agricultural exports fails to account for marginal differences across export groups. Ignoring these disparities might lead to erroneous interpretations favouring the Export-Led Growth theory. Given that there is limited literature on the impact of disaggregated agricultural exports on economic growth in Malawi, and owing to a lack of generalizability of the ELG study findings, it is imperative to conduct a study that will address Malawi's unique situation. As a result, this study aimed to fill that gap and contribute meaningfully to the current body of literature on the trade-growth nexus. To fill this void, this study empirically investigated the short and long-run impact of disaggregated agricultural exports on Malawi's real GDP by decomposing aggregate agricultural export values into sub-components of (Tobacco, Tea, and Sugar) exports. Using time series data from 1968 to 2019, we examined the growing impact of Tobacco, Tea, and Sugar export values in Malawi.

1.3 Research objectives

1.3.1 General objective

The overall research objective was to estimate the impact of disaggregated principal crop exports (Tobacco, Sugar, and Tea) on Malawi's economic growth.

1.3.2 Specific objectives

This research proposal was specially designed:

- i. To investigate cyclical correlations in the trends of Tobacco, Tea, and Sugar export value series linked to Real GDP series from 1969 to 2019 in Malawi.

- ii. To assess the short and long-run impact of exportable crop commodities (Tobacco, Sugar, and Tea) on economic growth in Malawi,
- iii. To determine the direction of causality between exportable crop commodities (Tobacco, Sugar, and Tea) and economic growth in Malawi,

1.4 Research questions

- i. Are there cyclic correlations between the annual trends of the export values series for tobacco, tea, and sugar and the real GDP series from 1968 to 2019??
- ii. What is the short and long-run impact of Tobacco, Sugar, and Tea exports on Malawi's real GDP?
- iii. Do the export values of Tobacco, Sugar, and Tea Granger cause Real GDP or vice versa in Malawi?

1.5 Justification of the study

The Knowledge of the impact of the disaggregated agricultural crop exports on Malawi's economic growth is crucial in developing trade policies and strategies to improve the trade balance, which has been structurally in deficit since independence. Further, this would present a unique opportunity in which the performance of agricultural commodity export is estimated thereby enhancing understanding of their impact on Malawi's GDP. The study's findings about the unique contributions of each primary crop to Malawi's real GDP could assist in refining customized export strategies to enhance the export performance of each crop, as opposed to a one-size-fits-all strategy. Given that Malawi's economic growth is persistently volatile, and efforts to reduce poverty are illusive as poverty is intricately linked to low agriculture productivity, it is both timely and imperative to evaluate trade strategies streamlining

the agricultural sector and foreign sector in light of the apparent failure of agriculture export-led growth. In essence, the results of this analysis are expected to be relevant to Malawian policymakers, economists, and interest groups because promoting growth through export expansion can contribute to poverty reduction and job creation. The empirics generated from the study will further help identify specific exportable crop commodities that positively impact real GDP.

1.6 Scope and limitation of the study

The study applied time series data on selected crop exports from 1968 to 2019 to assess the influence of exportable agricultural commodities (Sugar, Tea, and Tobacco) on Malawi's GDP. Prior series were dropped due to a lack of data on some crops. Despite Malawi's exports of more products, including services, this research was restricted to Tobacco, Sugar, and Tea. Identification of the (Tobacco, Tea, and Sugar) exports was necessitated by their major contribution (80% combined) to the total export earnings. The study utilized validated data from legitimate trade transactions; hence, illegitimate flows of the equivalent crops to foreign countries were ignored, as in the case of Tobacco, which is illegally trafficked across the borders.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter systematically summarizes the reviewed literature. Empirical and theoretical literature are covered in sections 2.2, 2.3, and 2.4. Section 2.5 provides the conceptual framework

2.2 Literature review of the previous approaches to the ELG-Hypothesis

In terms of methodology, a plethora of empirical studies evaluating the causal effect of exports on economic growth is categorized into cross-sectional and time series approaches. These findings were determined by empirical reviews on ELGH for industrialized and developing countries (Castro-Zuniga, 2004). Limitations and deficiencies emerging from the use of either of the approaches indicate that the debate is nowhere near being resolved.

2.2.1 Cross-Sectional Approach

Under this approach, the ELGH is estimated by employing the Spearman Rank Correlation or the regression model in which a traditional production function is empirically estimated using exports along with labor and capital as regressors.

2.2.2.1 Spearman Rank Correlation Approach

Under the Spearman Rank Correlation, ELGH was estimated in a bivariate model, within the neoclassical framework, involving exports and economic growth only. ELGH claims were deduced from the correlations between exports and GDP (Bhagwati, &1978). Subsequently, most economic scientists would implicitly

attribute economic growth to higher exports. However, this approach is prone to suffer spurious correlation, including failure to disentangle correlation from causality.

2.2.2.2 Regression Approach

Between 1968 and the late 1980s, certain cohorts of researchers conducted ELGH investigations using regression techniques to operationalize the neoclassical production function. The export variables, labor, and capital were incorporated into the neoclassical model. Significant values of the export estimator would merely support the ELG hypothesis. Though the cross-sectional approach may illuminate why growth differs across countries, it has numerous weaknesses, particularly in the validity of the results. Such studies have categorized countries with the same level of development as one, with an unfounded assumption of sharing comparable economic conditions and technology (Shiraz & Manap, 2005). Another drawback is that the approach failed to differentiate between association and causation. Furthermore, the cross-sectional analysis fails to capture the influence of exogenous determinants on growth relative to the long-run dynamics within nations.

2.2.3 Time Series Approach

Faced with the constraints of cross-sectional research, more recent econometric studies on the export-economic growth nexus employ country-specific time series data to verify the ELG hypothesis by applying the Granger Causality Test (Silvestro & Herzer, 2005). However, divergent findings from the time series empirical studies fail to support the ELG Hypothesis. The stark reality is that most findings generated by these tests are mixed and often contradictory. However, the vast disparities in empirical outcomes are due to the sensitivity of the causality tests when some

variables are omitted (Silvestro & Herzer, 2005). Moreover, if exports cannot granger-cause GDP within the context of bivariate analysis, this scenario may not hold when an augmented neoclassical production function is applied (Awokuse, 2003). Three tests sequentially adhere to Stationary, Cointegration, and Granger causality tests when applying Granger causality tests. The most common challenges plaguing Time series techniques approaches in investigating the ELG Hypothesis include; data aggregation and appropriate lag-length selection (Castro-Zuniga, 2004).

2.3 Empirical review of Agricultural exports and economic growth studies

applying time series data

Seok & Moon (2021), in light of a shared market among nations, investigated the validity of the export-led growth theory in the context of the agriculture sector in developed nations. They examined the impact of agricultural exports on agricultural growth using annual data from 1997 to 2016 from countries that are members of the Organization for Economic Co-operation and Development (OECD). Instead of the dynamic common-correlated effects model, the authors adopted the common-correlated effect model as all variables are stationary in the total sample and subsamples. They assigned three subsets (the OECD, the economies that are a part of the European Union (EU), and the countries outside the EU within OECD nations) to compare advanced economies that have and do not have shared markets. The study's findings showed that, only in the case of the EU subsample, agricultural exports positively impact agro-economic growth. The results suggest that export-led growth theory needs to be verified relative to access to broader global markets in the developed world's agricultural sector.

El Weriemmi et al. (2024) analyzed the influence of agricultural exports on the economic growth of 30 upper-middle-income countries from 2004 to 2023. The study employed World Bank data and estimated a static gravity model. The research findings indicate that agricultural exports positively impact economic growth, with a 1% rise in exports associated with a 0.13% increase in growth rates. Capital investment and labour substantially impact economic growth. The results indicate that improving agriculture export policies and infrastructure may significantly enhance economic growth. It is also advisable to balance trade policy to ease the adverse impacts of imports.

Kyaw (2017) analyzed the impact of agricultural and manufactured exports on the economic growth of the ASEAN nations using the time series data that spanned 1995 to 2014. The author estimated fixed and random-effect models to determine how agricultural and manufactured exports influence economic growth. The study findings established that primary agriculture exports exhibited a significant and negative correlation with economic growth; manufactured exports positively impacted growth, unlike agricultural exports. The study recommended promoting domestic value-added processing over exporting raw materials to overseas markets.

Essotanam & Essossinam (2022) investigated the effects of agricultural exports on agricultural growth and overall growth in ECOWAS countries from 1996 to 2018. The econometric employed the instrumental variables approach to control the cross-sectional dependence and endogeneity issues. Their Findings indicated that the agricultural export-led agricultural growth hypothesis was validated. They further demonstrated that agricultural export increases the overall economic growth while the

combined effect of the agricultural export and agricultural growth does not affect overall growth.

Chowdhury (2023) conducted an extensive literature review to examine the impact of commodities markets on the economies of the DCs. The research demonstrated that commodity markets play a crucial role in shaping the economic framework of these nations, contributing to export revenues, GDP, and general growth. Nonetheless, the impact remains ambiguous, as price instability and oscillations present significant risk factors for economies reliant on commodities. The reliance on commodities impairs investment broadening, technological innovation progression, and human capital development. Positive instances of economic evolution through diversification and innovation may serve as a guiding framework for developing nations; however, challenges arise from corruption, political instability, and inadequate institutions. Factors affecting the development of commodity markets in emerging nations encompass population and income expansion, technological innovation, economic integration, and trade openness. The influence of commodities markets on economic growth is intricate, yielding beneficial and detrimental impacts, as demonstrated by varying results across different areas and nations. To foster sustainable economic growth, emerging nations should diversify their economies, invest in alternative industries, and emphasize technology and talent development.

Rahman & Hossain (2014) employed the (VAR) modelling to assess the influence of agricultural exports on GDP in Bangladesh. The study operationalized the Granger causality procedure to evaluate causation among agricultural exports and GDP. Study outcomes revealed a long-run relationship between Agro-exports and Real GDP, and

unidirectionally, agricultural exports granger-caused Real GDP. The (VAR) results affirmed that any variations in agricultural GDP affect economic growth proportionally, which indicates that improving the agricultural sector could effectively stimulate economic growth in Bangladesh.

Siaw (2018) undertook a study in Ghana to examine the relationship between agricultural exports and economic growth at a disaggregated level. The research applied the Autoregressive Distributed Lag (ARDL) model using annual time series data from the first quarter of 1990 to the fourth quarter of 2011 to offer insights for policymakers on economic patterns. Examining both long-term and short-term results indicates that cocoa exports have a positive and substantial effect on economic growth. In contrast, pineapple and banana exports negatively impact economic growth, with pineapple exports demonstrating no significant influence in either period. The study established a unidirectional causation from banana to economic growth, a bidirectional causal relationship between cocoa exports and economic growth, and no causal link between economic growth and pineapple exports in Ghana.

Adeabah & Asongu (2022) re-evaluated the influence of agricultural exports on economic growth by undertaking a meta-analysis approach. The meta-analysis revealed a notable negative publication bias within the current literature. Furthermore, after accounting for publication bias, the results indicated that agricultural exports contribute to economic growth in low-income and lower-middle-income African nations. The findings align with the hypothesis that agricultural exports propel growth.

Limited research has been conducted on the impact of agricultural exports on economic growth. Sanjuán-López & Dawson (2010) estimated a panel cointegration to investigate the causal link involving exports (agriculture and non-agriculture) and Real GDP amongst forty-two DCs. Research results confirmed long-run impact—the aggregate exports predicted Real GDP, and these findings supported ELGH. Moreover, it was observed that significant growth was attained from non-agricultural exports. Ouma et al. (2016) examined the relationship between agricultural trade and economic growth within the East African community, employing vector autoregressive and vector error correction models. Bidirectional causality is identified between agricultural exports and economic growth in Kenya, while unidirectional causality is observed in Rwanda.

In contrast, no causality exists in Tanzania, Uganda, and Burundi. To investigate the causal link between agricultural exports and Cameroun's economic growth, Noula et al. (2013) used the Vector Correction Model (VECM) and Granger causality procedure to estimate an extended generalized Cobb-Douglas production function. The study results generated varied outcomes concerning causality: while Coffee and banana exports granger-caused economic growth, cocoa exports did not granger-cause economic growth.

Mlambo et al. (2019) empirically evaluated the impact of both unprocessed and processed agricultural exports on the economic growth of South Africa. The analysis utilized time series data covering the period from 1986 to 2012. A Johansen cointegration approach was employed, along with the VECM, as the estimation technique. The analysis indicates that processed agricultural exports positively

correlate with economic growth, while unprocessed agricultural exports negatively correlate with economic growth. Manufactured agricultural exports play a crucial role in driving economic growth. The study advises that the South African government take measures to enhance and encourage investment in the processed agricultural commodities sector. Processed manufactured goods are typically sold at significantly higher prices, which can increase revenue for South African firms.

Simasiku and Sheefeni (2017) identified that agricultural exports exert a positive significant influence on economic growth, whereas non-agricultural exports have a direct effect on Namibia's GDP. This analysis utilized quarterly time series data from the period spanning from 1990 to 2014, the Augmented Dickey-Fuller test, error correction procedures, and the Johansen cointegration test, respectively. Ijirshar (2015) investigated the effect of agricultural exports on Nigeria's GD by employing the cointegration test and Error Correction Method (ECM). The analysis involved regressing GDP, which indicates economic growth, against variables such as Agro-exports, Trade Openness, exchange rates, and the Inflation rate. The research findings exhibited a long-run relationship amid the series, and overall, Agro-exports exerted a significant impact on the Nigerian economy.

Bokosi (2015) utilized the VAR approach to validate the ELG-Hypothesis in Malawi, employing time series data from 1980 to 2013. The export sector was subdivided into services and goods exports, with agricultural products comprising most of the exports. The analysis evaluated the relationship between exports and Real GDP within a dual equation system. The study findings demonstrated no long-run associations between aggregate exports and Real GDP. Instead, a short-run association between goods

exports and GDP was observed— unidirectionally, goods exports granger-caused Real GDP, and goods also granger-caused service exports.

2.3.1 Research gaps and shortcomings

The empirical analyses regarding the impact of agricultural exports on economic growth present a mixed and inconclusive stance on the robustness of the hypothesis. The existence of contradictory findings presents a challenge, as certain studies have established a causal relationship between agricultural exports and economic growth, whereas others have not provided supporting evidence for this connection. Secondly, a significant number of empirical studies exhibit a lack of consistent support for the ELGH, with this inconsistency becoming more evident when considering the specific product and the degree of transformation of the exported product, as well as the chosen econometric model.

Additionally, a review of the current literature reveals that there are limited studies that have disaggregated exports into specific subsectors, including agricultural exports. The absence of disaggregation results in an inaccurate representation of the ratio of agricultural exports to total exports, despite its substantial presence in many least-developed countries. The absence of these studies obscures the specific effects of key cash crops and assumes that these agricultural exports uniformly impact GDP. Moreover, an evaluation of studies investigating the impact of disaggregated agricultural exports on the economic growth of Malawi has not been conducted. This study identifies and examines the current knowledge gap.

2.4 Theoretical framework

2.4.1 Economic growth

Economic growth is sustained growth in the market value of goods and services generated in a particular economy within a specified and universally agreed-upon period. Apart from using monetary value in the dollar, it is also estimated as a percentage change in GDP, though adjusted to inflation. Economic growth denotes an upturn in the aggregate output of an economy. The reality is that a growing economy is crucial to poverty reduction and improving people's standard of living. Various growth theories in this section cover the aspects of economic growth and their importance.

2.4.2 Classical theory of economic growth

Classical economists emerged alongside the Industrial Revolution in Great Britain, and the most notable classicalists were Adam Smith, Thomas Malthus, and David Ricardo. Classicalists advanced a political and economic theory that promoted operations of free markets domestically and free trade internationally. Free trade was supported by the comparative advantage theory introduced by David Ricardo, who posits that free trade can flourish between trading partners capable of producing goods and providing services at lower opportunity costs than their trading partner. Consequentially, nations could attain both productivity and consumption levels rather than utility, which they could not have attained if they operated in an autarchy state. Structurally, classicalists believed that a nation's wealth is determined by aggregate national income, which was generated by labour, land, and capital as fundamental

factors of production in a capitalist structure. Based on these factors, society was categorized into three classes: workers, capitalists, and landlords, who would play specific economic roles. Workers would own labour, which is exchanged or sold for a subsistence wage. Landlords would get rent from transacting their land to capitalists. Capitalists profit from exploiting their productive capacities and resources by organizing productive processes. The agents' behaviour in the market is self-seeking as it is dictated by their venture to extract maximum benefits from their resources.

The classicalists believed that only capitalists would save from their earnings (Salvadori, 2003). They assumed that the social class one decided redistribution of income across the social class belonged; the transformation of savings into investment could be either direct or indirect depending on whether one is an entrepreneur or transacting in the capital markets. Classicalists accepted that savings are always converted into an investment, though this equalization was predicated on the adjustment in the labour markets. Fundamentally, classicalists believe that the GDP growth rate is attributed to the interaction of savings and demographic surges. Savings propel investments, and demographic growth is endogenously estimated to have a cumulative role in the real wage rate. Adam Smith (1776) demonstrated how aggregate output relies on capital, labour, and land. The technologies of the means of production are auxiliary essentials of growth. The classicalists also recognized the role of non-economic factors enabling economic growth, including political stability, private property, functioning laws, and institutions.

2.4.3 The Keynesian theory of economic growth

Keynesians heavily emphasized the function of aggregate expenditure and its impact on aggregate production and inflation. The name and theoretical basis of Keynesian economics are owed to John Maynard Keynes, the father of modern macroeconomics. "The General Theory of Employment, Interest, and Money," published in 1936, is one of his most well-known writings. The Keynesian theory came into play following the 1930 great economic depression as most economists faced the challenge of developing a competent economic policy that would stimulate economic growth by jump-starting production and employment following the damping impact of the economic depression. During the 1930s, most global economies faced austere economic depression; as a result, the Keynesian theory of growth stimulation was promoted by encouraging expansionary monetary (increasing money supply) and fiscal policy, as this would stimulate aggregate demand, leading to full employment.

Furthermore, Keynesian economists assumed that private individuals, including firms, constantly save part of their earnings that are converted into investments. However, contrary to other economic theories, not all savings are converted into investments. However, a steady state economy can be attained under a unique scenario once savings are converted into investments (Salvadori, 2003). During the post-Depression era, Sir Harrod (1936) and Sir Domar (1946) endeavoured to work out a macroeconomic model that would eventually enhance understanding of growth challenges within the Keynesian framework. Though studies lacked theoretical underpinnings, they focused on the role of consumption and saving within households and investment choices by firms. According to Keynesian macroeconomic modelling,

domestic demand drives economic growth by stimulating aggregate expenditure. Local consumption boosts productivity, allowing enterprises to meet domestic demand and contribute significantly to real GDP. Demand is stimulated, resulting in higher industrial output and increased economic activity.

2.4.4 Neoclassical Growth Theory

The neoclassical Growth theory, propounded by Ramsey, was later established by Solow and Swan in 1956 (Agenor & Montiel, 1996). The Theory hypothesizes that economic growth emanates from capital build-up through savings. The Theory examines economic convergence to a growth rate calibrated by exogenous population increase and rate of technical change (Barro, 1998). Prior growth theories propounded by Harrod and Domar had presumed fixed coefficients in factors of production, which the Solow-Swan theory adopted to permit substitution amidst factors of production (Stiglitz & Uzawa, 1969). The neoclassical growth model highlights the intricacies of attaining long-term steady-state growth of latent output when the economy is gainfully employed, though conceptualizing from the short-run Keynesian intricacies of effective aggregate demand. The neoclassical growth theory presumes the existence of cumulative production function expressed as $Y = f(K, L)$, whereas Y is the economy output, K symbolizes capital stock, and L represents the quantity of labour force. The production function exhibits invariable scale effects, though with declining marginal products of productive inputs.

Under neoclassical growth, the Keynesian saving principle spreads theory production among savings and composite consumption. Savings are assumed to be made as a pegged proportion of the aggregate output while technology progresses at an exogenous rate. If savings match investment in value, the economy is deemed to be in

a steady state. The declining capital efficiency hypothesis warrants the convergence process towards long-run equilibrium growth. While this illustration is conceivable, the model must account for government policies and institutions that signal fiscal policy in stimulating the economy's buoyancy (Bassanini & Scarpetta, 2001). This inadequacy and lack of validation for long-term economic rise generated under the model's parameters led to endogenous growth theory. Solow and Swan later established the neoclassical Growth theory, propounded by Ramsey (1928), in 1956 (Agenor & Montiel, 1996). The Theory hypothesizes that economic growth emanates from capital build-up through savings. The Theory examines economic convergence to a growth rate calibrated by exogenous population increase and rate of technical change (Barro, 1998). Prior growth theories propounded by Harrod and Domar had presumed fixed coefficients in factors of production, which the Solow-Swan theory adopted to permit substitution amidst factors of production (Stiglitz & Uzawa, 1969). The neoclassical growth model highlights the intricacies of attaining long-term steady-state growth of latent output when the economy is gainfully employed, though conceptualizing from the short-run Keynesian intricacies of effective aggregate demand.

2.4.5 Endogenous growth theories

The prior exponents of growth theories viewed exogenous factors as generating economic growth. On the eve of the 1990s, Romer, Lucas, and Barro formulated a new growth theory, which hypothetically endogenized the role of technology as an option that leverages Research and Innovation (Bassanini & Scarpetta, 2001). This theoretical proposition was dubbed as Endogenous Growth Theory. The Theory emphasized the role of innovation, human capital accumulation, new technology

development, and financial intermediation as critical factors of increased GDP growth. The Endogenous Growth Model estimates the rising scale effects of technology as it reduces knowledge-based growth over the long term (Cortright, 2001). In operationalizing the hypothesis of the Solow-Swan Model, New growth theories permit the workings of policy and Institutional dynamics to form the pathways to economic growth (Bassanini & Scarpetta, 2001). Barro (1998) contended that growth rate changes follow probable changes to save and admittance to technological knowledge and policy interventions. Governments that apportion intensified expenditure to lessen market distortions, administer proprietary rights, deliver infrastructural services, and guarantee improved financial markets engender efficiencies that render into growth.

2.5 Conceptual Framework

Malawi is naturally endowed with copious production factors in the form of labour and land, including capital in short supply. Due to short-term production and low-income elasticity of demand, agricultural export commodities, which comprise the majority of exports (80%) in Malawi's agrarian economy, are susceptible to price volatilities and external shocks. The impact of disaggregated agricultural exports on Malawi's economy is an exhausting yet crucial topic. Agricultural exports (tobacco, tea, and sugar) as commodities considerably impact the country's economic condition (Radetzki & Wårell, 2020). These commodity exports not only provide a significant contribution to export revenues, but they also have an impact on GDP and economic growth. Increased earnings from exports can be directed towards vital sectors such as infrastructure development, public services, and critical industry investment, ultimately raising living standards and fostering prosperity (Ayoo, 2022).

However, the effects of commodity markets on emerging economies are only sometimes clear-cut. These markets are known for their price volatility and swings, which enormously impact the economic growth of nations that rely heavily on commodities. Global demand fluctuations, geopolitical upheavals, and climatic factors can all cause abrupt swings in commodity prices, setting those nations at severe risk. Sustained price shocks cause severe economic downturns, budgetary limitations, and GDP contraction (Olayeni et al., 2020). Malawi's trade balance has been structurally in deficit since independence, compounded by the vulnerabilities associated with low complexity index export commodities, such as agricultural commodities. This scenario sets the economy on perennial trade imbalances due to its dependence on agricultural exports. Low productivity of export commodities has contributed to underinvestment in the export and agricultural sectors, notably in production capacity. This has led to poor forex earnings that cannot be recapitalized but are instead wiped out to pay high import costs.

Agricultural exports experience enhancements in both volume and quality due to increased productivity and a relatively low real exchange rate, which serves as an intervening predictor. This situation may lead to a subsequent rise in demand and competitiveness of these exports in the international market. This may result in enhanced earnings, greater capital formation, and a strengthened economy. Trade exerts a significant influence on economic growth. Given that most economies engage in trade, the real exchange rate is a crucial factor affecting overall output in Malawi's agricultural foreign sector. The foreign sector in Malawi exhibits significant

liberalization; therefore, fluctuations in the real exchange rate of the Malawi Kwacha may negatively impact agricultural exports.

Independent variables

Dependent variable

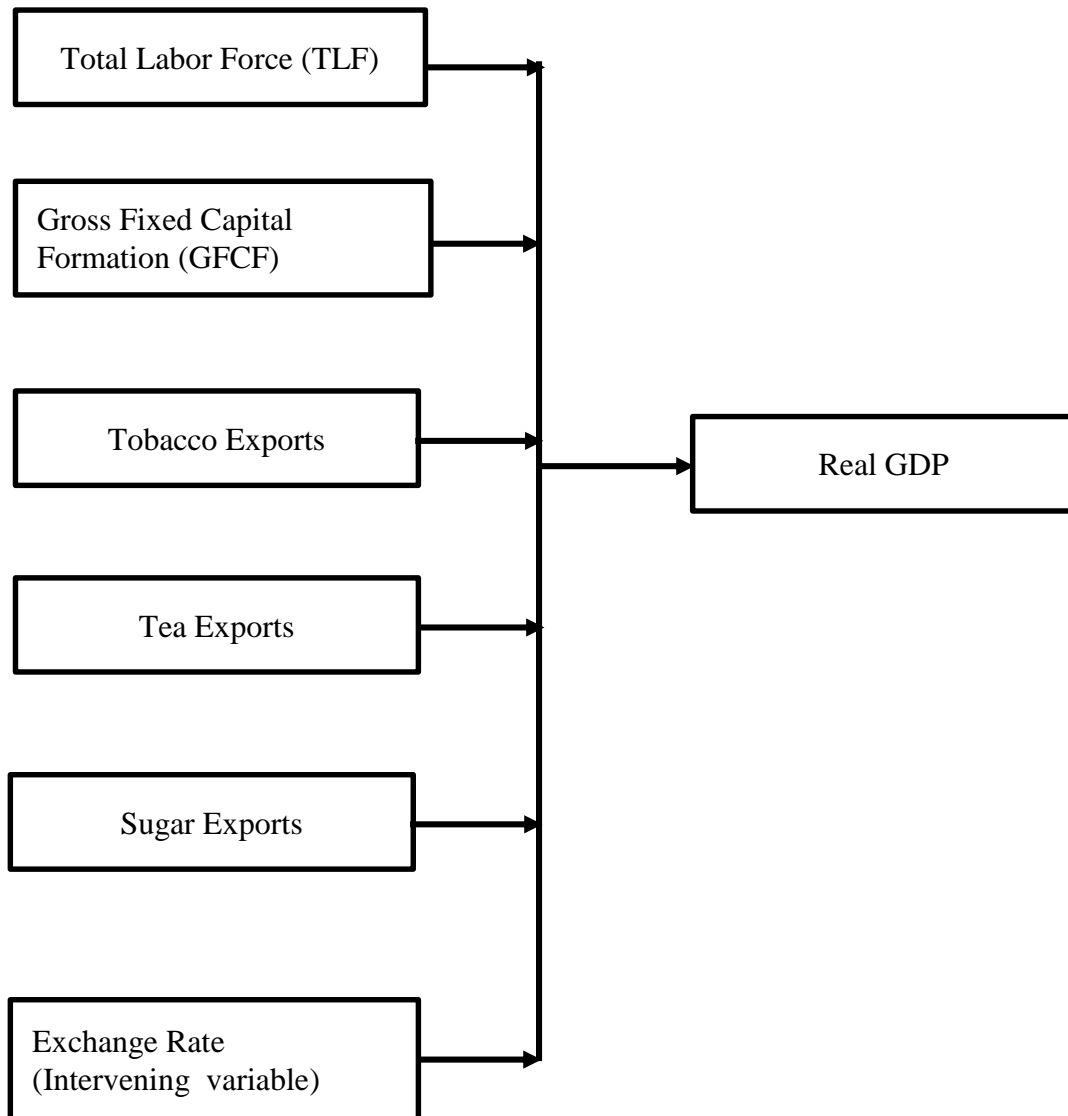


Figure 2.1: Conceptual framework

Source: (Author) 2020

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section of the research study discusses the methodologies applied to meet the research goals. It covers research design, model specification, estimating technique, variable definition and measurement, data sources, and analysis.

3.2 Study area

The research was conducted in Malawi, a non-coastal SSA economy situated in the South-Eastern part of the continent. In the Northern-East, Malawi shares a boundary with Tanzania; and Mozambique engulfs Malawi from North-East, the entire Southern part up to the southern-west. Zambia borders Malawi from the Central-western up to the Northern-west. Malawi is situated within the Great African Rift Valley. Malawi's economy is traditionally agricultural; the sector contributes about 33% the country's GDP.

3.2 Research design

The study employed a non-experimental correlational research design, which focuses on studying the social phenomenon by estimating an empirical association between two variables without manipulating the variables' conditions. A positive correlation result in a non-experiment correlational design study suggests that high values of one variable are associated with high values of another. In contrast, a negative correlation shows that the high values of one variable are related to the low values of another. All variables captured in the study were considered on annual observation from 1961 to

2019; hence, time series procedures were proposed to estimate the impact of agricultural exports on Malawi’s GDP.

3.4 Data Sources

The research employed time series data for Malawi, focusing on the principal agricultural crop exports—Tobacco, Tea, and Sugar—with control macroeconomic variables such as labor (TLF), capital (GFCF) and RGDP, as well as the intervening predictor of the exchange rate. The list of the series adopted for this study is presented in Appendix 9. The time series data covering the period from 1968 to 2019 was obtained from the Malawi National Statistical Office (NSO), FAOSTAT, and the World Development Indicators (WDI), which is a collection of development indicators by the World Bank (WB). The measurement of the disaggregated agricultural exports is based on their total value in US dollars, while the total labor force (TLF) includes individuals aged 15 and older who contribute labor for the annual production of goods and services. The capital (GFCF) is regarded as the acquisition of produced assets evaluated at current prices in US dollars, while economic growth is assessed through real GDP in US\$. Table 3.0 provides a summary of the variables used in the study along with their corresponding data sources.

Table 3.1: Variables and data sources

Variable	Data sources
Real GDP	The World Bank
Tobacco Exports	FAOSTAT verified with NSO database
Sugar Exports	FAOSTAT verified with NSO database
Tea Exports	FAOSTAT verified with NSO database
Exchange rates	The World Bank and IMF
Labour (TLF)	The World Bank
Capital (GFCF)	The World Bank

Notes: NSO, Nation Statistical Office (Malawi); FAOSTAT, Food and Agriculture Organization Corporate Statistical Database; IMF, International Monetary Fund.

All appropriate safeguards, including database triangulation, were taken to enhance data collection and collation validity. The data gathered from various databases underwent validation via the Malawi National Statistical Office (NSO), which is responsible for certifying the methodology employed by the custodian agency in compiling the indicator. The NSO database was effectively utilized as a reference to maintain consistency in the definition and classification of the indicators. This was precisely done to guarantee that the data was suitable, adequate, and reliable for the study. However, the data used in the analysis had certain limitations because the sample period was confined to 1968 to 2019 due to a lack of official account data prior to this era.

3.5 Empirical model specification

This study investigated the causal-dynamic association involving exportable crops (Tobacco, Tea, and Sugar) and Malawi's Real GDP. Most empirical economic studies on economic growth have applied the foundational Solow's neoclassical growth Model. The Solow-Swan Model, an exogenous model that investigates long-run economic development changes arising from differences in population increase (labor growth), capita accumulation (savings rate), and productivity gains, serves as the foundation model for the proposed study. The Cobb-Douglas production function is used to formulate the model. Economic growth Study findings for DCs have suggested that the labour supply is in excess, but most economies lack capital, a crucial factor to economic growth. Trade specialists have leveraged Solow's growth model to validate the ELG-Hypothesis, and these studies have derived augmented neo-classical production function by Solow (1957), Feder (1982), and Ram (1985). The Solow-Swan production function is popularised amongst economists because of its flexible

mathematical features and provides mathematically reasonable allowances for numerous applicable derivations. Theoretically, the specified model was introduced with a basic neoclassical production function:

$$Y_t = A_t K_t^\alpha L_t^\beta \quad 3.1$$

Whereas Y_t represents the aggregate economy output or real GDP in a specified time t , A_t factor productivity, K_t a capital proxy for domestic investment, and L_t labor stock. Since we intend to study the causal relationship between the exportable agricultural commodities (Tobacco, Tea, and Sugar) and Malawi's real GDP, our generalized neo-classical production function is extended to accommodate disaggregated agricultural (Tobacco, Tea, Sugar) exports as follows:

$$Y_t = f\left(L_t^\alpha, K_t^\beta, TOB_t^\gamma, TEA_t^\varphi, SUG_t^\psi, \varepsilon_t\right) \quad 3.2$$

And $(\alpha, \beta, \gamma, \varphi, \psi)$ denote elasticities of production relating to $(K_t, L_t, TOB_t, TEA_t, SUG_t)$ respectively. TOB_t Denotes Tobacco exports at time t ; TEA_t , denotes value of Tea exports at time t ; SUG_t , is value of Sugar exports at time t . Since exchange rates are crucial for export trade, the exchange rate variable is introduced to cater to any adverse effect on economic growth (Bermudez & Dabus, 2015; Miles, 2006). The real exchange rate is very critical in the foreign exchange market. When a country's exchange rate rises, its exports become more expensive compared to imports, resulting in a trade imbalance and, as a result, a decline in GDP (Salvatore, 2007).

$$\begin{aligned} &RGDP_t \\ &= f\left(TLF_t^\alpha, GFCE_t^\beta, TOB_t^\gamma, TEA_t^\varphi, SUG_t^\psi, EXR_t^\tau, \varepsilon_t\right) \end{aligned} \quad 3.3$$

Where $RGDP_t$ a proxy for annual aggregate output for the economy, TLF_t denotes total labor stock, $GFCE_t$ represents Gross Domestic Fixed Capital Formation, TOB_t is tobacco export value in dollars, TEA_t is tea export value in dollars, SUG_t is sugar

export in Dollars, EXR_t denotes exchange rate, and ε_t exchange rate error term. Eventually, as in equation (3), the augmented neoclassical production model is derived and empirically estimated to examine the causal effect of exportable crop commodities on Malawi's economic growth. Any variations in the unit of measurement across the variables are removed by transforming equation (3) through the application of natural logs on both sides, which results in the subsequent estimated model:

$$\begin{aligned}
 &LRGDP_t \\
 &= \alpha + \beta LTLF_t + \vartheta LGFCF_t + \gamma LTOB_t + \delta LTEA_t + \rho LSUG_t + \tau EXR_t \\
 &+ \varepsilon_t
 \end{aligned} \tag{3.4}$$

Where L introduced in front of the variables (denotes natural logs for all the variables introduced in the model, and ε_t stochastic disturbance term (error term), α is the constant, and $\beta, \vartheta, \delta, \rho$, and τ are the parameters.

3.6 Definition of variables

The model specification for validating the ELG-Hypothesis is anchored on the augmented neoclassical production function; therefore, it is assumed that all variables employed would positively influence economic growth (RGDP).

Gross Domestic Product (GDP): aggregate market value of goods and services generated in a particular economy within a specified period. According to the study, real GDP is used, which is the proportion of nominal GDP to the GDP deflator. The US\$ dollar value of GDP is captured annually. GDP is an outcome variable.

Total Labour Force (LF) is an explanatory variable that presently defines persons deemed eligible for employment during a specified ‘referenced’ period. The agricultural sector progresses rapidly as labour productivity increases. Going by neoclassical theory, the impact of labour on aggregate output is anticipated to be positive. The unit of measure is the total sum of people eligible for employment, and the data will be captured yearly.

Gross fixed capital formation (GFCF) is computed as value of assets acquired by all sectors of the economy (leaving their stand-alone enterprises) less fixed asset disposals (OECD, 2020). It is computed as the ratio to GDP and is reported annually.

The exchange Rate (EXR): is defined as the number of units of the domestic currency that can purchase a unit of a given foreign currency. EXR is captured annually as a ratio of 1 USD to Malawi Kwachas. The sign of the exchange rate parameter in relation to GDP would be expected to be positive, albeit this is predicated upon whether the exchange rate depreciates, leading to exports becoming competitive on the international markets and GDP increasing, as has been the situation in Malawi.

Tobacco Exports (Tob.): represents the market value of tobacco being exported out of Malawi. Tobacco is a major agricultural export product in Malawi, and it has been heavily linked with greater gains in export earnings plus positive impact on Malawi’s GDP. Exports are captured annually as total sum of US-Dollars.

TEA Exports (Tea): This represents market value of tea exports. Tea is number 2 export product in Malawi. Tea performance on the international market positively

impacts Malawi's GDP, and as a repressor, we anticipate to influence GDP favourably. Exports are captured annually as total sum of US-Dollars.

Sugar exports (SUG.): denotes total market value of Sugar exports. It is anticipated that Sugar exports will impact GDP positively. Exports are captured annually as total sum of US-Dollars.

Table 3. 1 Variables and expected signs

Variable	Variable name	Expected parameter sign
<i>RGDP_t</i>	Real Gross Domestic Product	
<i>TLF_t</i>	Total Labour Force	+
<i>GFCA_t</i>	Gross Fixed Capital Formation	+
<i>EXR_t</i>	Exchange Rate	-
<i>TOB_t</i>	Tobacco Exports	+
<i>TEA_t</i>	Tea Exports	+
<i>SUG_t</i>	Sugar Exports	+

3.7 Data Analysis Strategy

3.7.1 Objective one

The first objective was to investigate if yearly agricultural export values (tobacco, sugar, and tea) and real GDP in Malawi are cross-correlated over time. Cross-correlations was used to determine whether two series are related or co-move, and if so, whether the movement in one precedes, follows, or occurs contemporaneously with movement in the other. In this case, a cross-correlation was utilized as a preliminary phase in analyzing a possible causal association between two series recorded across time. Before estimating Vector Autoregression (VAR) models and determining if two series variables cause one another, cross-correlations are routinely

computed. Given the visible features of macroeconomic data, which includes a long-run trend rise of aggregate economic activity and a cyclical component that depicts short-termism dynamics in the business cycles, the Hodrick-Prescott Filter (HP) Filter detrending technique was employed to uncover the underlying trends in time series data. This was done by decomposing the series into a trend and a cyclical component, (Hodrick and Prescott, 1997). The fundamental mathematical concept underlying such filter is analogous to theories in time series detrending analysis. Given series, a mathematical expression underlying detrending analysis would be expressed as:

$$y_t = \tau_t + c_t + \varepsilon_t \quad (4)$$

The equation decomposes the series into (τ_t) a trend component, and (c_t) cyclical component, and ε_t is stochastic component. A multiplier (λ) is used to moderate the short-term variations of the time series trend component. The time series trend component gets resolved as:

$$\min_{\tau} (\sum_{t=1}^T (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2) \quad (4.1)$$

The technique involves minimizing both the deviation from the trend $(y_t - \tau_t)^2$ and approximated trend's curvature, which is the last part of the equation (4.1). The second part is (multiplied by the λ), thus a smoothing parameter that penalizes variations in the growth rate of the trend component. As a result, increasing lambda value leads to a higher penalty. The HP filter estimated a λ multiplier value of 100 for the annual dataset (Backus et al., 1992). The generated cyclical components enhance our understanding of the co-movement between agricultural crop exports series and the real GDP gap. However, to ascertain the magnitude and the direction of

cyclical, a bivariate cross-correlation between individual exportable agricultural export series and GDP was calculated to examine the relationships between the series, specifically whether the movement in one series leads or trails movement in the other. The Cross Correlations Function (CCF) computes coefficients (r), which are then shown transversely with bars on a band of lags, displaying the cyclical relationship of the two series through the graphical presentation known as a Correlogram. The graphical presentation provided both strength and direction of the correlation; additionally, the stability of the series relationship is pronounced laterally by the degrees of symmetry along the lag-axis. Given that a real GDP series (x_t), crop exports series $y_{i,t-k}$ (at lead/lag), and the cross correlation is computed as:

$$\rho_{x,y}(k) = \frac{\text{Cov}(x_t, y_{i,t-k})}{\sqrt{\text{var}(x_t)\text{var}(y_{i,t})}} \text{ for } i = 1, 2, \dots, N \text{ and } k = -, -8, -4, \dots, +4, +8 \quad (5)$$

The outcome of this computation yields a scalar quantity x_t and the K^{th} lag/lead of series i , where K represents lags: and ρ_{xy} denotes cross correlation and when the Cross Correlation Function (ρ_{XY}) is asymmetric, it implies that $\rho_{XY}(K) \neq \rho_{XY}(-K)$. The CCF estimates correlation between reference series in this case (Tobacco or Tea or Sugar series relative to GDP series) at numerous separate lag distance band, which are both positive and negative. Any significant cross-correlations along negative lags implies that an input variable precedes the Output. In contrast, significantly tested cross-correlations at positive lags show that variations in X_t trail variations in Y_t . Contemporaneous correlations, computed at lag 0, are used to determine if the association between GDP and the reference series is procyclical, countercyclical, or acyclical. According to Agenor et al. (2000), a positive contemporaneous correlation coefficient [$\rho(0)$] above zero deemed procyclical, greater values ranging from 0.26

to 1 imply strong contemporaneous correlation; contrary, a negative cross-correlation is implied countercyclical. Two series can be associated contemporaneously, suggesting that when one series varies, the other series varies in the same years. Nonetheless, the series can exhibit nonsynchronous correlation, with oscillations occurring at different periods. Cross-correlation is a preliminary step in determining a potential causal relationship between series.

3.7.2 Objective Two

Objective two evaluated the short and long-term causal relationship between principal crop exports (Tobacco, Sugar, Tea) and real GDP, proxied as economic growth. Fundamentally, the goal was to estimate the dynamic impact of (Tobacco, Sugar, Tea) exports on Malawi's GDP, which was preceded by the operationalization of requisite time series data techniques. To achieve this, augmented neoclassical production function estimated leveraging neoclassical trade theory. Under this function, the principal crop exports were introduced into the equation as regressors along with autonomous capital and labour factors. Subsequently, several Times series (VAR) models were employed strictly to model specifications, including selection tests. Procedurally, after applying Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests; and ARDL Bounds Test of Cointegration was implemented to investigate both short and long run dynamic impact of disaggregated exportable agricultural commodities (Tobacco, Tea, sugar) on Malawi's real GDP. ARDL was adopted because it can perform with series that are integrated of different orders $I(0)$ and $I(1)$, and cointegrated.

3.7.2.1 Testing for Stationarity

Time series is considered stationary when statistical values such as means and variance show constant changes over some specified period and when the covariance value emerging from the two series relies only on the lag between the series but not the real times when variables are observed (Guajarati, 2004). The nonstationary series mean varies at various time points, and the variance rises as the sample size increase (Harris & Sollis, 2003). Nonstationary series are random and cannot be conveniently used for modelling and forecasting. The results of using nonstationary time series can be spurious. To attain reliable results, Nonstationary series must be changed into stationary series.

To circumvent reporting spurious regression outcomes, the series was subjected to the Augmented Dickey-Fuller (ADF) and the Phillips–Perron (PP) Unit Root tests to examine if the series under study are stationary. ADF accommodates more complex dynamic models involving ARMA (p, q) models than the standard Auto-Regressive [AR (1)] model (Said & Dickey, 1984). In this study, the PP test was applied jointly with ADF to improve the robustness of the outcomes since the PP test can be applied without specifying the ARIMA model. Technically, the PP test is less disposed to misspecification than the ADF test (Nahanga & Vera, 2016). Furthermore, the PP test compensates for serial correlation, whereas ADF is plagued with instances of low power in determining the level of stationarity; also, the ADF test has a substantial risk of committing type II error with ADF-test (Kočenda & Černý, 2007). The typical (ADF) test is an extension of DF that accommodates more complex data by applying AR of any order and enhancing the modelling of a time trend. The Augmented

Dickey-Fuller Testing procedure inflates Dickey-Fuller (DF) test model to provides for higher-order AR processes, which include $\Delta Y_{t-\rho}$ within the equation form,

$$Y_t = \theta + \beta t + \alpha y_{t-1} + \Psi_1 \Delta Y_{t-1} + \dots + \Psi_{\rho-1} \Delta Y_{t-(\rho-1)} + \varepsilon_t \quad (6)$$

Whereas θ denotes an intercept, β an estimator of (t) trend, ρ represents lag operator of the AR process, α represents an estimator (autoregression parameter) on the first lag on Y .

Null and alternative hypotheses for DF test is specified as:

$H_0: \alpha = 0$ represent existence of unit root

$H_1: \alpha < 0$ absence of unit root or stationary series

We would like to reject the null hypothesis when we obtain p-value < 0.05 .

(OLS) is employed to operationalize ADF; however, serial correlation tends to be problematic. To deal with serial correlation, the Phillips-Perron (1988) Test was estimated as a DF regression model to test unit root, with the coefficient extrapolations adjusted to account for the impacts of serial correlations. The PP test is viewed as a modified ADF statistic that uses Newey–West Estimator (1987) to account for serial correlation and heteroskedasticity arising from correlated error terms. When the ADF test is parametrically autoregressed to estimate the ARMA models of the residuals, the Phillips-Perron Test ignores serially correlated errors. PP test employs the following regression:

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + \mu_t \quad (7)$$

μ_t is $I(0)$ and possibly heteroskedastic. D_t represents vector of deterministic terms, thus constant and trend; π thus, a parameter of interest to be estimated as a coefficient heteroscedasticity and autocorrelation constant t-statistic approximated p-Value. PP-Tests, non-parametric test whose process is operationalised by regressing the Δy_t on the lagged level with an assumption that a lag-one-model is suitable. PP-Tests modify the T-test statistics founded on the AF of the estimated differenced series. In the process, Phillips-Perron Tests would amend for serial correlation plus heteroskedasticity in μ_t through direct adjustment of the test statistics $t_\pi = 0$. PP test CVs are analogous to ADF test CVs, and both approaches were used in this study to enhance the validity of the results.

3.7.2.2 Co-integration test

Engle and Granger (1987) conceptualized Cointegration as an econometrical technique applied to assess the existence of long-run relationships amid series. According to Gujarati (2004), Cointegration represents an econometric outcome that establishes a long-run relationship among series that are independently nonstationary at the level form and stationary after initial differencing. Therefore, the cointegration concept is applied to estimate nonstationary series whose linear combination is stationary. Intuitively, when two series $I(1)$, the partial variance between the series could be constant within a static mean, implying that the two series are traveling together probably in a similar fashion. The series that meet this condition could be cointegrated (Green, 2000) and share a joint stochastic trend.

To estimate both short and long-run causal dynamics among exportable crop commodities -(Tabacco, Tea, Sugar) and real GDP, this study adopted the ARDL-

Bounds cointegration approach as a fundamental vector autoregressive (VAR) procedure, which was established by Pesaran and Shin (1999) and Pesaran et al. (2001). The Bounds Test technique is efficiently superior because it outfoxes the order of integration challenges related to the Johansen and Juselius (1990) cointegration approach, which requires that series be identically integrated of $I(1)$ before conducting cointegration. In most circumstances, this criterion is not met, hence for a long-run connection; it is appropriate to use the Bounds Cointegration Test, which could be approximated irrespective of whether the series in context are $I(0)$ or $I(1)$, rather a combination of the two. In this case, ARDL Bounds Cointegration could provide reliable and efficient parameters. Unlike the Johansen Cointegration technique, the (ARDL) cointegration approach assists in determining the cointegrating vector(s), implying that separate underlying series pose as a single cointegration equation. If a cointegrating equation is determined, the ARDL model of the cointegrating vector is re-parameterized into Error Correction Model (ECM), yielding both short and long-run dynamics of the series in one equation. In a regression model, a distributed lag model implies that the regressors' lag is unconstrained.

The ARDL Cointegration technique offers more significant advantages than the conventional Johansen cointegration approaches. Primarily, ARDL Test is more vigorous and performs efficiently with a small sample size. For all arrangements of independent series into pure $I(1)$, purely $I(0)$, or communally cointegrated for multiple sample sizes, binary critical values are given for both lower $I(0)$ and upper $I(1)$ bounds in the determination of cointegrating series. Secondly, Johansen's Cointegration Test is applicable when underlying series are integrated in the same order, while the ARDL procedure may be used with series that are integrated into

various orders. Moreover, underlying series are parameterized into a single equation, and endogeneity becomes less problematic in the ARDL system due to the absence of residual correlations, as all series are deemed endogenous. For a long time, studies applying the ARDL procedure have delivered unbiased long-run estimates validated by binding t-statistics, particularly when some explanatory variables are endogenous (Narayan, 2005). More importantly, the ARDL procedure analytically allows evaluating short and long run dynamic effects of one series over the other by reparameterization of ARDL into ECM (Bentzen & Engsted, 2001). Concerning optimal lag length, Pesaran and Shin (1999) explained that AIC and SC perform efficiently under smaller samples, but for this study, AIC was applied for the lag selection.

The ARDL empirical model for the estimation of the long run impact is presented below:

$$\begin{aligned}
 LRGDP_t = & \alpha_0 + \beta_7 LRGDP_{t-i} + \beta_8 LGFCF_{t-i} + \beta_9 LTLF_{t-i} + \beta_{10} LTOB_{t-i} + \\
 & \beta_{11} LTEA_{t-i} + \beta_{12} LSUG_{t-i} + \beta_{13} LEXR_{t-i} + \varepsilon_t
 \end{aligned} \tag{8}$$

Where; (LRGDP, LGFCF, LTLF, LTOB, LTEA, LSUG, and LEXT) are variables under study, and ε_t is white noise. The ARDL Cointegration Bound Test is effected by transmuting equation (8) to the Bound Testing model by incorporating short- and long-run dynamism. Overall, the approach is estimated to investigate the short and long run interactions among series, and the ARDL Bound Testing (p, q_1, \dots, q_n) model presented below is applied to test the cointegration of the series understudy:

$$\begin{aligned}
\Delta LR GDP_t = & \alpha_0 + \sum_{i=1}^p \beta_{1i} \Delta LR GDP_{t-i} + \sum_{i=0}^{q_1} \beta_{2i} \Delta LGFCF_{t-i} + \sum_{i=0}^{q_2} \beta_{3i} \Delta LTLF_{t-i} \\
& + \sum_{i=0}^{q_3} \beta_{4i} \Delta LnTOB_{t-i} + \sum_{i=0}^{q_4} \beta_{5i} \Delta LnTEA_{t-i} + \sum_{i=0}^{q_5} \beta_{6i} \Delta LnSUG_{t-i} + \sum_{i=0}^{q_6} \beta_{7i} \Delta LnEXC_{t-i} \\
& + \beta_7 LnRGDP_{t-1} + \beta_8 LnGFCF_{t-1} + \beta_9 LnTLF_{t-1} + \beta_{10} LnTOB_{t-1} + \beta_{11} LnTEA_{t-1} + \\
& \beta_{12} LnSUG_{t-1} + \beta_{13} LnEXR_{t-1} + \varepsilon_t \tag{9}
\end{aligned}$$

Δ is denotes difference operator; and $p \geq 1, q \geq 0$ are selected lag operators for differenced dependent variable and for all series identified as independent variables respectively. while $LnRGDP_t$ denotes natural log real GDP, proxy of economic growth; $LnGFCF_t$ is an natural log for Gross Fixed Capital Formation, an equivalent of domestic investment; $LnTLF_t$ represents natural log of Total labour force: [$LTOB_t, LTEA_t, and LSUG_t$] denotes log values of Tobacco, Tea and Sugar exports respectively; $LEXR_{\varepsilon_t}$ denotes log value of exchange rate, ε_t ($n \times 1$) vector of innovations. The parameters of the ARDL model (long-run relationship) model were used to determine their impact on the dependent variable.

The ARDL Bounds Procedure provides fewer challenges in determining the series' short- and long-run variability. Under the null hypothesis of no cointegration, the ARDL Bounds Cointegration is founded on a combined F-statistic and t-statistic whose asymptotic distribution is atypical. The ARDL Bounds Test is procedurally conducted to estimate equation (9) using (OLS) to examine the presence of long-run interactions amidst the series by applying an F-test for the combined significance of the parameters of the lagged levels of the series. The F-statistic is estimated on combined H_0 : that the parameters of lagged series are zero. From the equation (9),

parameters (β_7 to β_{13}) correlate to long run, dynamic while (β_{1i} to β_{7i}) characterizes short-run dynamic. The H_0 of no cointegration and the H_A of cointegration are presented subsequently:

$H_0: \beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = \beta_{13} = 0$, there is no cointegration

$H_A: \beta_7 \neq \beta_8 \neq \beta_9 \neq \beta_{10} \neq \beta_{11} \neq \beta_{12} \neq \beta_{13} \neq 0$, cointegration

Narayan (2005) identified two critical values for examining sample observations ranging from 30 to 80 for a particular significance level. The F-statistics are computed in two levels, though, assuming that all series in the ARDL procedure are integrated I(0) as a lower critical bound, implying no cointegration. In contrast, the other level assumes that series are integrated of I(1) being the upper critical bound, suggesting cointegration amongst the underlying series. According to the bounds test output, the no cointegration test decision is not accepted if F-statistic surpasses the upper bounds critical value I(1), and it is not rejected if the F-statistic is lower than the lower bounds value I(0). In the joint application of both F-statistic and t-statistic, we do not accept the H_0^F or H_0^t , correspondingly, when the calculated statistic is larger than the upper bound critical values. According to Narayan and Smyth (2008), short-run estimates are generated by approximating ECM related to the long-run parameters; the ARDL equation of no cointegration is not accepted and is determined with an error-correction term.

3.7.2.3 ARDL-Error Correction Model (ECM)

ECM was deployed when the cointegration of the series understudy existed by applying residuals from the cointegration model. The ECM was employed to generate the short-run parameters linked to the ARDL long-run estimation. While a

long-run equilibrium is an association among series which are integrated in order of one, a short-run dynamic is a relationship between series that are integrated in order of one; hence the notion of cointegration and error correction model is meticulously intertwined (Asteriou, 2007). ECM is viewed as an appropriate reparameterization of the autoregressive distributed lag (ARDL) model, and a typical ECM is stated as:

$$\Delta LR GDP_t = \alpha_0 + \beta_0 \Delta LR GDP_{t-1} + \beta_1 \Delta LG FCF_t + \beta_2 \Delta LTLF_t + \beta_3 \Delta LTOB_t + \beta_4 \beta \delta \Delta L TEA_t + \beta_5 \Delta LSUG_{5t-i} + \beta_6 \Delta LEXR_{6t-i} + \pi ECM_{t-1} + \mu_t \quad (10)$$

Whereas Δ is the first difference estimator; π represents error correction coefficient or feedback effect, adjustment effect, speed of adjustment or equilibrium error; and μ_t is white noise. $\beta_0 - \beta_6$ represents the short-run effect estimating the short run impact of variations in regressors (series) lead variations in $RGDP_t$. ECM_{t-1} (Error Correction Term) is estimated out of residuals mined from the long-run equilibrium estimates (Gujarati, 2004). The ECM provides an opportunity of incorporating both long and short-run dynamics. Thus, the ECM method examines the speed of adjustment by which explanatory series yields to equilibrium induced by variations in other series (Maddala, 1992). The error correction coefficients indicate how quickly the cointegrating equation adjusts its preceding period's disequilibrium; instead, they demonstrate the extent to which disequilibrium is being adjusted. An $(-\pi)$ error correction coefficient, with statistical significance, suggests that any short-run drift between the response and explanatory series shall return to the state of equilibrium in the long-run, as it captures how strongly the regressand series responds to drift from the equilibrium dynamic in a single period (Shahbaz et al., 2013). This is how distortions are equilibrated. Moreover, the higher the (π) error correction coefficient,

the more significant the speed of adjustment of the dynamic equation from short to long-run.

3.7.2.4 Models residual diagnostics

To rule out a situation of model misspecification of the determined models, residuals were tested for autocorrelation, heteroscedasticity, normality, and stability. For the Serial correlation, the Breusch-Godfrey LM test was deployed; Breusch-Pagan and White test was used to assess heteroscedasticity, while the Jarque-Bera test was applied to examine normality. The Jarque-Bera test examines that the residuals are normally distributed. ARDL procedure stability was validated by conducting the Cumulative Sum of Recursive Residuals (CUSUM) proposed by Brown et al. (1975). After cointegration and diagnostic test for residuals for autocorrelation and normality, the likelihood estimation was applied to fit the ultimate model, which was further applied in testing the Granger causation.

3.7.3 Objective Three: Determination of Granger causality and direction

Under objective three, the goal was to determine whether values of exportable commodities (Sugar, Tea, and Tobacco) granger cause Real GDP or vice versa. The causality concept is not causation, but it implies that changes in one series (X) explain better changes in another series (Y) (Siaw et al., 2018). Implicitly it can be suggested that X Granger-causes Y; supposing Y cannot be described by the Y lags. Supposing Y, yet X series and its lags shall effectively forecast the conduct of series Y. The goal is to examine if the series' lags could be incorporated into an alternate equation model.

The Granger causality procedure adopted exploited the work done by Toda and Yamamoto (1995), which leverages a technique anchored on augmented VAR

estimation, in which a modified Wald test is introduced to avert inadequacies of specification bias and spurious output encountered by Granger causality introduced by Granger (1969). Technically Toda & Yamamoto (1995) based granger causality technique applies an augmented structured VAR of k (lag-length) with d_{max} (maximum order of integration) that forms asymptotic VAR statistic by means of χ^2 distribution. When the VAR of $[p + d_{max}]^{th}$ order is operationalised, the parameters of the lagged $[d_{max}]$ vectors are disregarded. The original granger causality assumed two series (Y & X) to be cointegrated if their linear grouping is stationary, though this not always the case in most circumstances. Furthermore, the usual causality inference may be unsatisfactory if such series are not stationary yet co-integrated, Engel and Granger (1987). To address this challenge, Toda and Yamamoto (1995) demonstrated that though set of series signals different order of integration, their typical asymptotic theory would not be invalid, as long as integration order could not surpass the lag-length of the VAR (k) equation.

Several stages are schematically implemented to operationalise Toda-Yamamoto Granger Causality. Primarily, each series were subjected to ADF and PP tests to establish maximum order of integration. Secondly, the process involved determination of optimal lag-length by estimating the VAR in levels by means of the Akaike Information Criteria (AIC). The modified Wald technique is used to analyse the VAR (k) model for causality and its likely direction in the final step. The optimal lag length is equivalent to $k = (p + d_{max})$. Accordingly, a multivariate VAR model could be estimated regardless of either the series levels or the outcome of cointegration, and Granger non-causality tests could be experimented. Below the Toda-Yamamoto based

Granger causality is presented, the bivariate VAR model demonstrating relationship between RGDP and Exportable Crop Commodities.

$$Y_t = \alpha_1 + \sum_{i=1}^{k+d} \beta_{1i} Y_{t-i} + \sum_{j=1}^{k+d} \gamma_{1j} X_{t-j} + \xi_{1t} \quad (11)$$

$$X_t = \alpha_2 + \sum_{i=1}^{k+d} \beta_{2i} X_{t-i} + \sum_{j=1}^{k+d} \gamma_{2j} Y_{t-j} + \xi_{2t} \quad (11a)$$

Where d denotes maximum order of integration of the series (Y and X) in the VAR model, k represents lag length, d denotes order of integration, ξ_{1t} and ξ_{2t} , are white noise with zero mean, homoscedastic and are not serially correlated. From the equation 11, the null hypothesis of ‘no Granger causality’ is conducted with F-test, and is presented as follows: H_0 : ‘ X_t does not Granger cause Y_t ’ if $\gamma_{1j} = 0$, counter to the H_A : ‘ X_t does Granger causes Y_t ’ if $\gamma_{1j} \neq 0$ for each j . Likewise, in equation 11, H_0 ‘ Y_t does not Granger cause X_t ’ if $\gamma_{2i} = 0$ against the H_A : ‘ Y_t does Granger causes X_t ’ if $\gamma_{2i} \neq 0$ for each j .

Under this objective, the study sought to examine if Tobacco, Tea, and Sugar exports Granger-causes GDP or contrariwise. To undertake Yoda-Yamamoto approach of Granger non- causality, we empirically computed the system of equations of Structural VAR presented below.

$$RGDP_t = \alpha_1 + \sum_{i=1}^{k+d} \beta_{1i} RGDP_{t-1} + \sum_{j=1}^{k+d} \gamma_{1j} TOB_{t-i} + \xi_{1t} \quad (12)$$

$$TOB_t = \alpha_2 + \sum_{i=1}^{k+d} \beta_{2i} TOB_{t-1} + \sum_{j=1}^{k+d} \gamma_{2j} GDP_{t-i} + \xi_{2t} \quad (13)$$

$$RGDP_t = \alpha_1 + \sum_{i=1}^{k+d} \beta_{1i} RGDP_{t-1} + \sum_{j=1}^{k+d} \gamma_{1j} TEA_{t-i} + \xi_{1t} \quad (14)$$

$$TEA_t = \alpha_2 + \sum_{i=1}^{k+d} \beta_{2i} TEA_{t-1} + \sum_{j=1}^{k+d} \gamma_{2j} GDP_{t-i} + \xi_{2t} \quad (15)$$

$$RGDP_t = \alpha_1 + \sum_{i=1}^{k+d} \beta_{1i} RGDP_{t-1} + \sum_{j=1}^{k+d} \gamma_{1j} SUG_{t-i} + \varepsilon_{it} \quad (16)$$

$$SUG_t = \alpha_2 + \sum_{i=1}^{k+d} \beta_{2i} SUG_{t-1} + \sum_{j=1}^{k+d} \gamma_{2j} GDP_{t-i} + \varepsilon_{2t} \quad (17)$$

Causality between real GDP and individual crop exports was determined by rejecting the aforementioned H_0 , which required obtaining a statistically significant MWALD statistic for the aforementioned lagged explanatory series. According to the Granger causality theory, the existence of a co-integration vector would prove that there must be at least one direction of Granger causation.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter discusses study findings on the trends and impact of Tobacco, Tea, and Sugar exports on Malawian GDP over the (1969-2019) span. There are three sections in this chapter. The first section discusses trends in (Real GDP, Tobacco, Tea, and Sugar) and bivariate cross-correlations between each crop export and Real GDP. The second section provides a transient analysis of the variables before the comprehensive econometric analysis for subsequent objectives. The last section covers the results of the econometric analysis ranging from Stationarity, Cointegration, and the Granger-causality tests to the estimation of the dynamic causal impact of (Tobacco, Tea, and Sugar) exports on Malawi's GDP.

4.2 Descriptive analysis of the time series data

Table 4.1 reports a summarized statistical assessment of the macroeconomic indicators involving Real GDP, (GFCF), Total Labour Force (TLF), Tobacco export value, Tea exports, Sugar exports and exchange rate. The values of Real GDP, GFCF, (Tobacco Tea and Sugar) exports values are captured in Millions of US Dollars (\$'M). The real GDP mean for Malawi over 1969-2019 period was US\$4,260 Million; and the minimum value of the Real GDP in 1969 was US\$1,372.37 Million while US\$ 9,7544.08 Million is the Maximum. This demonstrates that in real terms Malawi's GDP has been increasing steadily since 1969. The average Gross Fixed Capital formation is at US\$428.91 Million while on average the economy has been employing

4.12 million people, thus for Total Labour Force. Table 4.1 further shows that Tobacco has been averaging US\$289.32 million of which the highest

Table 4.1: Descriptive Statistics for Real GDP, (GFCF), Total Labour Force (TLF), Tobacco (Tob), Tea and Sugar (Sug) Exports Values, and Exchange rate (EXC) for Malawi (1969-2019)

Variables	RGDP	GFCF	Tob	Tea	Sug	TLF	EXC
	\$'M	\$'M	\$'M	\$'M	\$'M		
Mean	4,260.00	429.00	289.00	44.80	41.80	4,119,329.00	118.279
Std. Dev.	2,360.00	331.00	206.00	22.50	37.50	1,729,337.00	211.244
Minimum	1,370.00	90.69	19.80	11.40	0.185	1,704,458.00	0.802
Maximum	9,750.00	1,460.00	875.00	121.00	214.00	7,950,418.00	745.541

Source: own computation using data sources from the World Bank, FAOSTAT, and the NSO

Export value of US\$874.90 Million was obtained in 2011. On average Tea and Sugar exports are US\$44.84 and US\$41.78 respectively, though apparently sugar earnings have surged higher than Tea. In all exportable commodities (Tobacco, Tea and Sugar) export values for each crop has been growing over the past five decades. Appendix 4.2 presents a descriptive analysis of naturally log-transformed data with rather large standard deviations, demonstrating that all variables are extremely volatile. This implies that these macroeconomic aggregates are susceptible to business cycle fluctuations brought on by either domestic or external shocks.

4.3 Determination of cyclical correlations associated with Tobacco, Tea, and Sugar export value series associated with Real GDP series from 1969 to 2019

Figure 4.1 illustrates that the four macroeconomic indicators have been trending upwards with persistent fluctuations around the (HP) trend: implying that the series might be nonstationary. The graphs, in particular, reveal that the natural log values of Malawi's GDP in real US dollars

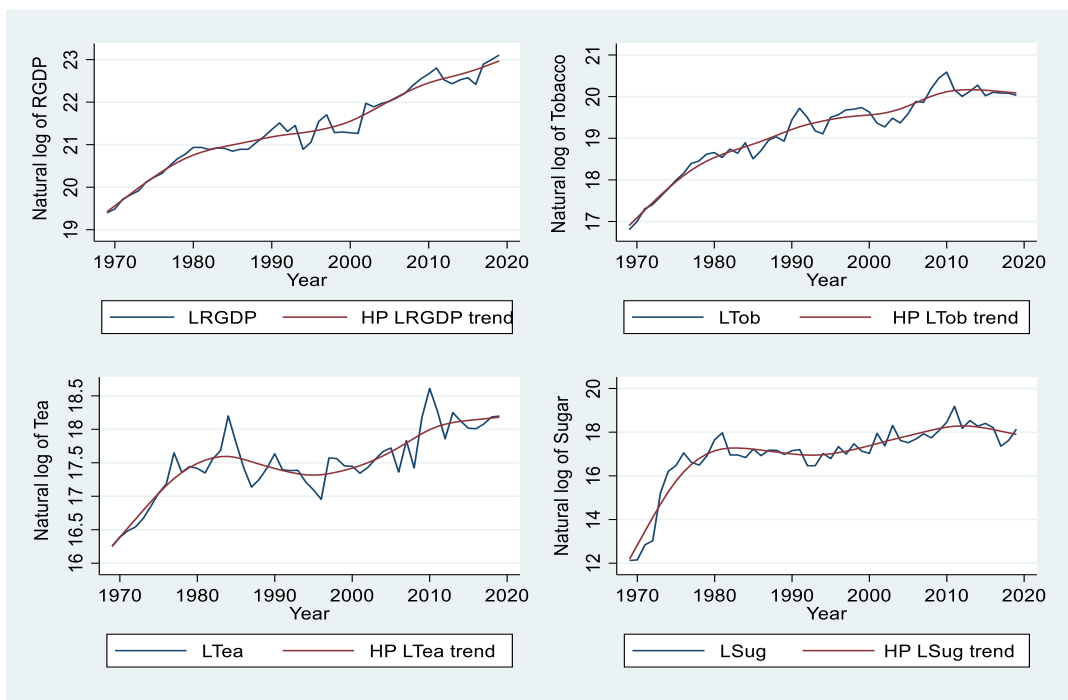


Figure 4.1: Trends in logs of Tobacco, Tea, Sugar export values and Real GDP in Malawi

Source: own computation using data sources

appeared to be trending higher, albeit strongly at first, then mildly since 1980 with some significant fluctuations. Figure 4.1 additionally illustrates the lengthy streaks of growth and decline that characterize Malawi business cycles. Specifically, both Tobacco and Tea Exports appear to be up trending and fluctuations around the trend greater beyond 1980s. The Tea export trend has been rising rapidly, and slowed down

beyond 1980 though with significant fluctuations observed from 1982 to 2019. The fluctuations in Tea export earnings have been attributed primarily to international market price volatility and the unpredictability of Tea production. With respect to sugar, the trend increased rapidly from 1969 to 1980 and then plateaued off, though it peaked in 2011 with the highest export earnings of US\$214 million (ln19.2), representing a 106.47 percent increase from the previous year's earnings of US\$104 million (ln18.5). All the four series displayed a decline in the trend around 1979 to 1980, and this was the time Malawi's terms of trade decreased precipitously in 1978, 1979, and 1980, and exhibited no recovery in 1981. This downturn occurred because of the 1979 global oil crisis recession.

4.3.1 Cyclical component of Logs of Real GDP, Tobacco, Tea, and Sugar

Figure 4.1 depicts the cyclical behaviour of Real GDP, Tobacco, Tea and Sugar Exports for

Figure 4.2: Cyclical component of Logs of Real GDP, Tobacco, Tea, and Sugar

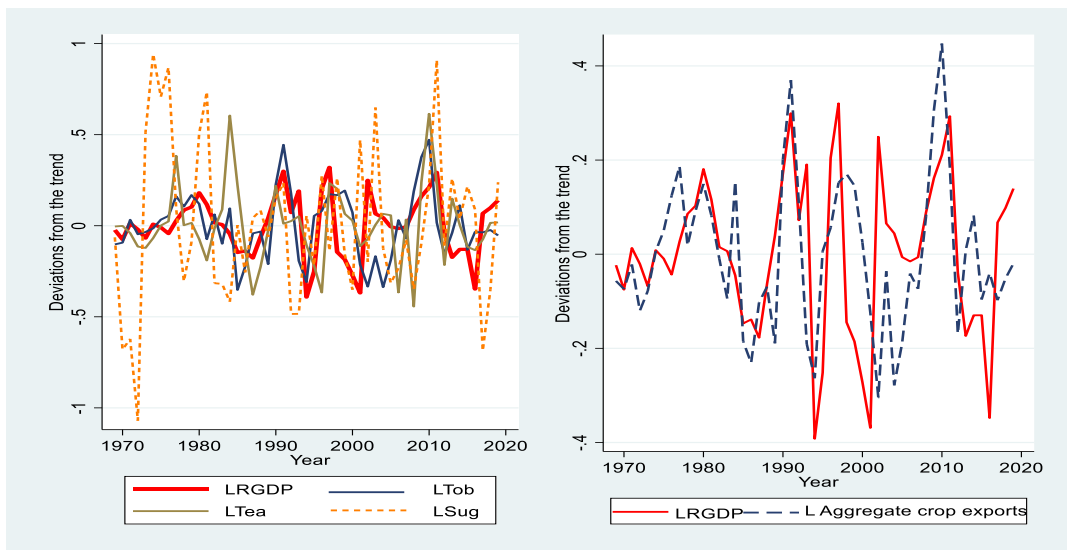


Figure 4.2A Cyclical component for the 4 series for
RGDP and Log of aggregate crop exports
Source: own computation using data sources

Figure 4.2B Cyclical component

Malawi. This aims to explain co-movement of macroeconomic variables in relation to long-
with big jumps and drops in the Tobacco exports, Tea exports and sugar exports up to an average of 40% above or below trend. Male (2010) corroborates the evidence of persistent fluctuations and irregularities in developing nations' macroeconomics, particularly those whose major earnings come from exporting raw commodities. Such commodities are typically characterized by significant price volatility, making both planning and macroeconomic management problematic. Figure 4.2A shows that crop exports variables displayed a clear cyclical pattern with high persistent fluctuations against Real GDP. The pattern is not complete lockstep rather synchronized. Figure 4.2B displays a comparative visualization of our cyclical components for natural logs of Real GDP and the aggregate crop exports values. The deviations from the trend are moderately persistent and tend to move towards a particular fashion that is closely synchronized with each other. This can be interpreted as a procyclical co-movement, which indicates that aggregated crop exports co-moves with the real GDP: and hardly surprising given that agricultural exports account for a significant portion of Malawi's total exports.

4.3.3 Cross-correlations between agricultural crop exports with Real GDP

To further analyze the extent of cyclicity, Table 4.1 reports contemporaneous correlation and inter-temporal cross-correlations for all the export series with the real GDP captured across 8

Table 4.2: Cross – correlation Functions (CCF): RGDP; Tobacco, Tea and Sugar Exports and Aggregate Export Value

<i>Lag_j</i>	-8	-4	-3	-2	-1	0	1	2	3	4	8
L Tob	-0.01	-0.06	0.03	0.10	0.23	0.36	0.34	0.02	-0.26	-0.29	-0.27
L Tea	0.17	-0.15	-0.05	0.22	0.33	0.23	-0.04	-0.26	-0.33	-0.10	0.14
L Sugar	0.03	-0.04	-0.13	-0.04	0.17	0.06	0.12	0.00	-0.05	-0.04	0.13
L Exports	0.00	-0.06	0.00	0.12	0.32	0.39	0.32	-0.06	-0.34	-0.32	-0.15

Source: own computation using data sources

(lead-lag) time range. A strong contemporaneous correlation (0.36) is registered between log of Tobacco export values and log Real GDP series implying a procyclical correlation between the two series. This indicates that demand for and prices of tobacco exports tend to rise during economic booms and fall during recessions. This phenomenon arises when the exports of tobacco, rather than serving as a stabilizing factor, amplify periods of economic rapid growth and decline, making Malawi's economy more vulnerable to shocks emanating from tobacco markets. The Correlogram with extended lags was captured in appendix 1. At lags (+3, +4, and 8), Table 4.1 displays significant negative correlations, implying real GDP tends to lead Tobacco export values three, four, or eight years later. Likewise, Table 4.1 does depict a positive correlation coefficient (0.23) between the rGDP and Tobacco series at lag 1. This shows that a rise in Tobacco export values in one year is fairly correlated with a rise in rGDP in the subsequent year. The contrary is true, as evidenced by the presence of a significant correlation at lag +1.

The contemporaneous correlation coefficient (0.23) of the Natural log of Tea signals a moderately strong procyclical relationship with real GDP: A phenomena that is characterized by agricultural commodities being exported unprocessed, which are likely to leave the economy vulnerable to external shocks. The significant correlation

at lags (-2 and -1) implied that lower Tea Exports tend to lead to Real GDP two and one year later, while significant negative correlations at lag +2 and +3, suggests that higher rGDP precedes lower Tea exports two and three years later. The majority of the correlations for tea exports were negative, revealing an inverse association between Tea exports gaps and real GDP growth.

The contemporaneous correlation between Sugar export values and Real GDP is characterized as acyclical. Sugar exports are acyclical, meaning their price changes are not robustly correlated with the economic cycles of expansion and contraction. Sugar exports in Malawi have demonstrated a tendency to sustain consistent demand; exhibit minimal correlation with GDP and have low sensitivity to economic cycles. From an investment standpoint, sugar commodities can serve as a means to mitigate the impact of economic downturns. Their inherent consistency in demand and pricing renders them a highly desirable asset in a diversified portfolio, particularly in economic uncertainty (Schaeffer, 2021). However, strong cross-correlations values greater than 0.35 are observed from lag +15 (appendix 1), which could be the co-movement implication in the long run. Overall, the contemporaneous correlation coefficient between aggregate crop exports and Real GDP is strongly procyclical: and it is clear that the agricultural crop exports and Real GDP co-moves in Malawi. Ji et al., (2019) studies support that exports are procyclical in developing markets; however, though aggregate exports are procyclical, there is a tendency for trade balances to be positive during expansions and minus during recessions. In developed nations trade balances are mildly countercyclical or even acyclical, while in emerging economies are significantly countercyclical, Engel and Wang (2011). However, at lag -1, a positive correlation (0.32) is seen, indicating that a rise in the total value of the

aggregated crop exports in a typical year is relatively correlated with an expansion in real GDP in the subsequent year. The significant negative cross-correlation (-0.34 and -0.32) at lags 3 and 4 implied that higher-than-average Real GDP leads to lower-than-average aggregate crop (Tobacco, Tea, and Sugar) export values three to four years later.

4.4 Time series econometrics analysis

4.4.1 Stationarity test

Accordingly, the study carried out both the ADF and PP tests to determine each series' stationarity. Table 4.3 shows that ADF and PP were not stationary at levels, with the exception

Table 4.3: Stationary test results

Variables	Level		First Difference	
	ADF	PP	ADF	PP
LnRGDP	-3.290	-3.296	-5.719***	-7.915***
LnGFCF	-2.631	-2.675	-4.779***	-7.199***
LnTLF	-2.045	-1.596	-4.702***	-4.863***
LnTOB	-2.730	-2.599	-6.782***	-7.584***
LnTea	-3.359	-3.223	-7.796***	-9.433***
LnSUG	-3.342	-3.656**	-7.824***	-7.824***
EXR	0.071	0.723	-4.985***	-4.943***

The H_0 : non-stationarity is rejected at ***, **, significant at 1% and 5% respectively
(MacKinnon) p-values corresponding to (ADF) and (PP): 1%=-4.152, 5%=-3.502, and 10%=-3.181

Source: study data (2022)

of the PP test for the log of sugar export series, which demonstrated stationary properties at the 5% significant level. The fact that the ADF and PP report different results for the same series may indicate that the series does not match the assumptions behind both tests, which is a no structural break. If the series has a structural break, the ADF erroneously reports it as non-stationary. This inconsistency was further investigated by subjecting the regression equation to the Quandt-Andrews unknown breakpoints test. However, after the first differencing, all series reached stationarity at the 1% significance level.

4.4.2 Quandt-Andrews unknown breakpoint test

ADF and PP tests produced inconsistent results for sugar export series at their levels, possibly due to structural breaks in the data generating process. Accordingly, all series were subjected to Quandt-Andrews Breakpoint Test (Appendix 5). The Quandt-Andrews Test is an adapted version of the Chow test computed to identify dominant endogenous structural breaks in the sample for an estimated equation. The approach can technically determine the time (year) of

Table 4.4: Result of Quandt–Andrews unknown breakpoint test.

Statistic	Value	Prob
Maximum LR F-statistic (2002)	6.253184	0.0000
Maximum Wald F-statsic (2002)	37.51910	0.0000

Null Hypothes: No Breakpoints within 15% Trimmed Data

Note: probabilities are calculated using Hansen’s (1997) method

Source: Study data (2019)

The break and also enhances analysis if the structural break on a series is linked to a significant or disruptive event. The test validates the null supposition that no break exists in less than 15% of the trimmed data. According to Andrews (1993), the maximum, average, and exponential test statistics are utilized in the test, and when the test statistics are large, the null hypothesis of no break is rejected. Additionally, Hansen (1997) developed a technique to generate estimated asymptotic p-values for the statistic. Table 4.4 shows the Quandt-Andrews unknown breakpoint test's probability value below 0.05. As a result, we established that there was a breakpoint in the series of the estimated equation. The Structural Break Point (SBP) was registered in 2002, when the GDP had declined because donors had withheld aid to Malawi's government in response to her efforts to circumvent presidential term restrictions. After the timing of the significant structural break is determined endogenously, the structural break is introduced in the ARDL model as a structural dummy variable. (DY2002), a dummy variable was factored into the ARDL model, with a value of 0 for years until 2001 and 1 after that.

4.4.3 ARDL Cointegration Test

The estimation of the ARDL model was preceded by determining the optimal lag length among the variables guided by the iterative operationalization (AIC) and SC information criterion. Despite ambiguities in the information criteria outputs, AIC was selected above SIC as it offered the lowest value between the two Information criteria. Theory guided the choice of AIC, which performed efficiently under parsimonious conditions given the study's modest sample size, Pesaran and Smith (1998). The optimal lag lengths for all the series are presented in (Appendix 4) as ARDL (1 2 0 3 0 2 1 3). Table 4.5 reports the evidence of cointegration between real GDP and all

other regressors for the ARDL model as specified in the methodology. To validate cointegration, the study applied F-statistics suggested

Table 4.5: ARDL bounds test results for cointegration.

Test Statistic	Significance level	Lower bound I(0)	Upper bound I(1)	Conclusion
(F-statistic) 7.2853	10%	2.03	3.13	Evidence of cointegration
	5%	2.32	3.5	
	1%	3.498	4.26	

Source: study data (2022)

By Pesaran et al. (2001); accordingly, the null supposition of no cointegration is rejected since the F-statistic of (7.285) is found to be significantly greater than the upper bound values of (4.26), at 1% alpha. As a result, real GDP and the other regressors exhibit a cointegration relationship in the circumstance of a structural break, indicating that the variables have a long-run cointegrating relationship.

4.5 Results of estimated long-run impact of exportable crop commodities

(Tobacco, Sugar, and Tea) on economic growth in Malawi

After validating the existence of cointegration among the series, the ARDL model was estimated. Table 4.6 exhibits the long-run parameters computed, and the findings demonstrate that four out of the six regressors' parameters were statistically significant. The coefficients of

Table 4.6: Estimated ARDL long run coefficients.

Dependent Variable: LRGDP				
Variables	Coefficient	Standard	T-Statistic	Probability
Error				
LGFCF	0.250863	0.088537	2.833437	0.0084***
LTLF	0.934555	0.364042	2.567163	0.0159***
LTob	0.043085	0.182735	0.235779	0.8251
LTea	-0.008362	0.084014	-0.099535	0.8930
LSug	0.193320	0.050133	3.856141	0.0006***
EXC	0.000663	0.000232	2.851762	0.0081***
DY2002	0.257529	0.119949	2.147000	0.0406**
Const.	-1.584345	0.189379	-8.36596	0.0000***

***significant at 1%, **significant at 5%; Adj. R squared=0.77 DW statistics

=2.3578:

Source: Data source (2022)

Log of total labour formation (LTLF), log of gross factor capital formation (LGFCF), log of sugar exports (LSug), exchange rate (EXC), and dummy (DY2002) were significant at the 1 percent alpha. In contrast, coefficients of the log of tobacco (LTob) and the log of tea (LTea) were not. The adjusted R square is significantly high (about 77 percent), suggesting that the independent variables explained around 77% of the variations in the dependent variable. The dependent variable Real GDP has a significant causality relationship with the four independent variables LTLF, LGFCF, LSug, and EXC. As a result, if any of the regressors increase, the response variable will also increase reciprocally.

4.5.1 Tobacco exports' impact on economic growth

According to Table 4.6, the tobacco export coefficient (LTob) was positive but had no significant long-run effect on Malawi's economic growth. However paradoxical considering the economy's historical reliance on tobacco, Bokosi's (2015) study revealed no evidence of a long-run relationship between export products and GDP, even though Tobacco constituted a larger proportion of the exported commodities. This could be attributed to a global decline in tobacco demand, which has resulted in a drop in Tobacco export prices, impairing aggregate economy, and export earnings in particular. Moreover, in the past 50 years agricultural commodities, factoring in inflation, have steadily fallen over time reflecting rise in productivity and the low income of elasticity of demand (Nigatu et al., 2020). Consequentially, over the past 20 years, the proportion of crop farmers who grow tobacco has declined dramatically, from 16% to 5%, as has the proportion of Tobacco in the total value of crops produced (Appau et al., 2020) reflecting a fundamental shift away from tobacco is taking place. The price decline is exacerbated by global anti-smoking efforts to reduce demand for tobacco products and address supply issues (Lencucha et al., 2017), as well as the actions of business cartels that collude to keep auction prices low. Tobacco's low earnings due to depressed and volatile global prices may also imply that the sector's contribution to economic growth is presumptively overstated, given the economy's long history of trade deficits combined with persistent spending procyclicality, which forces the government into debt crises.

4.5.2 Tea exports impact on Malawi's economic growth

Table 4.6 indicates an insignificant long-run negative relationship between tea exports and economic growth in Malawi, suggesting that increased tea exports have no effect on Malawian economic growth. The inverse relationship is due to a general decrease in the real price of tea over the past decade (FAO, 2018). The gradual decline in tea prices could be attributed to oligopsonistic tendencies in which producers have severely limited bargaining leverage with buyers and increased competition from other exporting countries that may have a comparative or competitive advantage in unit cost or unit prices. Furthermore, there has been a shift in demand due to changes in preferences and taste, accentuating the shift in Tea processing from commoditisation to premiumisation, fetching high prices. In contrast, most Malawi Tea is exported as a commodity, implying that most of the profit remains further down the value chain.

4.5.3 Sugar exports' impact on Malawi's real GDP

The elasticity of Sugar export (LSug) exhibits a positive sign (0.193320) and is significant at a 1% alpha level. This implies that sugar exports positively and significantly impact economic growth of Malawi, suggesting that a 1% rise in Sugar exports translates in 0.19 % gain in Malawi's GDP on average *ceteris paribus*. Thus, sugar is directly linked to economic growth in Malawi. This study's finding is in sync with those of (Pawlak and Kołodziejczak, 2020), who observed that the sugar industry has great potential to generate foreign currency, contribute to GDP, and have a domino effect of positive outcomes like food security, increased employment opportunities, and reduced poverty rates, especially in economically challenged and detached rural regions. Due to fundamental changes in international market dynamics, such as global

demand for ethanol, the emergence of new Asian markets, and supply shocks, global sugar prices have surged dramatically in recent decades, making the performance of sugar exports increasingly significant (Mabeta et al., 2023). The acyclical nature of Sugar commodity can be attributed to their indispensable role in human consumption. Notwithstanding recessions in the economy, the demand for sugar stays robust as individuals persist in their need for sustenance. Furthermore, sugar has a higher product complexity index than tobacco and tea, which are usually marketed in raw form and consequently fetch lower prices. This enabled feasible integration of sugar exports into well-developed global value chains while also exhibiting resilience against external shocks. This observation is also consistent with the findings of Mlambo et al., (2019).

4.5.4 Gross Fixed Capital Formation (LGFCF) Impact on real GDP

The (LGFCF) variable varies directly with economic growth proxied as Real GDP; this implies that GFCF positively and significantly impacts Malawi's real GDP at 1% alpha. Hence in this respect, a 1 % rise in the Gross Fixed Capital Formation (domestic investment) increases Real GDP by about 0.250863 percent in the long run, though less elastic. By establishing a direct GFCF-economic growth relation, the positive sign validates the notion given in the theoretical framework. This suggests Gross Fixed Capital Formation implies the difference between an economy's strong and subpar growth rate. Furthermore, this conclusion suggests that increasing domestic investment in physical assets and resources leads to a stronger economic outlook.

4.5.5 Labour Force (LTLF) Impact on real GDP

Table 4.6 shows a Total Labour Force parameter that is significantly positive at the 1% alpha. Thus, a one percent upsurge in labour force participation enhances growth in the economy by 0.93 % in the long-run. This confirms the theory that labour positively impacts economic growth. Siaw et al. (2018) study work on the causal impact of disaggregated agricultural exports on economic growth in Ghana supports this position. Chibaya (2018), in her study of the foreign trade impact on Malawi's GDP, confirmed that the labour force positively affected Malawi's economic growth. However, the labour force had a greater effect on GDP, owing to the considerably higher labour intensity of Malawi's economy. Malawi is densely populated, and its labour force is steadily growing as a result of expanding education and training facilities, as well as the provision of better health care; hence, human capital is commonly considered the key source of economic growth.

4.5.6 Impact of Exchange rate (EXC) on economic growth

The exchange rate coefficient was positively significant at 1% alpha in predicting long-run growth. Since GDP and the exchange rate have a log-linear connection, GDP grows by 0.07 for every unit increase in the (US Dollar against Malawi kwacha) exchange rate over time. This empirical outcome aligns with the previously reported findings of (Abdinur et al., 2022); Touitou et al., 2019; David O. 2021; Guechati & Chami et al., 2021, and Yifru 2015). In addition, this finding attests to Malawi's consistent relaxation of exchange rate policy to cushion the shocks of forex shortages, which are significantly exacerbated by a persistently surging import bill and a drop in tobacco export prices. To boost exports and, by extension, forex, and GDP, the Malawian currency is episodically discounted relative to major currencies like the US

dollar. Although devaluation alters the relative prices of imports and exports, encouraging export volumes while decreasing imports, such adjustments do not always benefit the trade balance and could dampen the effect of exchange rate adjustments on export volumes, Gopinath et al. (2020).

4.6 Results of the Error Correction Model (ECM)

Table 4.7 reports the (ECM) results, which was specified to estimate the short run impact of Tobacco, Tea and Sugar exports on Malawi's real GDP. The parameter accounting for the error-correction (ECT_{t-1} measures the pace our model takes to adjust toward a steady state in

Table 4.7: Estimated results of ARDL-ECM short-run coefficients

Dependent Variable LRDP				
Variables	Coefficient	Standard Error	T-Statistic	Probability
D(LGFCF)	0.074113	0.059561	1.638087	0.1126
D(LGFCF(-1))	-0.215915	0.065205	-3.311316	0.006***
D(LTLF)	0.820734	0.334458	1.244321	0.2237
D(LTob)	0.190544	0.081980	2.324274	0.0276**
D(LTob(-1))	0.221616	0.088113	2.506202	0.0186***
D(LTob(-2))	0.318471	0.033701	3.614359	0.0012***
D(LTea)	0.007344	0.073532	-0.099874	0.9212
D(LSug)	0.067978	0.033701	2.017113	0.0534**
D(LSug(-1))	-0.100342	0.034647	-2.896145	0.0073***
D(EXC)	-0.002078	0.000546	-3.803181	0.0007***
D(DY2002)	-0.0061897	0.111055	-0.557354	0.5817
D(DY2002(-1))	0.483021	0.126179	3.828057	0.0007***
ECM ($t-1$)	-0.878208	0.102890	-8.535412	0.0000***

***significant at 1%, **significant at 5%,
 $R^2=0.835274$, $\bar{R}^2=0.778797$; F-statistic =14.78953 (0.0000), DW = 2.400218

Source: data source (2022)

The long-run due to exogenous shocks. To ensure long-run convergence towards equilibrium, the ECT ought to be negative and statistically significant. The ECT_{t-1} , including the regressors' corresponding immediate impact parameters, was estimated using equation 10. The ECT parameter is negative (-0.878208) but also highly significant at 1%, implying that 88% of disequilibria from the preceding period shock converge to the steady state in the next period. The findings also demonstrate that the labour force impacts Malawi's real GDP positively and significantly in the short run. Real GDP is likely to increase by 0.82% if the labour force increases by 1% ceteris paribus, at a statistical significance level of 1%. This observation agrees with the result of Siaw et al. (2018).

At levels, the domestic investment (LGFCF) showed no short-run effect on economic growth; however, the first lag of the LGFCF indicated an inversely significant impact on growth at 1% alpha. This meant that a 1% increase in the first lag of LGFCF resulted in a 0.22% decline in real GDP the following year, all else equal. Contrary to the long-run findings, the exchange rate parameter (EXC) was negatively significant at one percent within the short term: suggesting that if the exchange rate rises by 1%, the Malawi economy will decline by 0.2%. This implies that any appreciation of the Kwacha currency can negatively influence growth. Overall, the consistent short- and long-run findings suggest that the exchange rate could be a growth catalyst.

At 5% alpha, the tobacco export elasticity $D(LTOB)$ was 0.247951, which means that for every 1% increase in tobacco export values, there is a short-run improvement in real GDP growth of roughly 0.25%, everything else being equal. Both first and second lag parameters of Tobacco (LTOB) were all significant at a 1% alpha level. By

extension, a 1% rise in tobacco export values over the previous two years would likely increase Malawi's economic growth by 0.22% and 0.32% over the subsequent two years, respectively. Tobacco being Malawi's principal forex earner, the short-run effects of tobacco exports are particularly accentuated by a short-term increase in forex after farmers sell tobacco between April and June. The subsequent period is punctuated by extended Forex shortages, forcing the government to resort to foreign debt to shore up its foreign exchange reserves to cater to the country's imports bill.

The export parameter for Tea (-.007344) was not statistically significant, and tea export appeared to have no significant effect on Malawi's economic growth in the short run. Both at levels and the first lag of the sugar coefficients were significant at 5% and 1% significant levels, respectively. Though the study's findings suggested that the causal impact involving sugar export and economic growth was positive at levels, it was proven to be inverse at the first lag. All else being equal, the positive link meant that a 1% rise in sugar exports might translate into a 0.7 per cent gain in Malawi's real GDP, implying that increasing sugar exports have the potential to stimulate short-term economic growth in Malawi. The present discovery aligns with the findings of Ndzinisa et al. (2019), which indicate that sugar exports have a substantial effect on GDP in the short run.

4.7 Postestimation diagnostic tests for the ARDL model

Table 4.8 below displays various diagnostic statistics following the estimation of the ARDL-ECM model, which included the autocorrelation, heteroskedasticity, and stability tests.

Table 4.8: Diagnostic Test Results

Statistical-Test	F	Probability
Breusch-Godfrey for autocorrelation LM test	1.280256	0.1163
Heteroskedasticity Test: Breusch-Pagan-Godfrey	1.439487	0.2072
Jarque-Bera (Histogram Normality Test)	7.245089	0.026715

Source: data source (2022)

Summarized statistics in Table 4.8 reveal that the H_0 of no autocorrelation and Heteroscedasticity cannot be rejected. Breusch Godfrey LM test illustrates F-statistics (2.139) at probability values (0.1163>5%), denoted that residuals are serially uncorrelated. Similarly, the presence of homoscedasticity could not be rejected as Breusch-Pagan-Godfrey F-statistics (1.4624) and probability value (0.2072>5%) show the absence of heteroskedasticity. From the normality test results in Appendix (4.5), the Jacque-Bera Test was employed, and the probability value obtained was (0.026715<0.5): hence the series faces normality issues; however, this is not a challenge as the basic asymptotic framework for stationary series does not require the assumption of normality to hold.

4.7.1 Stability tests

The robustness of the ECM and ARDL models and the structural stability of their parameters were assessed by applying the (CUSUM) and (CUSUMSQ) techniques.

CUSUM and

Figure 4.3: CUSUM and CUSUMSQ charts

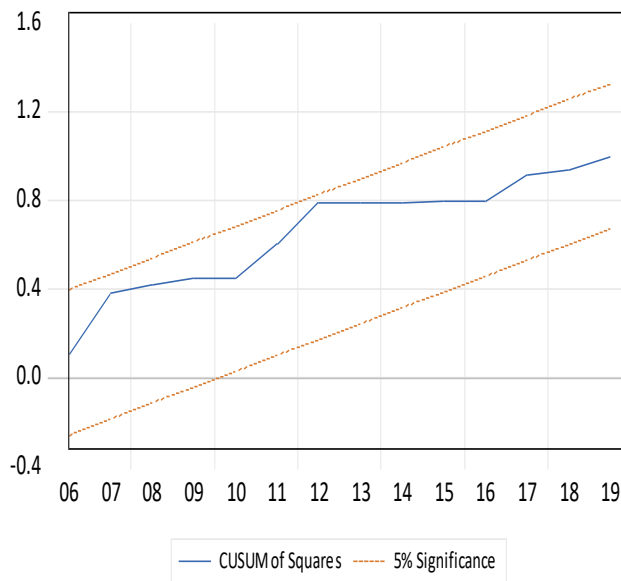
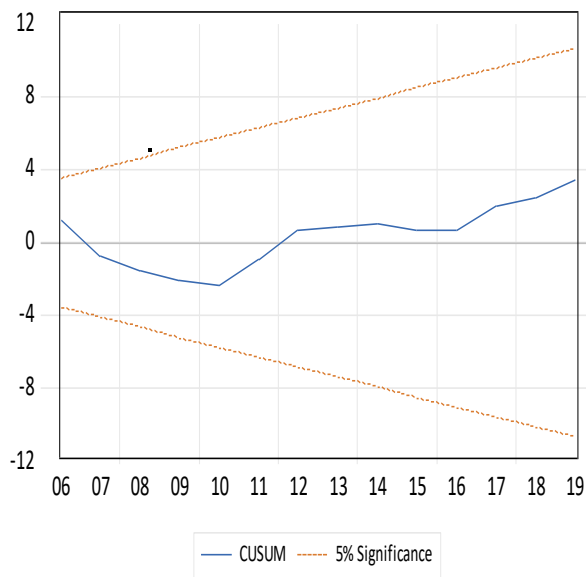


Figure 4.: 2A CUSUM Test

Figure 4.2B: CUSUMSQ Test

CUSUMSQ are schematically presented in Figures 4.2A and 4.2B, where the H_0 could not be accepted 5% alpha levels should the plots remain inside the 5% critical bound, implying the model coefficients were robustly stable.

4.8 Granger causality between economic growth and agricultural exports

The cointegration of Real GDP and agricultural crop exports suggests that there may be long-run causality in more than a single direction: from agricultural crop exports to Real GDP or contrariwise. The Toda-Yamamoto-based Granger non-causality Test was employed to

Table 4.9: Toda Yamamoto Granger Non-Causality Test: 1969 -2019

H_0	F-statistics	P-values	Granger Causality
L _{Tob} does not Granger cause LR _{GDP}	3.28	0.5123	No causality
LR _{GDP} does not Granger cause L _{Tob}	9.70	0.0458**	Unidirectional
L _{Tea} does not Granger cause LR _{GDP}	3.72	0.4451	No causality
LR _{GDP} does not Granger cause L _{Tea}	1.96	0.7423	No causality
L _{Sug} does not Granger cause LR _{GDP}	24.02	0.0000***	causality
LR _{GDP} does not Granger cause L _{Sug}	23.84	0.0001***	causality

Note: Rejection of the H_0 is indicated by ***, **at 1%, and 5% significance level.

source: data source (2022)

Establish the direction of causation. Table 4.9 summarizes the findings of Toda and Yamamoto's (1995) technique computed using the MWALD test, whose estimates reveal outcomes consistent with the χ^2 distribution with four df according to the appropriate lag length and probability. The Granger non-causality test results for the export commodity variables and Real-GDP are consistent with the long-run impact findings that tobacco and Tea have no causal effect on economic growth; hence, they do not grange cause economic growth.

However, given the probability values of ($0.0000 < 0.05$ and $0.0001 < 0.05$), bidirectional causality between Sugar export and Real GDP was confirmed. The

export-led growth (ELG) theory is supported by the implication that rising Sugar exports cause (Real GDP) economic growth and vice versa. This finding supports the notion of a feedback mechanism in which Sugar exports and GDP mutually influence or predict each other. Further, the implication is that the utilization of economies of scale brought about by enhanced productivity increases may lead to an increase in sugar exports; and those larger exports lead to greater earnings (rise in GDP), and a rise in income stimulates sustained sugar trade flow. This outcome is comparable to Yifru's (2015) study, which established a bidirectional causal relationship between Ethiopian GDP and exports of coffee and oilseeds. Siaw et al., (2018) also established bidirectional causality between Cocoa export and economic growth. The bidirectional causality relationship between exports and growth entails that both real GDP and sugar exports assist and benefit each other in the process of economic development.

Tea exports, on the other hand, offered no evidence of causality; however, given that the (H_0) of Granger non-causality was rejected at ($0.0458 < 0.05$), a one-way reverse causation from Real GDP to Tobacco was confirmed, implying that real GDP Granger causes Tobacco exports. This conclusion aligns with the findings by Chhikara and Pasricha (2021), who demonstrated unidirectional causation from GDP to agricultural exports. This shows that there is no feedback link between tobacco and real GDP, and that income from other sources supports tobacco production: this could signal ineffective management of Tobacco revenue, in which earnings are not redirected into Tobacco production and trade processes. As a result, inefficiencies may arise, undermining the positive impact of increasing GDP on Tobacco exports while failing to mitigate the adverse implications of a decline in export performance. Appendix (4.9) contains the outcomes of domestic investment (LGFCF), Total Labour Factor

(LTLF), and Exchange Rate (EXC). LGFCF had a bidirectional correlation with Real GDP, but LTLF and Exchange rate had unidirectional causality from the regressors to Real GDP.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the study's results and conclusions, including some proposed policy recommendations and areas for further studies. The proposed policy recommendations generated from the study findings are designed to be easily understood and implemented to improve the performance of the agricultural export sector.

5.2 Summary of Findings and Conclusions

Malawi's trade balance has historically been structurally in deficit due to its commodity dependence on exports, exacerbated by insufficient export diversification, making foreign trade vulnerable to the vagaries of global commodity markets and resulting in chronic foreign exchange shortages. Malawi's external exports are primarily agricultural commodities, and the study was primarily conducted to empirically assess the impact of agricultural export commodities (tobacco, tea, and sugar) on Malawi's economic growth (as measured by Real GDP) based on annual time series data of the (1968- 2017) span. The research's key objectives were to investigate cyclical correlations in the trends of Tobacco, Tea, and Sugar export value series linked to the Real GDP series; to assess the short and long-run impact of exportable crop commodities (Tobacco, Sugar, and Tea) on economic growth in Malawi; and determine the direction of causality between exportable crop commodities (Tobacco, Sugar, and Tea) and economic growth in Malawi.

To explore cyclical correlations in the trends of the Tobacco, Tea, and Sugar export value series related to the Real GDP series, descriptive and trend analysis techniques involving cross-correlation analysis leveraging HP filtering were applied. The findings revealed that the four macroeconomic variables had been trending upward: whereas Tobacco and Tea exhibited significant contemporaneous correlations with real GDP, sugar had a weak correlation. However, aggregate export commodities have experienced significant procyclical fluctuations with real GDP.

This study diverged from prior studies in that it decomposed the export commodities into (Tobacco, Sugar, and Tea), whereas most studies used aggregated agricultural exports. Accordingly, the ARDL and ECM were estimated to evaluate the long as well as short-run impact of agricultural exports on GDP; however, this was preceded by performing the stationary test (ADF and PP tests) and the ARDL Bounds Test to determine cointegration between real GDP and agricultural exports. The Bounds test revealed the presence of cointegration, validating the presence of a long-run association between real GDP and agricultural exports.

The ADRL long-run results revealed that the impact of sugar exports on economic growth was significantly positive; however, there was also a negligible causal effect between (Tobacco and tea exports) and economic growth. As expected, control variables such as GFCF (a proxy for Capital), Total Labour, and the Exchange Rate significantly impacted economic growth. The Error Correction Mechanism, a feedback effect, returns 88%, indicating how much the disequilibrium adjusted in the subsequent forecasting period. The ECM parameters revealed a positive and significant impact for both (tobacco and sugar exports) on economic growth (Real

GDP). However, the study findings registered an insignificant negative impact of Tea on real GD. The relative speed of adjustment could be attributed to the government's importance placed on export growth strategies and incentives for export trade.

The Granger-causality test based on Toda Yamamoto was performed to identify the direction of causation. The findings demonstrated that Granger causality between sugar and economic growth was bidirectional, suggesting a causal relationship that flows across both directions. Further, the study establishes no causality from Tobacco and Tea exports to real GDP; however, a reverse 'one-way' causality from real GDP to Tobacco is reported, implying real GDP tends to lead to Tobacco exports. In a nutshell, the key conclusion of this study is that while both Tobacco and Sugar exports, except for Tea, had an impact on Malawi's GDP in the short run, sugar exports have been especially crucial for long-run economic growth. However, given Malawi's chronic trade deficit and contracted growth, the overall impact of the agricultural exports is negligibly significant, as the economic prognosis is symptomatic of commodity-dependent economies that lack export diversification. These exports' low demand elasticity exacerbates Malawi's situation.

5.3 Policy Implications and Recommendations

According to the study findings, tobacco and tea commodities were found to be procyclical and had no long-run causal impact on Malawian economic growth. Dealing with such export commodities can be challenging, especially for economies that heavily depend on such exports. As a result, the current administration should reduce reliance on these commodities, in particular, tobacco. Instead, the Malawi government should move quickly to undertake export diversification to mitigate the

risks of export commodity procyclicality. Robust export diversification may demand an appreciation of market incentives (growth potential) and government involvement in supplying the industry with the necessary inputs and easing market access. Most importantly, these export diversification initiatives must be bolstered by concrete proof of value chain development and appropriate industrialization strategies. For tea and tobacco manufacturing industries that add value to these commodities, thereby creating more stable revenue streams., instead of exporting raw materials, the Malawi government should support value-addition initiatives in processing and

Among the three export commodities, sugar, which is processed, was found to impact GDP positively both in the short and long run. This shows that manufactured agricultural exports contribute significantly to economic growth. The study recommends that the Malawi government promote and stimulate investment in the processed agricultural commodities sector. There should be more production and expansion in the manufacturing agricultural commodities sector. Processed commodities are usually sold at a much higher price, which may generate more income and forex for farmers and the economy. There should be industries which turn raw agricultural goods into high-value manufactured goods. Further, the Malawi government should encourage the expansion of sugar exports by increasing the hectarage and number of mills to permit more processing.

Given prolonged global price declines, no long-term impact on the GDP, and doggedly mounting pressure to reduce tobacco production through the anti-smoking campaign, Malawi's government should progressively divest away from tobacco by expanding export markets for sugar. However, this policy prescription may need to be

optimally guided by a series of ex-ante simulations to analyze the welfare changes the divestment option would cause.

Furthermore, while the government favours export expansion, it should not abandon import substitution entirely but instead put together a strategy that blends an acceptable degree of import substitution with zestful support for export-oriented growth. This strategy encourages domestic industries while addressing Malawi's unsustainable import bills in the long run. Additionally, the government should consider supporting the expansion of non-agricultural exportable goods and services to complement agricultural exports.

5.4 Suggestions for Further Studies

Regarding subsequent research on the agriculture-led growth hypothesis, there is still a considerable amount of empirical and theoretical exploration to be undertaken.

1. Empirically, future studies should consider assessing the impact of non-agricultural and agricultural exports on GDP. This study will aid in determining which export category is outperforming the others.
2. Future scholars may require a study incorporating these agricultural exports utilizing their economic complexity and technological development indices to determine whether product diversification occurs in sophisticated products reflecting structural change and higher production capacities.
3. To improve the comparability of the assessment regarding the performance of agricultural commodity exports, researchers need to conduct a comparative analysis study on the E-L-G hypothesis, explicitly targeting countries that exhibit economic conditions and production structures akin to those of Malawi.

4. Theoretically, future studies may need to incorporate other control variables such as imports, real effective exchange rate, Consumer Price Index (CPI), and manufactured goods, which would be crucial in providing estimates that are much more robust and closer to reality in scope and scale.

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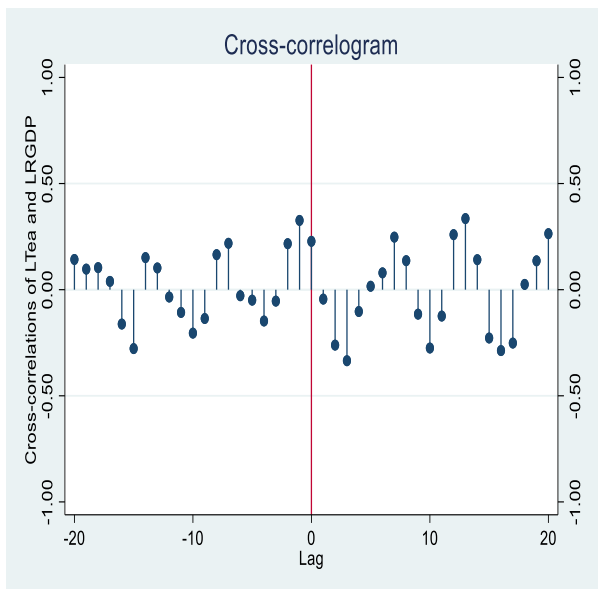
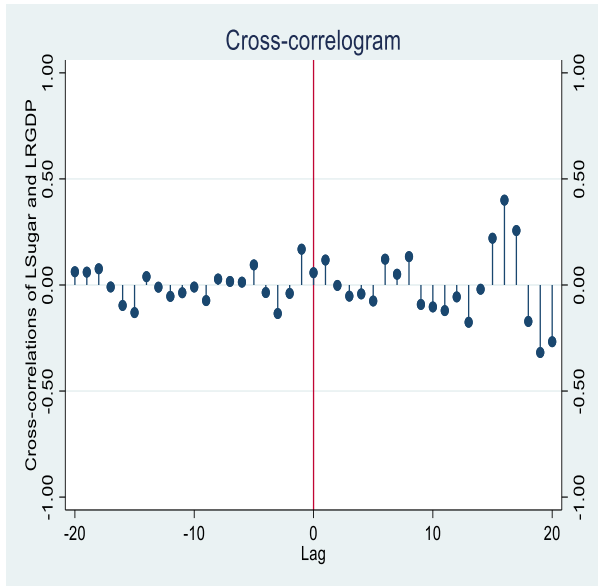
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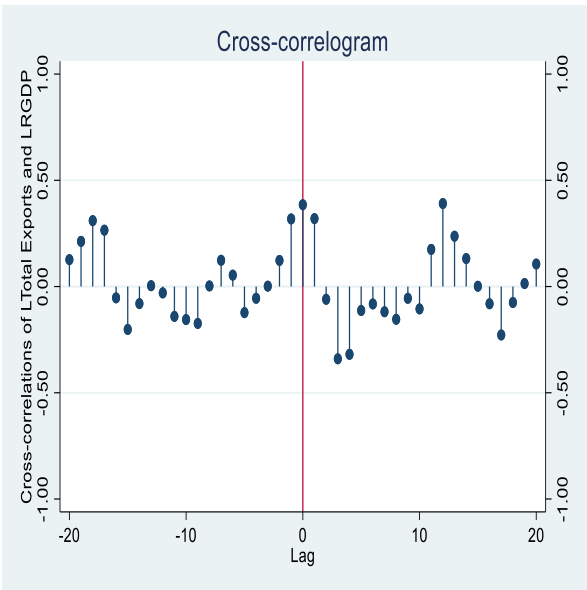
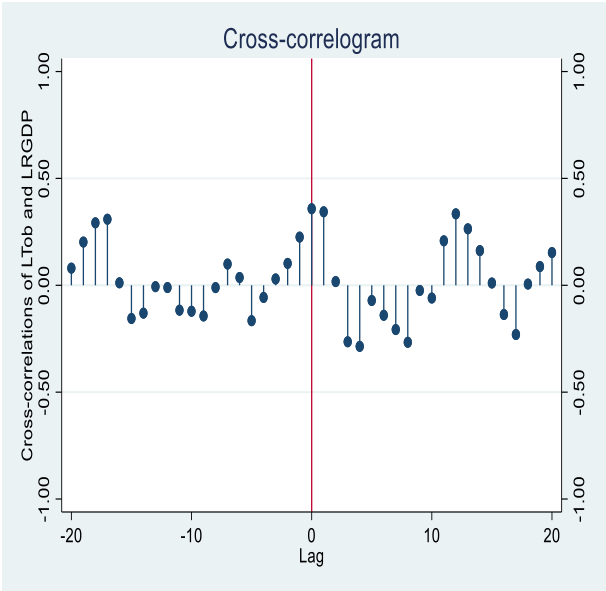
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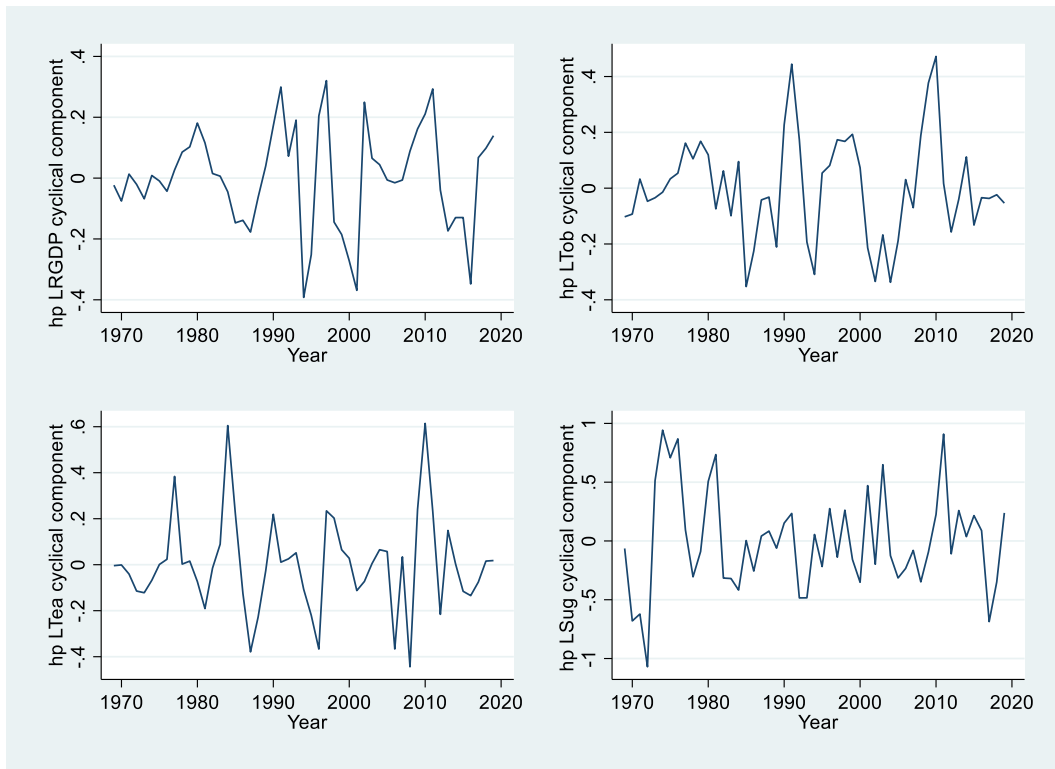
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Appendix 1: Correlogram for cross-correlations of logs of Tobacco, Tea, Sugar, and Total Exports with LRGDP spanning 1969-2019





Appendix 2: Hp filtered cyclic components for LRGDP, LTob, LTea and LSug



Appendix 3: Summary statistics of Log-Transformed Data

Variables	LRGDP	LGFCF	LTLF	LTob	LTea	LSug	EXC
Mean	21.38114	19.6304	15.14082	19.15254	17.49628	16.99187	118.279
Median	21.28322	19.50410	15.20976	19.36837	17.44485	17.17596	8.736405
Std. Dev.	0.9568622	0.691382	0.438281	0.926609	0.512288	1.491947	211.244
Minimum	19.39829	18.32293	14.34876	16.80266	16.25184	12.12811	0.801558
Maximum	23.10859	21.10348	15.88874	20.58962	18.60954	19.18210	745.5407
Skewness	-.0915998	0.3959817	-0.19098	-0.75213	1.058791	2.98319	2.097881
Kurtosis	2.269101	2.256348	2.077404	2.869613	4.120275	10.00843	6.206122
Jarque-Bera	1.206524	2.507977	2.118795	4.844601	0.786635	70.19341	59.25272
Probability	0.547024	0.285364	0.346665	0.088717	0.674814	0.00000	0.00000

Appendix 4: Lag selection Criteria & Quandt-Andrews unknown breakpoint

test

Model Selection Criteria Table

Dependent Variable: LRGDP

Date: 07/08/22 Time: 17:08

Sample: 1969 2019

Included observations: 48

Model	LogL	AIC*	BIC	HQ	Adj. R-sq	Specification
7385	51.295168	-1.303965	-0.524298	-1.009328	0.984031	ARDL(1, 2, 0, 3, 0, 2, 1, 3)
7386	50.265368	-1.302724	-0.562040	-1.022818	0.983905	ARDL(1, 2, 0, 3, 0, 2, 1, 2)
7377	52.632778	-1.276366	-0.418732	-0.952265	0.983734	ARDL(1, 2, 0, 3, 0, 2, 3, 3)
7381	51.548894	-1.272871	-0.454220	-0.963501	0.983613	ARDL(1, 2, 0, 3, 0, 2, 2, 3)
7369	51.486181	-1.270258	-0.451607	-0.960888	0.983570	ARDL(1, 2, 0, 3, 0, 3, 1, 3)
7378	51.481975	-1.270082	-0.451432	-0.960713	0.983567	ARDL(1, 2, 0, 3, 0, 2, 3, 2)
7322	50.462011	-1.269250	-0.489583	-0.974613	0.983466	ARDL(1, 2, 0, 3, 1, 2, 1, 2)
6361	51.447469	-1.268645	-0.449994	-0.959275	0.983544	ARDL(1, 2, 1, 3, 0, 2, 1, 3)
7382	50.439852	-1.268327	-0.488660	-0.973690	0.983451	ARDL(1, 2, 0, 3, 0, 2, 2, 2)
7321	51.387375	-1.266141	-0.447490	-0.956771	0.983503	ARDL(1, 2, 0, 3, 1, 2, 1, 3)
7370	50.350257	-1.264594	-0.484927	-0.969957	0.983389	ARDL(1, 2, 0, 3, 0, 3, 1, 2)
6362	50.344955	-1.264373	-0.484706	-0.969736	0.983386	ARDL(1, 2, 1, 3, 0, 2, 1, 2)
3289	51.297387	-1.262391	-0.443741	-0.953022	0.983441	ARDL(1, 3, 0, 3, 0, 2, 1, 3)
3290	50.295975	-1.262332	-0.482665	-0.967695	0.983352	ARDL(1, 3, 0, 3, 0, 2, 1, 2)
7361	52.884849	-1.245202	-0.348585	-0.906369	0.983261	ARDL(1, 2, 0, 3, 0, 3, 3, 3)
6353	52.840475	-1.243353	-0.346736	-0.904520	0.983230	ARDL(1, 2, 1, 3, 0, 2, 3, 3)
3281	52.762351	-1.240098	-0.343481	-0.901265	0.983175	ARDL(1, 3, 0, 3, 0, 2, 3, 3)

LogL/LR: Sequential Modified Likelihood Ratio test statistic (each test at 5% level)

FPE: Final Prediction Error

AIC: Akaike information Criteria

BIC/SC: Schwarz Information Criterion

HQ: Hannan-Quinn Information Criterion

Appendix 5: Quandt-Andrews unknown structural break test

Quandt-Andrews unknown breakpoint test
Null Hypothesis: No breakpoints within 15% trimmed data
Varying regressors: All equation variables
Equation Sample: 1969 2019
Test Sample: 1977 2012
Number of breaks compared: 36

Statistic	Value	Prob.
Maximum LR F-statistic (2002)	6.253184	0.0000
Maximum Wald F-statistic (2002)	37.51910	0.0000
Exp LR F-statistic	1.660734	0.0040
Exp Wald F-statistic	15.86891	0.0000
Ave LR F-statistic	2.361047	0.0043
Ave Wald F-statistic	14.16628	0.0043

Note: probabilities calculated using Hansen's (1997) method

Appendix 6: ARDL and ECM model and ARDL-Bounds Test

Levels Equation				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGFCF	0.250863	0.088537	2.833437	0.0084
LTLF	0.934555	0.364042	2.567163	0.0159
LTOB	0.043085	0.182735	0.235779	0.8153
LTEA	-0.008362	0.084014	-0.099535	0.9214
LSUG	0.193320	0.050133	3.856141	0.0006
EXC	0.000663	0.000232	2.851762	0.0081
DY2002	0.257529	0.119949	2.147000	0.0406

$$EC = LR GDP - (0.2509 * LGFCF + 0.9346 * LTLF + 0.0431 * LTOB - 0.0084 * LTEA + 0.1933 * LSUG + 0.0007 * EXC + 0.2575 * DY2002)$$

ECM Regression				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.584345	0.189379	-8.365996	0.0000
D(LGFCF)	0.074113	0.059561	1.244321	0.2237
D(LGFCF(-1))	-0.215915	0.065205	-3.311316	0.0026
D(LTOB)	0.190544	0.081980	2.324274	0.0276
D(LTOB(-1))	0.221616	0.088427	2.506202	0.0183
D(LTOB(-2))	0.318471	0.088113	3.614359	0.0012
D(LSUG)	0.067978	0.033701	2.017113	0.0534
D(LSUG(-1))	-0.100342	0.034647	-2.896145	0.0073
D(EXC)	-0.002078	0.000451	-4.602719	0.0001
D(DY2002)	-0.061897	0.111055	-0.557354	0.5817
D(DY2002(-1))	0.483021	0.126179	3.828057	0.0007
D(DY2002(-2))	0.156107	0.112108	1.392465	0.1747
CointEq(-1)*	-0.878208	0.102890	-8.535412	0.0000

R-squared	0.825645	Mean dependent var	0.070669
Adjusted R-squared	0.765866	S.D. dependent var	0.201145
S.E. of regression	0.097329	Akaike info criterion	-1.595632
Sum squared resid	0.331551	Schwarz criterion	-1.088848
Log likelihood	51.29517	Hannan-Quinn criter.	-1.404118
F-statistic	13.81167	Durbin-Watson stat	2.357877
Prob(F-statistic)	0.000000		

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.285326	10%	2.03	3.13
k	7	5%	2.32	3.5
		2.5%	2.6	3.84
		1%	2.96	4.26

Asymptotic: n=1000

Appendix 7: Diagnostic tests results

Breusch-Godfrey Serial Correlation LM Test:

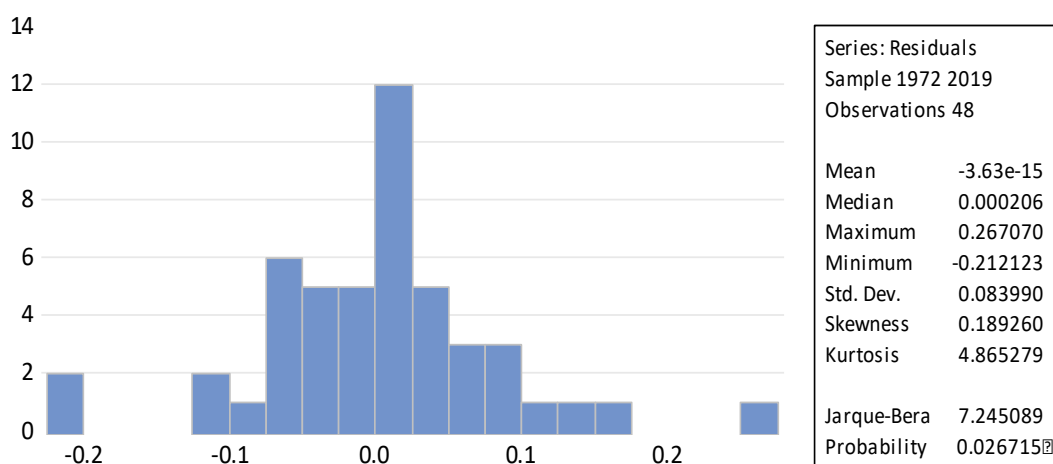
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	1.280256	Prob. F(2,26)	0.2949
Obs*R-squared	4.303303	Prob. Chi-Square(2)	0.1163

Heteroskedasticity Test: Breusch-Pagan-Godfrey

Null hypothesis: Homoskedasticity

F-statistic	1.439487	Prob. F(19,28)	0.1862
Obs*R-squared	23.71827	Prob. Chi-Square(19)	0.2072
Scaled explained SS	15.59795	Prob. Chi-Square(19)	0.6839



**Appendix 8: Today Yamamoto Granger Causality Results between Real GDP
and all independent variables**

Null-hypothesis	Chi2	Prob > chi2
LRGDP does not granger cause LGFCF	25.25	0.0000***
LGFCF does not granger cause LRGDP	10.55	0.0321**
LRGDP does not granger cause LTLF	13.87	0.0077***
LTLF does not granger cause LRGDP	0.8	0.9389
LRGDP does not granger cause LTOB	9.70	0.0458**
LToB does not granger cause LRGDP	3.28	0.5123
LRGDP does not granger cause LTea	1.96	0.7423
LTea does not granger cause LRGDP	3.72	0.4451
LRGDP does not granger cause LSug	27.97	0.0000***
LSug does not granger cause LRGDP	24.02	0.0001***
LRGDP does not granger cause EXC	23.84	0.0001***
EXC does not granger cause LRGDP	3.78	0.4370

***significant at 1%, ** significant at 5%

Source: Author's computations using Stata.

**Appendix 9: Natural log transformed values of LRGDP, LGFCF, LTLF,
Agricultural crop exports (Tobacco, Tea and Sugar) in millions USD, and EXC
from 1969-2019**

Year	LRGDP	LGFCF	LTLF	LTob	LTea	LSug	EXC
1969	21.0398	19.17737	14.34876	16.80266	16.25184	12.12811	0.833333
1970	21.04458	19.56527	14.36634	16.99544	16.38805	12.1495	0.833333
1971	21.19488	19.5041	14.4048	17.30344	16.48142	12.84529	0.830894
1972	21.25533	19.71751	14.4308	17.40299	16.54035	13.02585	0.801558
1973	21.27808	18.32293	14.46362	17.59025	16.66541	15.21719	0.819262
1974	21.34738	18.45779	14.49983	17.77832	16.84984	16.2073	0.841203
1975	21.40647	18.84321	14.53443	17.9847	17.04382	16.46896	0.863834
1976	21.45524	18.81402	14.55693	18.15202	17.18332	17.05057	0.913011
1977	21.50324	19.00278	14.58059	18.39281	17.6484	16.61911	0.902928
1978	21.59623	19.49526	14.62482	18.45379	17.35679	16.49152	0.843745
1979	21.63926	19.46406	14.65727	18.61856	17.44485	16.91276	0.816878
1980	21.64332	19.43126	14.77088	18.65673	17.41701	17.6543	0.812096
1981	21.58896	19.04888	14.79702	18.5376	17.34739	17.9702	0.895299
1982	21.61369	18.96385	14.83024	18.73988	17.55812	16.95703	1.055509
1983	21.6502	18.93914	14.8799	18.6399	17.68149	16.95547	1.174763
1984	21.70242	18.87534	14.90714	18.89336	18.19988	16.8374	1.41338
1985	21.74711	18.83247	14.94294	18.50594	17.80182	17.22527	1.719097
1986	21.74496	18.79054	14.98691	18.69849	17.42554	16.9239	1.861073
1987	21.76109	19.01981	15.01282	18.95196	17.13655	17.17596	2.208743
1988	21.79236	19.33724	15.07316	19.03519	17.25281	17.17168	2.561301
1989	21.80572	19.59011	15.12679	18.92985	17.42017	16.98065	2.759524
1990	21.86108	19.75139	15.16968	19.43842	17.63437	17.15363	2.728882
1991	21.94478	19.74126	15.19747	19.71955	17.39611	17.20325	2.803313
1992	21.86863	19.54812	15.20976	19.50259	17.38341	16.46466	3.603275
1993	21.96113	19.40916	15.20519	19.18052	17.38749	16.46473	4.402778
1994	21.8531	19.57256	15.2093	19.10458	17.2136	17.02426	8.736405
1995	22.00778	19.14853	15.21608	19.5047	17.09499	16.79053	15.28374
1996	22.0784	19.21996	15.23104	19.56383	16.95426	17.33893	15.30847
1997	22.11562	19.32931	15.25791	19.68232	17.57181	16.99261	16.44418
1998	22.15383	19.08464	15.2709	19.69654	17.56325	17.4691	31.07268
1999	22.1838	19.22663	15.28119	19.73794	17.4531	17.13333	44.08814
2000	22.19944	19.18539	15.28469	19.63262	17.44782	17.03038	59.54381
2001	22.23143	19.28299	15.28967	19.3644	17.34446	17.94701	72.19733
2002	22.16527	19.70273	15.30237	19.27261	17.42762	17.37166	76.68661
2003	22.22075	19.65263	15.30558	19.48191	17.55482	18.3097	97.43248
2004	22.27354	19.86956	15.34236	19.36837	17.6699	17.62317	108.8975
2005	22.3057	20.13626	15.37322	19.58607	17.72152	17.51787	118.42
2006	22.35163	20.37855	15.37925	19.88344	17.36141	17.68538	136.0125

2007	22.44319	20.66093	15.42506	19.86214	17.83036	17.92593	139.9575
2008	22.51692	20.85939	15.47972	20.19561	17.42266	17.74234	140.5217
2009	22.59691	21.05735	15.53536	20.44751	18.17533	18.07343	141.1683
2010	22.6634	21.10348	15.59669	20.58962	18.60954	18.45711	150.4858
2011	22.7108	20.56002	15.62786	20.164	18.27405	19.1821	156.5158
2012	22.72948	20.40361	15.66076	20.00556	17.86009	18.17725	249.1067
2013	22.78017	20.36807	15.69454	20.12788	18.25009	18.53354	364.4058
2014	22.83561	20.4015	15.72663	20.27595	18.12333	18.27658	424.8967
2015	22.86322	20.47341	15.75839	20.02141	18.01679	18.40192	499.6058
2016	22.88776	20.18831	15.79048	20.10539	18.0097	18.20635	718.005
2017	22.92698	20.53878	15.82223	20.08619	18.08019	17.35824	730.2725
2018	22.95819	20.43768	15.85377	20.08136	18.18392	17.62271	732.3333
2019	23.00095	20.66523	15.88874	20.03285	18.19857	18.13964	745.5407