



**SUPPLY RESPONSE OF MALAWI'S MAIN
EXPORT CROPS TO PRICE AND NON-PRICE
STRUCTURES**

MASTER OF ARTS (ECONOMICS) THESIS

BY

HAROLD S.J. KUOMBOLA

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DEDICATION

To my Father, Mother, Brothers, and Sisters for their
encouragement and support throughout my academic endeavors.

May GOD Almighty bless you all.

CANDIDATE’S DECLARATION

This thesis is an outcome of my own work and wherever other people’s work has been used an acknowledgement has been made. I declare that it has not been submitted anywhere else for any degree or any other purpose.

Candidate:.....

Date:.....

CERTIFICATE OF APPROVAL

We, the undersigned, declare that this thesis is an outcome of the student's own work and effort. Where other people's work has been used, it has been acknowledged. This thesis has been submitted with our approval.

Supervisor's Signature..... Date.....

Dr. Patrick Kambewa

Supervisor's Signature..... Date.....

Dr. Winford Masanjala

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ABSTRACT

The agricultural sector in Malawi provides livelihood to about 90 percent of the population, accounting for about 38 percent of GDP, employing over 80 percent of the workforce, and contributing over 90 percent of the foreign exchange earnings. Performance of agricultural exports is of critical importance to poverty alleviation, economic growth and development. Government efforts to improve export performance include price and marketing liberalization, exchange rate decontrol, subsidies, and international trade agreements. With these policy initiatives response of smallholder farmers is of critical importance to supply of agricultural exports to attain national economic goals.

This study analyzes the impact of price and non-price incentives on supply of the nation's main export crops. This study attempts to fill a farmer's response research gap identified in several studies on farmer responses of analyzing agricultural response at two decision levels; crop output, and aggregate export. This study adds a level before these two levels, farmer's hectarage allocation. This implies in addition to output, and aggregate export responses, this study estimates hectarage responses. To achieve this, the study applies the unrestricted Nerlovean supply response model to three export crops; tobacco, tea, and cotton.

Results of the study show that farmers are responsive to crop's own price and non-price incentives. Despite being responsive to price and non-price incentives, hectarage results indicate that farmers allocate land to export crops mainly basing on their previous allocation pattern rather than relative crop prices and foreign income. The study also confirmed that an influx of cheap imports is depressing domestic production for the local market and re-orienting local produce towards the export market.

Major policy implications drawn are that government efforts of diversifying the export base should be complimented with low cost value-adding technologies to enable farmers attract better prices and attain higher income. To reap benefits of international trade

agreements like SADC, COMESSA, and bilateral agreements, supply-side constraints, especially communication and marketing infrastructure need to be efficiently operative. To compliment this policy, the institutional capacity of respective crop farmer associations, Ministry of Trade and Private Sector Development, and private sector stakeholders needs to be enhanced.

CHAPTER ONE

INTRODUCTION

1.1 Introduction to the Study

The fact that Malawi still ranks among the world's poorest countries, despite being one of the most liberalized economies implies that the nation is not accruing benefits of globalization and trade liberalization. In fact with trade liberalization, the country's trade in goods fell from 97% of GDP in 1994 to 74% in 1999, i.e. from 30% to 27% for exports and from 67% to 47% for imports (WTO, nd), decreasing further to 60.6% in 2003 (The Africa Trade Insurance Agency, nd). Integration in the world economy and the fast pace of developments in technology implies that terms of trade are fast drawing against exports of raw unprocessed products towards those of highly manufactured products. This calls for a thorough analysis of what determines Malawi's exports in the context of trade liberalization and globalization.

An examination of relevant determinants of export supply response in agricultural crops is vital for formulation and implementation of current effective economic reforms in the face of current global economic trends. This is based on the understanding that the overall success of an export promotion strategy heavily depends on the extent to which it has incorporated factors affecting export growth and the responsiveness of producers to price and non-price incentives offered in the market.

Efforts to recover from the 1980/81 economic slump saw the nation turning to conditional loans on recommendation from the IMF and the World Bank. These structural adjustment programs (SAPs) commenced in 1981. In the agricultural sector the general objective of SAPs was to attain efficiency by implementing policies aimed at reducing government participation in the market, promoting and diversifying the export base, and enhancing food production to achieve food self-sufficiency. The driving force for the SAPs achieving efficiency in the agricultural sector (and also the economy as a whole) as proposed by these institutions is the market through prices. In international

trade government was expected to decontrol export prices, deregulate the exchange rate, remove tariff and no-tariff barriers to trade, and withdraw participation in the market, among others. Such adjustment was termed “getting prices right” and “opening up the economy.”

These policies were implemented along with an export policy of diversifying the export base from tobacco, to other export crops. Due to persistent economic dismal performance and the need for export base diversification, government’s development policies are turning towards cotton, tea, and sugar to explore further opportunities in international trade. An analysis of how these export crops respond to trade policies is crucial for effective implementation of the Malawi Growth and Development Strategy.

The Malawi National Strategy Team (2005) identifies various economic hardships and constraints facing the export sector which need to be overcome to enhance competitiveness of domestic exports in the international markets. On the supply side these are: high transport costs being a landlocked country, high cost and poor service delivery of utilities (water, electricity, and telecommunication industries), weak skilled human and capital base, poor private sector development, and heavy tax burden on narrow economic activities. Demand side constraints include agricultural subsidies from developed economies, technical barriers to trade and sanitary and phytosanitary restrictions in international trade. In addition to these constraints identified by this team, other constraints include low adoption of technology by smallholder farmers, lack of access to agricultural investment capital, over-reliance of national produce on rain-fed agriculture, heavy post-harvest losses, lack of backward and forward linkages from the relatively low agro-processing industry, and poorly developed information and information-dissemination mechanisms in crop production (Kachule, 2000).

Various techniques have been developed in assessing the response of crop production to economic and social factors. One such technique was developed by Marc Nerlove in 1956 which has seen a number of modifications in subsequent decades. This technique captures crop elasticities at various production levels (individual crop, sub-sector or

sector level) and takes into account hectarage, individual crop output and aggregate crop output responses for a thorough supply analysis. It also incorporates farmer expectations and decision making mechanism in gauging both short term and long term elasticities.

1.2 Research Problem

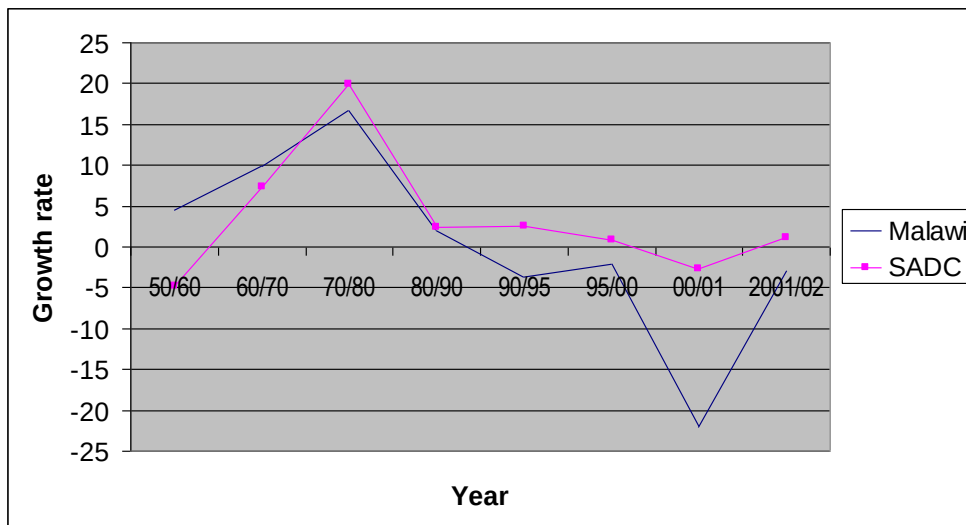
The role of agricultural exports in Malawi is central to stimulating national development, poverty reduction, and achievement of the nation's Vision 2020 of being a middle-income economy in the near future. Export volume of tradable crops and aggregate exports for Malawi show an overall increasing trend¹. In theory this would mean increased agricultural export earnings for the nation, which would spur national development, reduce poverty and improve household income.

Government support for the agricultural sector has included among others repealing of the Special Crops Act allowing smallholder farmers to grow high-value crop varieties (of tobacco, tea, cotton and sugar), which provided good course for increasing exports, mitigating poverty and inducing economic growth to the population. Unfortunately for Malawi, the reality seems not to follow this “trickle down effect” development strategy considering the persistent poverty and lack of development. As such the overall success of a poverty reduction and development strategy for Malawi, will depend on among others, knowledge of what factors induce supply in farmers and to what extent.

Despite the critical role exports play in development of any nation, trade statistics for Malawi indicate a declining trend of export growth since the period 1970/80 and performing below regional averages (Figure 1.1 below). This suggests a need for thorough analysis and an understanding of factors affecting integration of Malawi exports in world markets.

¹ Morrissey and Mold (n.d) indicates that export volume indices calculated at base 1990 (1990=100), show an overall increasing trend with 1994=112.6, 1998=131.0 and 2002=123.0

Figure 1.1 Percentage Average Annual Growth Rates of Exports



Data Source: UNCTAD, Handbook of Statistics, 1996/97 and 2003. Note: the value for 50/60 is for Sub-Saharan Africa.

The Malawi Growth and Development Strategy (MDGS) which is the overall operational strategy for the country's development plans outlines key guidelines for tobacco, tea and sugar as major export crops to achieve sustainable agricultural production and improve incomes of both smallholder and large-scale farmers (GoM, 2006). Thus there is special government emphasis on these crops because of their relative economic significance in international trade. Cotton is becoming incorporated in government development efforts as a high-growth potential sector, with a medium term objective of promoting the garment-manufacturing sector using locally woven cloth to substitute for imports in textile and garments. The long-term objective is to provide an enabling environment for development of a manufacturing sector, creation of jobs and markets to small-scale farmers to improve livelihoods and curb poverty. This long-term objective is resting on the assumption that agriculture is responsive to the enabling environment (price and non-price incentives) whose extent this study intends to establish.

Being the main cash crops for the economy, the effective and efficient contribution of tobacco, tea and cotton to poverty reduction and economic development, is realized only when they significantly respond to price and non-price incentives. Policies under SAPs that offered incentives include increase in export crop prices in 1984/85 crop season;

producer price deregulation, except maize in 1990/91 crop season; and the liberalization of the foreign exchange market in 1991 (Mnenula, 1999). These policies were substantiated by the repealing of the Agricultural and Livestock Marketing Act; amendment of the Fertilizer Farm Feeds and Remedies Act; and amendment of the Seed Act, all these in 1996 (Kachule, 2000), and periodic currency devaluations starting 1981 and eventual floatation of the currency in 1994 (Chirwa and Zakeyo, 2003).

Price and non-price elasticities are relevant as they are a medium through which market/trade policies are expected to induce domestic production. Several studies in Malawi have been conducted estimating short- and long-run supply elasticities of various crops (Mnenula, 1999; Kachule, 2000; Madola, 1999). These studies have focused on estimating price elasticities of major agricultural crops like burley tobacco, maize, groundnuts and cotton, in pursuit of economic policies addressing food insecurity and low farmer income problems. This study concentrates on export crops as a basis for achieving national long-term objectives as specified in the MGDS and the Vision 2020. Price elasticities need to be estimated for the nation's key export crops to assess the extent to which prices are fulfilling their role of inducing and directing domestic production in the face of emerging global economic trends.

Common practice amongst the studies (referred above) for Malawi on supply response is to estimate supply elasticities basing on quantity produced and/or export volumes. This study identifies and attempts to fill a farmer's response research gap of analyzing agricultural response at two decision levels; crop output, and aggregate export. This study adds a level before these two levels, farmer's hectare allocation. This implies in addition to output, and aggregate export elasticities, this study estimates hectare elasticities. This is on the basis that for a complete analysis of crop supply, hectare cultivated by a respective export crop is an important determinant of the export market of that respective crop. This is an effort to incorporate farmer production constraints as early as possible in the production decision making framework.

Non-price incentives that complement price incentives also play a critical role in linking policy to production. For instance roads and rural infrastructure rehabilitation currently

underway, enhanced irrigation, institutional development, and availability of agricultural equipment among others are non-price incentives that induce production. This study seeks to estimate price elasticities and elasticities of some of these non-price incentives to determine how these are shaping export production and to provide insight information for policy decision making in export promotion strategies.

In the global economy sustainability of developed economies relies on exploiting developing countries for a market of their excess produce due to the latter's lack of integration in the world market, as products from developing countries no longer require as much raw materials from a country like Malawi as before (Phiri, 2006). This has come to the extent that development efforts in developing countries are becoming subverted and dependent on trade policies of developed economies. It is therefore imperative to monitor and gauge the supply response of the economy's development hub (agriculture) in the light of developments in international market.

1.3 Significance of the Study

This study is significant as it seeks to estimate individual and aggregate elasticities in agriculture, the mainstay of the economy. Firstly, achievement of national policy of diversifying the export base from tobacco heavily depends on the response of other export crops (tea, sugar, and cotton), whose supply elasticities this study intends to estimate.

Secondly, price and non-price elasticities give insight on relative performance of export crops in the work of opening up to trade in regional groupings, overall international trade, and to a larger extent, the globalization process. As such this study will help assess the direction and magnitude of relevant elasticities to gauge the extent to which Malawi exports are coping up in trade.

Thirdly, resource allocation among crops depends on relative responses of individual crops to price and non-price incentives. In view of scarce agricultural resources supply elasticities are relevant for resource re-allocation between tradable and non-tradable crops. Thus estimates of supply response are crucial to both short-term forecasts and

long-term projections of land use and resource needs both at national and individual crop level.

1.4 Research Objectives

Based on the research problem presented above the main objective of this paper is to analyze the impact of price and non-price incentives on supply of Malawi's main export crops.

The following are the specific objectives in attaining this main objective:

1. to estimate quantitative effects of price and non-price structures on agricultural export crop production and hectareage.
2. to assess the effects of changes in domestic prices of other food crops such as maize and groundnuts on supply of export crops.
3. to assess whether some major policies affecting agriculture sector (real exchange rate policy, and export crop production liberalization) implemented during the period of study led to improved exports.

1.5 Study Hypotheses

Based on the research objectives the following hypotheses will be tested

1. price and non-price structures do not offer any positive incentive to agricultural export production and hectareage.
2. changes in domestic price of competitive food crops such as maize and groundnuts do not have any effect on exports of tradable crops.
3. the agricultural policies implemented during the time of the study (real exchange rate policy, and export crop production liberalization) have not led to improved exports.

1.6 Organization of the Study

The rest of this study is organized as follows: the next chapter presents a review of the agricultural policy and agricultural export performance over the period of study. This section contains a brief presentation of some agricultural policies, and international trade

agreements affecting agricultural exports and finally reviews performance of agricultural export. The third part of the study presents the theoretical foundations and developments in theory of Nerlovean price supply response and presents some empirical literature in Nerlovean price supply response. The fourth part develops and presents the econometric model to be estimated and a description, nature and sources of data used in the study. The fifth part presents the econometric estimation of the elasticities of supply for the different crops and an interpretation of the regression results obtained. Finally the last section presents summary, policy implications, and conclusion.

CHAPTER TWO

OVERVIEW OF AGRICULTURAL SECTOR IN MALAWI

2.1 Introduction

Soon after independence, Malawi embarked on addressing her development problems through an agricultural growth oriented strategic intervention. In this approach emphasis was on expanding and diversifying agricultural and livestock exports to raise the farm family incomes and promote economic growth (GOM, 1995). Such a policy seems to have been successful as in the period up to the late 1970s the nation's economic performance was one of the few success stories in Sub-Saharan Africa. Economic performance then was fuelled by two main developments; estate exports of tobacco and aid expenditure that allowed rapid expansion of the public sector (Kydd, 1985).

However, over time such strategies have proved to be insufficient, as Malawi is now characterized by low development, low farm-family incomes, low economic growth, rampant poverty levels and currently the nation struggles to achieve development levels attained during the period soon after independence. In an effort to address these development challenges, Government in the 1980s adopted open market policies under the International Monetary Fund (IMF)/World Bank supported Structural Adjustment Programme (SAPs). Under this programme, overall national development strategies targeted economic growth to generate efficient income earning opportunities for the poor, improved access to social services and social safety nets for the most vulnerable (Chilowa, 1994) and stabilizing farmer incomes. Emphasis was placed on development of the agricultural sector as the engine of economic growth and development.

Government in 2006 adopted the Malawi Growth and Development Strategy (MGDS) which is the Government's overarching medium-term development strategy. As the objective of the MGDS is to transform the country from a predominantly importing and consuming nation to a predominantly producing and exporting one, Government seeks to diversify the economy beyond the agricultural sector. It is however, acknowledged that in

the medium term agriculture shall continue to play a crucial role in the country's economic development (GoM, 2006).

The agricultural sector has remained the mainstay of the Malawi economy despite facing heavy hiccups. It provides a livelihood to about 90 percent of the population (USAID, 2005) and support to the small-scale industrial sector as most firms are in agro-processing activities. The agricultural share of gross domestic product (AGDP) is about 38 percent, Table 1.1 below, depicts the heavy reliance of national output on agriculture.

Table 1. 1 Importance and Performance of Agricultural Sector

Indicator	1970-79	1980-89	1990-94	1995-2001	2002-05
Share of agriculture in GDP (ADGP, %)	39.6	36.6	33.4	39.6	38.1
Share of agricultural sector employment (%)	40.6	47.3	50.2	51.2	
Trade surplus in the current account (K'mn)	-33.5	82.2	320.5	-946.2	-32,888.3

Sources: Chirwa and Chilowa (1999) and NEC (2002), and RBM Financial and Economic Reviews (various reports)

This means that agriculture is a key sector to national development and poverty alleviation. In realization of such and in a bid to revive the economy, recognition of tobacco, tea, sugar, and cotton by the MGDS as core sectors of the Malawi economy implies that these are the key crops to attaining the economy's targeted average economic growth of 6 percent per annum (GoM, 2006). These being the main export crops for the economy, their production policies have to be market oriented. The role of these export crops and the aggregate agricultural sector in overall response of the Malawi economy to trade reform policies (stabilization and liberalization) is critical.

2.2 Malawi Agricultural Policy

The Malawi Integrated Household Survey (GoM, 2005_b) indicated that 52.4 percent of a population of 12 million lives in poverty with 22 percent of the population in dire poverty.² In search for agricultural strategic interventions to alleviate these poverty levels, the Government intends to strengthen the manufacturing and exporting economic

² This IHS says a poverty line for the Malawi is MK16,165 per person per annum, and that of dire poverty is MK10,029 per person per annum.

activities of agricultural products being the main sector employing over 80 percent of the workforce and contributing over 90 percent of the foreign exchange (GoM, 2006). Such being the case, the need and relevance of an effective agricultural policy, to stimulate economic activities is outstanding and directly correlated to poverty levels and development agendas. The United Nations Conference on Trade and Development (UNCTAD) recognizes that the government is now envisaging rapid growth of key agricultural commodities: tobacco, tea, sugar, and cotton, to provide economic base for the agro-processing industry (UNCTAD, 2006). According to UNCTAD (ibid), specifically the goals of this new development strategy are:

- a) To promote high quality agro-processed exports, upgrade labor skills, and address high taxes and low domestic demand, and enhance linkages in commodity value-chain adding processes,
- b) To diversify export base by encouraging production of a range of agricultural crops, and
- c) To reduce marketing inefficiencies to improve smallholder incomes and productivity.

2.2.1 Overview of Malawi Agricultural Policy

Malawi is coming from a background where prior to economic liberalization, government controlled the production, and marketing of almost all crops. Restrictions were imposed on smallholder farmers from producing high valued crops (under the Special Crops Act). Smallholder access to capital was limited by restricting private trader participation in marketing and distribution of agricultural inputs and produce, and limited institutional development. Smallholders were allowed to grow on a large scale tobacco and sugar in 1990, and cotton in 1991, and marketing and distribution of agricultural inputs and outputs was granted in 1993 and smallholders' direct access to the tobacco auction floors started in 1994 (Mbekeani, 2005). Following these policy realignments the smallholder access to production services of high value crops improved.

Currently, the Malawi agricultural development policy is centered on three basic ideas: improving food security and nutritional status of the population and the promotion of drought-resistant food crops and livestock varieties; improving farm incomes and promoting economic growth by agricultural programs in soil fertility, capital credit, market access and technology; and agricultural produce diversification (GoM, 2002).

In improving smallholder incomes and productivity, to mitigate the widespread effects of drought in the mid 1990s government introduced the Drought Recovery Inputs Program (1995/1996), which targeted smallholders with free inputs to recover from the previous year's drought. This was followed by the smallholder Starter Pack Scheme, introduced in 1998/1999, which distributed free small packs of fertilizer and hybrid seed to smallholder farmers. Other activities to compliment these policies include development and promotion of communal small-scale irrigation schemes in feasible areas like the Lower Shire and Nkhota-kota; ensured proper management of the strategic grain reserves (SGRs) for maize to attain inter-year stability in maize prices (GoM, 1995_b); and institutional reforms which saw the formation and strengthening of various crop-farmer organizations like Mzuzu Coffee Farmers Trust, and Tea Growers Association of Malawi.

2.2.2 Government Policies to Support the Agricultural Export Sector

With a liberalized economy, government is now emphasizing on commercial and industrial activities to boost economic performance. Policy measures undertaken to achieve this objective include: relaxing exchange rate controls, reducing import and export licensing requirements on some products, price decontrols, tax reforms aimed at broadening the tax base, reducing maximum import duty, and enacting a zero percent duty on capital equipment and raw materials (Mandindi, 2006).

Structural re-alignments in the export sector aim at setting an export conducive macroeconomic environment to boost domestic production and export market. In view of such policies and to make exports more competitive in the international market, the

exchange rate was deregulated in the 1991 with a formal flexible exchange rate regime adopted in 1995 (MDTIS, 2002). Other policies to boost exports include strengthening of the institutional sector especially the credit sector by allowing microfinance institutions to operate in the economy since the mid 1990s and strengthening government parastatals.

Government also offers export incentives in a bid to foster agricultural production and growth of exports. The smallholder subsector being faced with capital constraint for production, government has been offering subsidies to imports of agricultural inputs like fertilizer and machinery. Under the Export Processing Zone (EPZ) arrangement, an exporting company is allowed a duty waiver on imports used in production of export produce and is given tax breaks to enhance its activities. In the tobacco sector to boost tobacco exports government reduced the 10 percent export tax enacted in 1995 to 8 percent in 1996 and later to 4 percent in 1997 (World Bank, nd).

Malawi is a signatory to a number of international trade agreements aimed at attaining a fair trade and integrating the world market. In multilateral agreements the World Trade Organization (WTO) is the prominent one. This organization looks at an eventual conversion to a fair and equitable environment, improving market access and eliminating discriminatory treatment to developing countries, creating a forum for international trade conflict resolution and registers a concern on non-trade issues like food security, and health (Action Aid, 2004). The major issue under the WTO which has negatively affected Malawi and other developing countries exports is the digression of developed countries from WTO agreement of removal of subsidies despite most developing countries, Malawi inclusive, having conformed.

In regional trade agreement the COMESA established to reformulate regional trade allowing free movement of goods and services in a free trade environment removing all tariff and non-tariff barriers amongst member states whilst non-member trade will attract a common tariff under a customs union, create a favorable investment climate in the region allowing free capital transfer, and eventually establish a monetary union with a common currency (UNCTAD, 2006). The SADC trade protocol aims at opening intra-regional trade of goods and services by utilizing comparative advantage, enhancing

economic development and diversification and also establishing a free trade area. The zero tariff merchandise trade of COMESA and the economic and trade integration objective of SADC offers an opportunity for Malawi to explore regional markets. Other international trade agreements are the bilateral agreements Malawi has with South Africa, Zimbabwe, Botswana, and Mozambique. These bilateral agreements offer conducive trade flow environments, with the Malawi-South Africa bilateral agreement having a recognizable impact in cotton, textile and garment market for Malawi.

2.3 Agricultural Export Performance over the Period of Study

Soon after independence in 1964 to mid 1980s national development strategy emphasized and restricted production of high value export crops to the estate sector as the hub of economic growth. This policy seemed to be successful as during this time overall agricultural production grew at an average annual rate of 3.2 %, with gross crop production and crop exports growing at an average annual rate of 5.0% and 5.1% respectively (Pryor, 1990). This was the period Malawi experienced a long boom in the economy. It came to an end in the late 1970s and early 1980s for among other reasons declining terms of trade between mid 1970s and 1980s by about 40% (Kydd, 1985), escalating transportation costs, high interest rates on externally borrowed capital, and price controls which squeezed profits of exports (Chilowa, 1998). It is depicted from Table 1.2 in chapter one, which shows growth rates of Malawi exports, that for the period prior to implementation of SAPs, (1950/1960 to 1970/1980) exports grew at a faster rate than the period of the implementation (1980/1990 to 2000/2001). Due to current worsened poverty levels and poor export performance, it is envisaged that though policy reforms under SAPs could be said to have achieved further avoidance of deterioration in the economy, they have not been sufficient to improve incomes, curb poverty and induce economic growth to the population (Chilowa, 1993). This raises a cloud of uncertainty over government's capacity to design and implement effective agricultural policies.

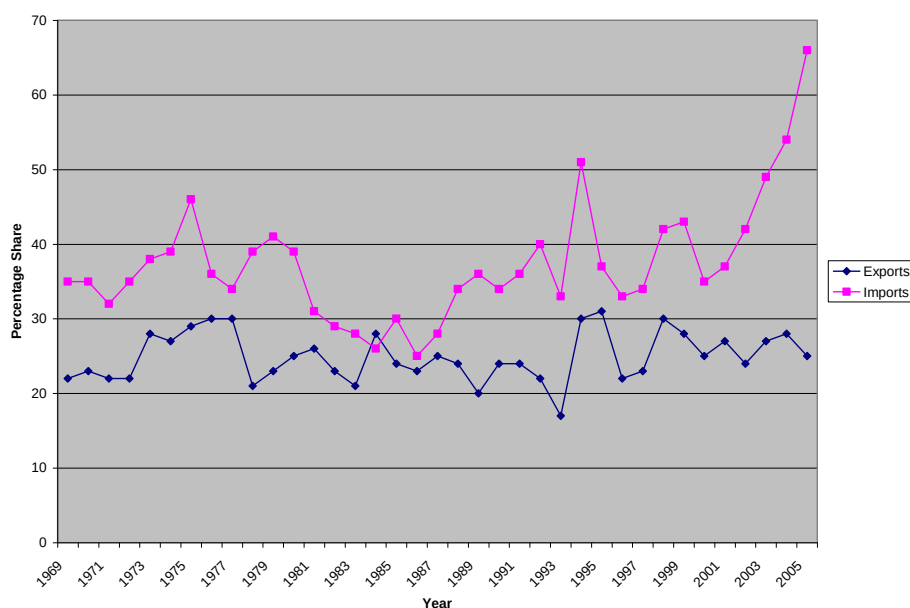
The EU offers the largest export market for Malawi seconded by the upcoming COMESA regional market. Despite the long existence of the EU market, Malawi is failing to penetrate its market mainly due to lack of export product diversification as 97 percent of exports to EU are composed of only tobacco (69 percent), sugar (16 percent),

and tea (12 percent), (ECA, 2005). The European Union is currently negotiating Economic Partnership Agreements (EPAs) in the African, Caribbean, and Pacific (ACP) regions, mainly with its 75 former colonies. The EPAs are to offer preferential market access to EU, mainly coming under the theme of liberalization and globalization by integrating LDCs into the world economy (Griffith and Boyd (ed.), 2007). However, unlike their predecessors (the Lome Convention, ACP-Cotonou Agreement, and Everything But Arms (EBA)), EPAs are to offer reciprocal trade to Malawi (Griffith and Boyd (ed.), *ibid*). Such reciprocity in trade between unequal partners³ like Malawi and the EU, is likely to increase exports from the EU, depress local agricultural production and industry, and loss of tariff revenue for government (Griffith and Boyd, ed., *ibid*).

Currently exports of tobacco, tea and sugar account for over 80% of total exports with the rest from manufactures of textiles, motor vehicle trailers and parts and re-exports of various commodities (MCCCI, 2006). In international trade despite heavy government intervention in export trade the Malawi trade performance indicates that the nation is still an importing and consuming country with average share of export to total trade (GDP) continuously less than that of imports. Figure 2.1 below shows the average share of export and imports to GDP.

³ Unequal in terms of commanded market share in the international market, negotiation capacity, and national capability to integrate international market.

Figure 2.1 Ratios of Exports and Imports in GDP (%)



Source: Computed from IMF International Financial Statistics, 1999 and 2007

The share of exports to GDP has averaged between 20 and 25 percent and that of imports has been between 30 to 40 percent since independence and recently since the year 2000 shows a steady increase. On a year-to-year trend analysis these ratios still show import ratio continuously greater than export ratio depicting an importing and consuming nation.

In the year 2000, Malawi was among the top four leading non-fuel exporters of tobacco (un-manufactured, and tobacco refuse), tea and mate, and sugar, molasses and honey in Sub-Saharan Africa commanding 25.3 percent, 6.8 percent and 6.0 percent market shares in these products respectively (UNCTAD, 2003). Such a huge difference in market share of leading agricultural export products (see graph in Appendix VI) indicates huge dependence of agricultural exports on a narrow export base. The Malawi export concentration and diversification indices are also high ranging between 0.46 and 0.74 (see graph in Appendix VII) supporting lack of export diversification.

In the tobacco sector there has been an increase in world production of tobacco leaf from 5.26 million tons in 1980 to 6.97 million tons in 2001 entirely accounted for by

developing countries as developed countries' production declined from 1.99 million tons to 1.29 million tons over this period (Diagnostic Trade Integration Study, 2002). Malawi exports of tobacco have varied from year to year, largely due to yearly weather related shocks which affect the rain-fed production. Malawi tobacco exports during the study period show a steady increase from 17,382 tons in 1970, reaching 60,311 tons in 1980, 89,066 tons in 1990, attaining a record high of 126,900 tons in 2000, before decreasing to 121,970 tons in 2005, see Appendix VIII. Tobacco is mostly exported to the EU and the USA.

In the cotton sector Malawi's major trading partners are South Africa, enhanced by the bilateral trade agreement, and the USA through the African Growth Opportunity Act (AGOA) initiative. With the AGOA and the influx of cheap Asian textiles and garments, the Malawi cotton industry is becoming more export oriented as the local market is flooded with cheap textile imports (UNCTAD, 2003). International cotton prices have been declining over the period of study, with sharpest drops in 1985 due to a shift in trade policy of USA from stockholding to price support, and other countries like China, which then was another major stockholder in cotton trade, in 1999, leading to further decline of cotton export prices, with average cotton prices declining by about 0.9 percent per year between 1985 and 2002 (UNCTAD, 2003).

Cotton production in Malawi, has been declining and production is currently lower than it was in the mid 1980s attributed to collapse of the cotton support system at the institutional level including collapse of the extension services and collapse of David Whitehead and Sons (DWS) Limited, which was the only textile manufacturing company of size in Malawi (Diagnostic Trade Integration Study, 2002). The DWS being the only textile manufacturing company provided the industrial linkage between cotton producers and garment manufacturers lacking after its collapse. Current emergency of other companies like Clark Cotton Malawi and Great Lakes Company is providing this industrial linkage. Malawi cotton exports show that they are picking up in the international market as export volume has risen to 17,040 tons in 2005, more than doubling from 8,517 tons in 2000, coming from a background of 5,859 tons, 3,013 tons, and 3,881 tons in the years 1970, 1980, and 1990 respectively, see Appendix VIII.

The United Kingdom is the main export destination of Malawi tea. Other export markets are South Africa, Kenya and USA. Tea marketing is mainly through the Limbe Auction Floors or directly sold to manufacturing companies which blend the tea. The EU supports the tea sector through the EU STABEX Program and the European Investment Bank Loan facility aiming at increasing the hectareage cultivation, improving quality of tea produce and renewing the infrastructure in tea growing (Diagnostic Trade Integration Study, 2002). The world supply of tea in international market has continued to grow over the past years, depressing world prices. Despite a remarkable increase in tea exports in the first half of the study period, with 17,700 tons exported in 1970, 31,274 tons in 1980, and 43,000 tons in 1990, the second half has seen tea exports decreasing to 42,400 tons in 2000 and 37,200 tons in 2005 (National Statistical Office (NSO), various monthly statistical bulletins). This could be a reflection of the declining world tea prices.

Despite government efforts to diversify the agricultural export base, commodity composition of exports over time indicates tobacco dominating with such a trend remaining throughout the period of study (see graph in Appendix VI).

CHAPTER THREE

LITERATURE REVIEW

3.1 Theoretical Review

Theoretical formulation of price supply response faces a methodological issue of how agents model expectations (specifically price expectations) based on actual and/or past observations, and other relevant variables, in a process of expectations formulation.

The initial Nerlove 1956 supply response function was based on expected price in time period t , p_t^e assumed to be a fraction of observed price, p_t , and previously anticipated price p_{t-1}^e (Hartely et. al., 1987). As such an adaptive expectations hypothesis was applied that farmers build current price expectations on previously expected price and the previous error in estimation (equation 3.1 below). It also recognized that full adjustment to desired cultivated area, q^d , may not be possible in the short-run, such that actual adjustment to area q , is a fraction of the desired (Danielson, 2002). As such acreage and price adjustments are modeled as

$$p_t^e - p_{t-1}^e = \gamma(p_t - p_{t-1}^e) \quad \text{where} \quad 0 < \gamma < 1, \text{ or} \quad (3.1)$$

$$p_t^e = \gamma p_{t-1} + (1 - \gamma)p_t^e + \mu_{2t} \quad \text{where} \quad 0 < \gamma < 1, \text{ and}$$

$$q_t - q_{t-1} = \delta(q_t^d - q_{t-1}) + \mu_{1t} \quad \text{where} \quad 0 < \delta < 1 \quad (3.2)$$

Where γ and δ are coefficients of expectation and adjustment respectively. Equation (3.1) says that in the learning process, farmers adjust their expectations as a fraction of the magnitude of the mistake made in the previous period. According to Nerlove formulation, this equation taking into account n previous periods incorporated in the farmers decision making, implies

$$p_t^e = \gamma p_{t-1} + (1 - \gamma)\gamma p_{t-2} + (1 - \gamma)^2 \gamma p_{t-3} + \dots + (1 - \gamma)^n \gamma p_{t-(n+1)} ; n \geq 0. \quad (3.3)$$

Based on these three equations, acreage cultivated was initially hypothesized to be a linear function of anticipated price only such that

$$q_t = \alpha_1 + \alpha_2 p_t^e + \mu_{1t} \quad (3.4)$$

Around this time when the Nerlove supply response was being propounded, (late 1950s and early 1960s), there existed an alternative supply response model, Cobweb model⁴. Sadoulet and de Janvry (1995) state that this model was based on the assumption that in underdeveloped countries marketing boards intervene in marketing agricultural produce and fix produce prices at some constant level unrevised. In this case static expectations modeling is appropriate as expected price only depends on constant price, implying that in the above formulation, the coefficient of expectation in unit, $\gamma = 1$ and no partial adjustment, such that $\delta = 1$. This implies supply response is modeled as

$$q_t = b_0 p_t + z_t \quad \text{where } z \text{ are other fixed factors.} \quad (3.5)$$

Yet another hypothesis on farmer expectations modeling was the Rational Expectations Hypothesis developed by John Muth in 1961. This is optimal prediction or forecast of the future value of a variable based on all available relevant information at the time the forecast is being made. It is a forward looking hypothesis where a farmer formulates expectations about the future basing on available information on the past, the current, as well as the future anticipated state. As the future information anticipated state of events is highly subjective, supply response analysis rarely uses this hypothesis.

Over time, another competing model to the Nerlove supply response modeling was proposed by Pope (1981) which specifies that in cases where farmers have a diverse price expectation, then supply response should be modeled as follows;

$$\sum_{i=1}^s A^i = \sum_{i=1}^s N^i f(\bar{P}^i) \quad (3.6)$$

- A is total acreage of crop supplied by an individual i .
- $\bar{P}$ is the farmer's expectation of price (or relative price) from firm i .

⁴ This model was developed by Ezekiel (1938) and Waugh (1964)

Rewriting this equation by noting $g(\bar{P}^s)$ as a function mapping the number of individuals with expectation $\bar{P}^s$ and $\bar{A}$ as the expected value of A^i then equation (1) becomes

$$\bar{A} = \int_{\Omega} g(\bar{P}) f(\bar{P}) d\bar{P} \quad (3.7)$$

- Ω denotes integrating over the appropriate range of the expected price, $\bar{P}$.

Defining another variable $\bar{P}^\circ$ such that $\bar{P}^\circ = \gamma\bar{P} + \mu$ for all $\bar{P}$ and P^* as the mean observed price level then the following function can be estimated

$$\frac{\partial A}{\partial \gamma} = \int_{\Omega} f'(\bar{P}) (\bar{P} - P^*) g(\bar{P}) d\bar{P} \quad (3.8)$$

This function gives the marginal response or the impact of hectareage supply of a crop to a change in price of farmer expectations. Integrating equation (3.8) by parts gives the correlation signs between the farmer price expectations and the acreage crops supply. Over time, this methodology has not been applied in most studies due to lack of adequate data to capture relevant dynamics of farmer price expectations, and lack of farmer price expectations' replicability. As such, the Nerlove supply response model becomes handy in research applications with formulations to use real/observed data other than expectations.

With developments in literature, non-price effects on q_t were recognized as exogenous factors and introduced as an extra regressor in equation (3.4). Danielson (2002) presents that in the late 1960s, Nerlove developed further his earlier model and came up with the following formulation based on equation (3.2), which he used to estimate supply elasticities of different crops

$$q_t = \pi_0 + \pi_1 p_{t-1} + \pi_2 q_{t-1} + \pi_3 Z_t + v_t^5 \quad (3.9)$$

⁵ Where $\pi_1 = \alpha_1 \beta$, $\pi_2 = 1 - \beta$, and $\pi_3 = \alpha_0 \beta$

This formulation assume that acreage under cultivation each year was solely a function of previously observed market prices, previous acreage cultivated and some unobservable components, in a linear smooth relationship. Introduction of fixed factors met some resistance as earlier on Brandow (1958) had argued that their introduction brings bias in the coefficient of expectation, which results in overestimation of the elasticities of supply. To sort out this bias, the general Nerlove Supply response model was re-formulated to consist of three equations; acreage cultivation as a function of anticipated price; anticipated price as a function of previously anticipated price and previous error in estimation; and acreage cultivation as a function of previous acreage cultivated and an adjustment deviation of actual from desired acreage (Braulke, 1982).

In other formulations on Nerlovian model (Bond, 1983) a farmer is assumed to form price expectations as a weighted sum of all past prices with relative weights modeled in a geometrically declining manner due to relative time significance. Hence p_t^e can also be modeled as

$$p_t^e = \gamma \sum_{i=1}^{\infty} (1-\gamma)^{i-1} p_{t-i} \quad \text{and desired output modeled as}$$

$$q_t^d = \alpha_1 + \alpha_2 p_t^e + \alpha_3 z_t + \mu_{1t} \quad (3.10)$$

Substituting equations (3.6) and (3.2) into (3.1) the following formulation was obtained which is estimated as the unrestricted Nerlovian supply response function for price and non-price elasticities

$$q_t = \pi_1 + \pi_2 p_{t-1} + \pi_3 q_{t-1} + \pi_4 q_{t-2} + \pi_5 z_{t-1} + \pi_6 z_{t-2} + \mu_{4t}^6 \quad (3.11)$$

Further developments to the Nerlovean supply response functions were incorporation of price and production-related risks in decision making of agricultural inputs and output. Just (1975), generalizing the application of Berhman (1968), specifies that risk can be

⁶ However this model is over-identified as it has six reduced form coefficients (π_1 to π_6) with only five structural parameters ($\alpha_1, \alpha_2, \alpha_3, \delta$ and γ). Hence need some estimation constraints on the reduced form parameters, such that $\pi_1 = \alpha_1 \delta \gamma$, $\pi_2 = \alpha_2 \delta \gamma$, $\pi_3 = (1-\delta) + (1+\gamma)$, $\pi_4 = -1(1-\delta)(1-\gamma)$, $\pi_5 = \alpha_3 \delta$, $\pi_6 = \alpha_3 5(1-\gamma)$, $\mu_{4t} = \mu_{2t} - (1-\gamma)\mu_{2t-1} + \delta\mu_{1t} - \delta(1-\gamma)\mu_{1t-1} + \alpha_2 \delta \mu_{3t}$

formed from squared errors and cross product of errors by a method of weighting. As such, Just (ibid) uses the following formulation

$$y_t = f^*(x_t^*, z_t^*, u_t, v_t, w_t) \quad (3.12)$$

$$\text{where } u_t = \sum_{k=1}^{\infty} \gamma_k (x_t - x_{t-k}^*)^2, \quad v_t = \sum_{k=1}^{\infty} \delta_k (z_t - z_{t-k}^*)^2 \quad \text{and}$$

$$w_t = \sum_{k=1}^{\infty} \rho_k (x_t - x_{t-k}^*)(z_t - z_{t-k}^*)$$

In this formulation, x_t^* and z_t^* are subjective expectations for explanatory variables x_t and z_t respectively. If values of γ_k , δ_k , and ρ_k assume values of $\frac{1}{n}$ then risk is modeled by subjective variances and covariances which ably checks changing risk structure. Later empirical analysis dropped the covariance term w_t , and risk is modeled using variances. Just (ibid) proposes that applying this risk formulation, there are other forms of risk in agriculture which researchers need to take care of, and can be modeled applying the above methodology. These are environmental risk (weather, pests and diseases among others); market risk such as supply from other exporting countries, export demand and input supply risks; and policy risk associated with uncertainty in government programs.

Recent development on supply response by Abrar et. al., (2004) applies profit-maximization principle and summarizes Nerlove model by a production transformation function set

$$f(y, x; z) = 0 \quad (3.13)$$

where y represents a vector of outputs, x represents a vector of inputs, and z represents a vector of fixed factors. Assuming a profit-maximizing farmer in this production function, profit function would be specified as

$$\pi = \pi(p, w; z) \quad (3.14)$$

where p and w represents vectors of output and input prices respectively. This formulation applies Hotelling's Lemma to equation (3.9) to obtain the profit maximizing level of output supply function (Abrar et al, ibid) and supply elasticities obtained as

$$y_m(p, w; z) = \frac{\partial \pi(p, w; z)}{\partial p_m} \text{ and } y_m = f(p, w, z, y_{m,t-1}) \quad (3.15)$$

Sadoulet and de Janvry (1995) present the basic Nerlovian supply response as

$$q_t^d = \alpha_1 + \alpha_2 p_t^e + \alpha_3 z_t + \mu_{1t} \quad (3.16)$$

q_t^d is desired cultivated area (in other formulations it is output/yield) in period t ; p_t^e is expected price or vector of relative prices including own price, prices of competing crops and factor prices, with one price chosen as the numeraire; z_t is a set of exogenous shifters (fixed factors); μ_t 's are error terms expected to be white noise. Since the desired is unobservable, recent formulations apply actual observations which most studies apply.

Applied formulations of the Nerlove supply response undertake supply response at two levels; individual crop response and aggregate crop response. Kwanashie et al. (1998) applied the following formulation for individual crop elasticities

$$x_i = f(p_i^\bullet, p_j^\bullet, w, z_i, x_{i,t-1}) \quad (3.17)$$

where $i=1, 2, 3, 4, 5$, for non-tradable crops and $j=1, 2, 3, 4$ for tradable crops

$$y_j = f(p_i^\bullet, p_j^\bullet, w, z_i, y_{j,t-1}) \quad (3.18)$$

where x_i is output of non-tradable crops; y_j is output of tradable crops; w is weather dummy for drought years; z_t represents various exogenous policy variables; $p_i^\bullet$ is relative price of crop i in terms of price of maize; and $p_j^\bullet$ is relative price of crop j in terms of price of maize. In this analysis if the dependent variable is sum of all tradable crops the resulting elasticities are estimated as sub-sectoral aggregate elasticities while if

it is sum of all exported products then the results are estimated as aggregate elasticities for the agricultural export sector.

3.2 Empirical Review

Simplifications of the above formulations are what empirical analysis often applies. Bond (1983) used the general Nerlove Supply Response formulation to estimate individual and aggregate crop supply response elasticities for Sub-Saharan Africa. The study used ordinary least squares (OLS) regression method. Bond (ibid) finds observed price, fixed factors (weather), and a trend variable capturing technology, to be significant variables in estimating supply response in Sub-Saharan Africa. Bond's findings for Sub-Saharan Africa were that own-price elasticities were positive and significant for most crops; elasticities tend to be larger in the long-run than in the short-run and confirmed that farmers are responsive to changes in producer prices. An overall conclusion was drawn that relative producer price is an important determinant of agricultural output.

Supply response functions are relevant for agricultural structural adjustment policy intervention appraisal. In analyzing the response of agriculture to adjustment policies in Nigeria, Kwanashie et. al., (ibid) used two stage least squares (2SLS) regression method to five tradable and four non-tradable crops. Their findings conformed to those of Bond that elasticities in the long-run tend to be larger than in the short-run. Sub-sector elasticity comparison yielded results that showed that non-tradables (food crops) are more responsive to short-run changes in price than tradables (cash crops) for the Nigerian economy. This paper also found that agricultural structural adjustment policies had a significant undesirable effect on supply response in Nigeria implying that although agricultural structural adjustment policies were intended to offer incentives to domestic production, overall they generated undesirable effects to output. The main possible reason provided for this undesirable result is lack of proper complementary policies to enhance agricultural structural adjustment policies.

In a similar study in Cameroon, to investigate determining factors of three agricultural exports; cocoa, coffee and banana between 1971/1972 and 1995/1996, Gbetnkom and

Khan (2002) obtained fairly significant and positive supply responses to price and non-price incentives for all the three crops. Factors found to be relevant determinants of export supply for cocoa, coffee and banana include transport captured by the nature of road network; credit, captured by loan amounts to exporters of these crops, rainfall (though it was found insignificant for banana exports), and structural adjustment program policies implemented to enhance export supply. The paper applied OLS regression technique of the form

$$\begin{aligned}
 XS_t &= f(RPP_{t-3}, RPX_t, XC_t, RNF_t, XS_{t-1}, RD_t, DTD_t, DFT_t, DICA_t) \\
 XS_t &= f(RPP_{t-3}, RPX_t, XC_t, RNF_t, XS_{t-1}, RD_t, DTD_t, DFT_t, DICCA_t) \\
 XS_t &= f(RPX_t, XC_t, XS_{t-1}, RD_t, RNF_t, DRES_t, DBM_t)
 \end{aligned}$$

where XS is the export supply measured in tons, RPP is the ratio of producer price relative to the domestic price index, RPX is the ratio of export price to the producer price, XC is agricultural export credit, RNF is average annual rainfall in millimeters, RD is classified road network (comprise both paved and unpaved roads by government definition and left out un-classified roads, likely because they could be non-essential in transporting these three crops to the port), and DTD , DFT , $DICA$, $DICCA$, $DRES$ and DBM are respectively dummy variables for three price policies implemented under structural adjustment (marketing activities deregulation, abandoning of producer price fixing, The International Coffee Agreement (ICA) quotas), the International Cocoa Agreement (ICCA) buffer stocks, restructuring of the banana sector, and dummy variable for years on the quota system imposed on ACP bananas entering the European Union. These three regression equations are for coffee, cocoa and banana, respectively.

One conclusion drawn in this paper is that for the case of Cameroon, marginal sensitivity of export crops to the relative price changes indicates that the price incentives were insufficient to induce adequate export supply in agricultural commodities. Another conclusion drawn on policy interventions under structural adjustment programs is that in Cameroon they indicated a positive impact, contrary to Kwanashie et. al., (ibid) results for Nigeria. Thus structural adjustment programs in Cameroon have had a significant

impact in development of their export market and export supply. The econometric significance of road network and availability of credit to exporters led to a conclusion that interventions aimed at increasing export supply of agricultural crops should emphasize on addressing infrastructure and institutional development.

In assessing whether economic reforms under the adjustment programs induced agricultural supply in Mozambique, Danielson (2002) analyses the relationship between individual and aggregate crops production and farm-gate prices. Individual crop and aggregate crop elasticities are calculated at farm-gate price to estimate the impact of market-oriented economic reforms. The econometric regression for the individual crops was estimated as follows

$$Q_{i,t} = \alpha_i + \beta_{i1}P_{i,t-1} + \beta_{i2}Q_{i,t-1} + \beta_{i3}Q_{i,t-2} + \beta_{i4}D_{t-1} + \varepsilon$$

where Q is quantity of output in million tones, P is farm-gate price, D is multiplicative dummy, and i indexes both cash and food crops; maize, paddy, cashew, coffee, cotton seed, tea leaves, and tobacco. Estimation of aggregate elasticities involved construction of aggregate indices of price and quantity in a Tornqvist formulation. One major observation from this study is that it hypothesizes that farmer decision making in crop production incorporates mostly and significantly two previous time periods, and as such uses two as the lag length of the dependent variable. This study finds out that farmers in Mozambique were responsive to price incentives but structural constraints in the agricultural sector barred improved incentives being translated into agricultural growth. These structural constraints identified include lack of development finance, lack of markets, and lack of communications infrastructure.

In another study on food crop supply response using a pooled cross-section time series model for selected six Sub-Saharan African countries, Jaeger (1990) estimated elasticities for agricultural exports as a function of real agricultural prices, real effective exchange rates, weather and disasters. Disasters were captured as a ratio of the number of years a country faced drought during the period of study to the total number of years in the study period. The agricultural export elasticities for Malawi and Kenya were negative and insignificant. The author argued that this could be the case as in these countries the

producer prices were determined ex-post at international markets to such an extent that they affect insignificantly farmers' expectations. This may imply agricultural exports in these countries were not responsive to price.

For Malawi, various studies have been conducted assessing export supply responses. In a study on determinants of current account in the Malawi balance of payments, Mkandawire (1997) sets out an objective of examining the fundamental determinants of the Malawi current account including among others the real exchange rate. In achieving this objective he examines a possible causal relationship between the behavior of the real exchange rate and the growth of Malawi exports. His methodology involved assessing Granger causality relationships in a linear regression of Malawi export growth on real exchange rate among the explanatory variables. In his analysis of Malawi exports after the subsequent devaluation of the Malawi currency, following the formal devaluation of 1973, a conclusion was made that devaluations attained an intension of improving Malawi exports competitiveness and profitability in international trade. For instance world share of Malawi tobacco rose from an average of 2.2 percent in the 1960s to 3.3 percent in the 1970s, while that of tea rose from 2.4 percent to 3.8 percent over the same period.

With keen interest to further examine what impact trade policy has had on agricultural export performance Madola (1999) examined the quantitative effects of the real exchange rate on agricultural exports, estimated quantitative effects of price incentives on aggregate agricultural exports of tobacco, groundnuts, and cotton. The real exchange rate was used in this study as the major policy tool of getting export prices right under structural adjustment programs. This study found that real exchange rate elasticities of agricultural exports for Malawi are inelastic in the short-run. With respect to real exchange rate, aggregate agricultural exports of tobacco exports, cotton exports, and groundnuts exports were found to be 0.181, 0.2, 0.257, and 0.261 respectively.

CHAPTER FOUR

METHODOLOGY

This study assesses the determinants of agricultural export crops by firstly estimating individual crop supply functions for three main export crops; tobacco, tea, and cotton, before estimating the aggregate agricultural export supply function⁷.

4.1 Econometric Specification and Description of Variables

The study applies the unrestricted Nerlovian supply response model combining formulations applied by Bond (1983), Kwanashie et. al. (1998) and Gbetnkom and Khan (2002) as reviewed in the literature. In her formulation Bond (ibid) estimates aggregate supply response elasticities defining the dependent variable from equation (3.11) as per capita agricultural output. In Bond's analysis an assumption is made that actual changes in per capita total agricultural output (Q_t) is a fraction of the desired equilibrium output level, ($\bar{Q}_t$) such that

$$\ln Q_t - \ln \bar{Q}_t = \beta (\ln \bar{Q}_t - \ln Q_{t-1}) \quad (4.1)$$

She further assumes that $\bar{Q}_t$ is a function of real producer price at time t, pr_t (measured as the average producer price deflated by the consumer price index); time trend t was used to capture technology; and weather dummy variable z_t such that

$$\ln \bar{Q}_t = \alpha_0 + \alpha_1 \ln pr_t + \alpha_2 t + \alpha_3 z_t \quad (4.2)$$

Substituting equation (4.2) into (4.1) the following equation was obtained which applied for the long-run elasticities

$$\ln Q_t = \nu_0 + \nu_1 \ln pr_t + \nu_2 \ln Q_{t-1} + \nu_3 t + \nu_4 z_t \quad (4.3)$$

⁷ This study dropped the crop sugar due to poor quality data.

⁸ $\nu_0 = \beta \alpha_0$, $\nu_1 = \beta \alpha_1$, $\nu_2 = 1 - \beta$, $\nu_3 = \beta \alpha_2$, $\nu_4 = \beta \alpha_3$, $\beta = 1 - \nu_2$, $\alpha_1 = \frac{\nu_1}{1 - \nu_2}$, $\alpha_2 = \nu_3 (1 - \nu_2)$

4.1.1 Individual Crop Estimations

The unrestricted Nerlovean supply response, following the formulation of Kwanashie et. al. (ibid), Q_t takes two measures (cultivated area and output produced/exported), thus empirical estimation in this study involves two sets of equations for these two variable estimates for a complete analysis. Applying this formulation, to estimate individual elasticities the following formulation will be used in OLS method as the first set with Q_t as area under cultivation.

4.1.1.1 Hectarage Cultivated Supply Estimation

This section presents the individual crop regression formulation for hectarage cultivation by a respective crop.

Tobacco

The hectarage supply function for tobacco is specified as follows

$$\ln HA_{T,t} = \beta_0 + \beta_1 \ln HA_{T,t-1} + \beta_2 \ln P_{T,t-1} + \beta_3 \ln \left(\frac{P_T}{P_{MA}} \right)_{t-1} + \beta_4 \ln \left(\frac{P_T}{P_G} \right)_{t-1} + \beta_5 \ln TPT + \beta_6 \ln WE_t + \beta_7 \ln AGP + \beta_8 \ln FERT_t + \beta_9 DEX + \varepsilon_t \quad (4.4a)$$

- HA_T is the hectarage cultivated by tobacco.
- $P_{T,t-1}$ is the previous price of tobacco. It is envisaged that the better the prices in a particular year the more will be the drive offered to farmers for land resources being allocated to tobacco from other food crops. Due to this positive relationship, it is expected that the coefficients for this variable will be positive.
- $\left(\frac{P_T}{P_{MA}} \right)$ and $\left(\frac{P_T}{P_G} \right)$ are price ratios of average tobacco prices to average maize price and average groundnuts price respectively. Maize and groundnuts are used as land resource competing crops with tobacco. An increase in any of these respective ratios means a relatively higher increase in the absolute value of P_T relative to P_{MA} and/or P_G , respectively. This should provide an incentive to hectarage

cultivation by tobacco, as in effect it means higher increases in the price of tobacco compared to either maize or groundnuts. As such their coefficients are expected to be positive.

- *TPT* is an estimate of transport network used to capture crop transportation problems farmers face in accessing markets. It is estimated by the road length. Due to the negative relationship between the transport network and transportation cost, its coefficient is expected to be negative.
- *WE* is a weather variable estimated by the annual rainfall amount.
- *AGP* is agricultural equipment. It is used to capture availability of equipment for agriculture purposes estimated by annual imports of agriculture equipment. Being inputs in production, their availability is expected to enhance land cultivation such that its coefficient is expected to be positive.
- *FERT* is a proxy of fertilizer amount available for agricultural purposes. It is estimated by total fertilizer imports for a particular year.
- *DEX* is a dummy variable for exchange rate deregulation in 1991. It takes the values 0 before 1991 and 1 after 1991.
- ε_t is an error term assumed to be white noise.

Cotton

The hectareage supply function for cotton is specified as follows

$$\ln HA_{C,t} = \alpha_0 + \alpha_1 \ln HA_{C,t-1} + \alpha_2 \ln \left(\frac{P_C}{P_{MA}} \right)_{t-1} + \alpha_3 \ln \left(\frac{P_C}{P_G} \right)_{t-1} + \alpha_4 \ln WA + \alpha_5 \ln WE_t + \alpha_6 \ln AGP + \alpha_7 \ln TI_t + \alpha_8 \ln FERT_t + \alpha_9 DEX + \varepsilon_t \quad (4.4b)$$

- $\ln HA_C$ is hectareage cultivated by cotton.
- $\left(\frac{P_C}{P_{MA}} \right)$ and $\left(\frac{P_C}{P_G} \right)$ are price ratios of average cotton prices to average maize price and average groundnuts price respectively. Maize and groundnuts are also used here as competing crops with cotton in allocation of land and other resources. Just as in the case of equation (4.4a) their coefficients are expected to be positive.

- TI_t is proxy of trade weighted income for Malawi's major trading partners (South Africa, USA, UK, Zimbabwe, German, Netherlands, Zambia, and Ireland). It was calculated as a weighted average of these partner's GDPs weighted by the relative share of Malawi's exports.⁹ Its coefficient is expected to be positive as it assumed to be one determining factor of domestic export market.
- WA is agricultural wage. This variable is included to estimate wage income of people engaged in agricultural sector. It is supposed to be an incentive to agricultural farmers whilst it can also be a proxy of production cost of hiring labor. As such its expected sign is ambiguous.

Due to lack of variation in the dependent variable hectareage cultivation for tea, hectareage supply responses for this crop have not been modeled in this paper to avoid violation of key Gauss-Markov classical assumptions of linear regression.

4.1.1.2 Individual Output Supply Estimation

This section presents the individual crop elasticities of output by each respective crop estimating equation 4.3 with Q_t as the volume output.

Tobacco

The output supply function of tobacco is estimated as follows

$$\ln QA_{T,t} = \delta_0 + \delta_1 \ln HA_{T,t} + \delta_2 \ln \left(\frac{P_T}{P_{MA}} \right)_{t-1} + \delta_3 \ln AGP + \delta_4 \ln P_{T,t-1} + \delta_5 \ln IPI + \delta_6 \ln WE_t + \delta_7 \ln FERT_t + \delta_8 \ln TI_t + \beta_9 \ln QA_{T,t-1} + \delta_{10} RER + \varepsilon_t \quad (4.5a)$$

- QA is annual production of a respective crop.
- $HA_{T,t}$ is the hectareage area under tobacco cultivation. It is envisaged that the more hectareage land being allocated to tobacco production the more tobacco is

⁹ This variable and other variables are not appearing in all equations to avoid functional misspecification as their inclusion caused this problem.

expected to be produced. As such the coefficient of this variable is expected to be positive.

- $\left(\frac{P_T}{P_{MA}}\right)$ and $\left(\frac{P_T}{P_G}\right)$ are price ratios of average tobacco prices to average maize price and average groundnuts price respectively. Applying the explanation from equation (4.4a), their coefficients are expected to be positive.
- *IPI* is the import penetration index used to capture the extent of imports into the country. The coefficient of this index is expected to be negative indicative of the negative relationship between commodity importing and home production.
- *RER* is the real exchange rate included on account of most of the tobacco produced in Malawi is exported.

Cotton

The output supply function of cotton is estimated as follows

$$\ln QA_{C,t} = \lambda_0 + \lambda_1 \ln HA_{C,t} + \lambda_2 \ln P_{C,t-1} + \lambda_3 \ln \left(\frac{P_C}{P_{MA}}\right)_{t-1} + \lambda_4 \ln \left(\frac{P_C}{P_G}\right)_{t-1} + \lambda_5 \ln IPI + \lambda_6 \ln QA_{C,t-1} + \lambda_7 \ln WE_t + \lambda_8 \ln FERT_t + \lambda_9 \ln TI_t + \lambda_{10} \ln AGP + \lambda_{11} DEX + \varepsilon_t \quad (4.5b)$$

Expected signs in the variables are as indicated in equation (4.4a).

Tea

The output supply function of tea is estimated as follows

$$\ln QA_{TE,t} = \pi_0 + \pi_1 \ln HA_{TE} + \pi_2 \ln P_{TE,t-1} + \pi_3 \ln IPI + \pi_4 \ln WE_t + \lambda_5 \ln TI_t + \lambda_6 \ln QA_{TE,t-1} + \lambda_7 \ln QA_{TE,t-2} + \lambda_8 \ln QA_{TE,t-3} + \lambda_9 \ln TPT + \varepsilon_t \quad (4.4c)$$

Expected signs in the variables are as indicated in equation (4.4a).

In this Nerlovean formulation, Kwanashie et. al. (1998) recognizes that there could exist an identification problem in the observed prices because as patterns of supply and demand operate through the price mechanism, an increase in demand will be reflected in an increase in price necessitating changes in supply and vice-versa. This could exist if the

observed prices are not exogenous. As a solution to this problem, Kwanashie et. al. (1998) makes an assumption, which is also applied in this study, that farmer's decisions are based on observed market prices per respective crop in the immediate past period.

4.1.2 Aggregate Export Supply Estimation

The Nerlovean supply response model proposes estimation of aggregate agricultural production to estimate aggregate elasticities for analysis on how the agriculture sector is responsive to various market factors. As such, the following agricultural export model will be estimated

$$\ln EX_t = \rho_0 + \rho_1 \ln EX_{t-1} + \rho_2 \ln WA + \rho_3 \ln TPT + \rho_4 \ln TI + \rho_5 \ln FERT_t + \rho_6 RER + \rho_7 \ln IPI + \rho_8 DCL + \varepsilon_t \quad (4.6)$$

- EX_t and EX_{t-1} are respectively current and previous agricultural export volumes. Previous exports are expected to be a stimulant to current exports and as such this variable's coefficient is expected to be positive.
- DCL is a dummy variable for the repealing of The Special Crops Act in 1996. As such this dummy takes values of 0 before the 1996 and 1 then after.

4.2 Data Used

The study uses annual data for the period 1970-2005, taken as averages across various varieties of respective crops. A complete data set used in the study is presented in the appendix, (Appendix II).

Data on most variables was obtained from the Ministry of Economic Planning and Development which they used in developing the national agriculture forecasting model specifically in the "Agricultural Production and Forecasting Model: Determinants of Growth in Malawi." The validity of this data was confirmed, and necessary collections made, by data from the National Statistical Office (NSO), Ministry of Agriculture and

Food Security, Reserve Bank of Malawi Financial and Economic Reviews (various issues), IMF International Financial Statistic, and from other published and unpublished studies and reports in Malawi agriculture sector.

CHAPTER FIVE

ECONOMETRIC ESTIMATION AND INTERPRETATION

In this section, an examination of the time series characteristics of all variables used in estimation is conducted, testing for variable stationarity, and undertaking diagnostic testing for functional specification in all equations. Econometric estimation and interpretation of obtained specification results is undertaken for each set of equations.

5.1 Variable Analysis

Empirical investigation of times series properties of the variables is the first step undertaken in this study before regression analysis for conventional time series regression analysis.

5.1.1 Stationarity Test

This is done by examining the underlying processes that generated the time series variables by undertaking the unit root test to determine whether each variable is stationary or non-stationary. The variables are tested in their log or log-difference form. If a variable is non-stationary, it is repeatedly differenced until it becomes stationary, which determines the respective order of integration. As a stationary variable has the property of fluctuating around the mean, whilst a non-stationary series does not return to the mean, graphical analysis was first applied (graphs obtained are presented in Appendix III), before two formal tests were applied: the Dickey-Fuller (DF) or Augmented Dickey Fuller (ADF) test and the Phillips-Perron (PP) test. The PP test has an advantage that it relaxes an assumption made by the ADF test of homogeneity and independence in the error terms. Use of both these test renders the stationarity test in the study more powerful. The PP test is run on three truncation lags as this is the default lag length proposed by Newey and West (1998).

As can be seen from Appendix IV, in both tests the hypothesis of unit root is rejected in some of the variables; $\ln HA_t$, $\ln WE$, $\ln FERT$, and $\ln PCPG$, indicating that these are stationary variables, integrated of order zero, whilst in the rest of the variables a hypothesis of unit root may not be rejected indicating that they are non-stationary series. However, these non-stationary variables in levels, were tested for stationarity in their differenced series form and in all variables a hypothesis of unit root is rejected indicating that they are variables integrated of order one.

Since cointegration regression requires that series be integrated of the same order (Mangani, 2003), cointegration analysis was not conducted as the series are integrated of different orders in all equations and regression analysis did not force a same order of integration.

5.1.2 Diagnostic Tests

Several diagnostic tests were conducted to detect and correct for time series properties as unless the models in the study satisfy the classical OLS regression assumptions, estimation gives misleading results. The following are the diagnostic tests that were conducted.

5.1.2.1 Functional Specification Test

One of the OLS classical regression assumptions is that the models should be correctly specified for meaningful results. The correct functional specification is in terms of no omitted variables, correct functional form, and correct measurement of variables. Violation of this assumption renders obtained OLS coefficients biased and inconsistent. As such, Ramsey's Regression Specification Error Test (Ramsey RESET) was conducted on each regression equation to test for functional misspecification. Results of the test are shown in Appendix V. As can be seen from this appendix, the associated *p-values* of the F-statistics in all equations are insignificant indicating the test may not reject a null

hypothesis of no functional misspecification. This implies all the regression equations are correctly specified.

5.1.2.2 Serial Autocorrelation Test

Application of OLS regression analysis also requires that an assumption of no serial autocorrelation in the error terms be attained for meaningful time series regression analysis. The assumption of no serial autocorrelation in time series implies that there should be no correlation between the subsequent error term observations in the time horizon. If this assumption is violated the OLS coefficients are no longer best linear unbiased estimators (BLUE) though still efficient such that the usual tests of significance (t-tests and F tests) becomes invalid and misleading (Gujarati, 2003). The presence of a lagged dependent variable as an extra regressor violates one of the assumptions of the Durbin Watson Test rendering it not applicable. As such, an alternative test the Breusch-Godfrey Serial Correlation LM Test was applied. Application of this test was also on the basis that it is a higher order serial correlation test making it possible to test for serial correlation of higher order.

Results of this test are presented in Appendix V. As can be seen from this appendix, in all equations the F-statistic is insignificant indicating that we may not reject a null hypothesis of no serial-autocorrelation in all models. The test was also conducted at higher lags to confirm the results and the F-statistics were all insignificant leading to the same conclusion.

5.1.2.3 Heteroskedasticity Test

Another classical assumption of the OLS regression analysis is that the error terms in each model should be homoskedastic. This implies that given any value of the explanatory variable the variance of the error term should be the same for all observations. Otherwise, heteroskedasticity condition is said to exist. Just like the case for serial autocorrelation, violation of homoskedasticity assumption compromises the

BLUE property of regression coefficients rendering inapplicable significance tests, inefficient predictions and invalid coefficient of determination, among others, yielding misleading conclusions (Gujarati, 2003). To test for heteroskedasticity, the White Heteroskedasticity Test was applied and results are indicated in Appendix V. As can be seen from that appendix, the *p-values* for the F-statistics are all insignificant indicating that on the basis of the data available we may not reject a null hypothesis of no heteroskedasticity (homoskedasticity). This is evidence enough of compliance to the classical regression analysis requirement of homoskedasticity in OLS modeling.

5.1.2.3 Normality Test for the Models

This study made an assumption that the error term in each model is white noise as required in classical linear regression modeling. This assumption implied that each error term has a normal distribution. Violation of this assumption renders classical test statistics (i.e. t-tests, F-tests, standards errors and confidence intervals) invalid and OLS coefficients become unbiased (though still efficient). Since the normal distribution has the property that any linear combination of normally distributed variables is itself normally distributed, a test of normal distribution was conducted in each model, to make sure that the resulting models are normally distributed. Inclusion of this test is on the basis of the critical role the normality assumption plays when using a small or finite sample of say less than 100 observations (Gujarati, 2003).

The Jarque-Bera (JB) test for normality which is also based on residuals of the OLS regression was used to calculate the skewness and kurtosis for assessing normality in modeling under the null hypothesis of normal distribution in the residuals. Results of this test are presented in Appendix V. The associated *p-values* of the JB statistics all indicate that we may not reject the null hypothesis of normally distributed errors, indicating that all the equations in this study satisfy the assumption of normal distribution in the error terms and OLS estimation will give meaningful results.

5.2 Empirical Estimation and Interpretation: The Short-run Supply Response Models

This section presents regression results for the hectarage, output and the aggregate export equation models. To derive these results some variables were systematically withdrawn from some estimation models. This was done by initially observing the statistical significance of each variable and assessing results with one variable withdrawn at a time. Though a variable could be insignificant it was not withdrawn unless doing so yields better results in Akaike Information Criterion and BIC, and that its inclusion was negatively affecting the signs and significance of other variables. Then after, a Ramsey RESET test was run to assess any errors in functional specification.

5.2.1 Hectarage Estimation Results and Interpretation¹⁰

The following table presents regression results of the hectarage equations for tobacco and cotton, equations (4.4a) and (4.4b).

¹⁰ There are two hectarage equations as one for tea has not been estimated due to lack of variability in the tea hectarage variable as required by OLS regression analysis.

Table 5. 1 Regression Results of Hectarage Equation

Regressors	Dependent variables			
	Tobacco hectarage		Cotton hectarage	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	4.192621*	1.963725	3.684665*	1.743409
$\ln HA_{T,t-1}$	0.431971**	2.693670		
$\ln HA_{C,t-1}$			0.516840**	2.975659
$D(\ln P_{T,t-1})$	0.094807**	2.183447		
$D(\ln WA)$			-0.255528**	-2.178845
$D(\ln PTPM)$	0.008889	0.094572		
$(D \ln PCPM_{t-1})$			-0.076031	-1.635086
$D(\ln PTPG)$	0.152458	-1.51924		
$D(\ln PCPG)$			-0.049922	-0.965905
$\ln WE$	0.103311	0.615899	0.154526	1.061881
$D(\ln AGP)$	0.021028	0.243598	-0.077535	-0.916431
$D(\ln TI)$			0.162080	1.172743
$\ln FERT$	0.100742*	1.781372	-0.006353	-0.092427
$D(\ln TPT)$	0.986637	0.991449		
DEX	0.072390	0.520861	0.198879**	2.400423
R-squared	0.886188		0.541152	
Pr(F-statistic)	0.000000		0.011973	

Note: *significant at 10%, ** significant at 5%, and *** significant at 1%.

The table above depicts that hectarage equations have a coefficient of determination of 0.89 and 0.54 respectively with associated F-statistics significant in both equations at 5 percent. This, in addition to diagnostic results presented in the section above, shows that the equations are good fits of the models with the residuals satisfying the normal distribution assumption.

From the table, it can be deduced that for the period of study the price ratios have had no significant influence on hectarage cultivated as they are statistically insignificant. Own price of tobacco is statistically significant at 5 percent indicating that the tobacco hectarage allocation is dependent on previously observed prices. The positive sign of the coefficient of previous price of tobacco indicate a positive relationship between observed prices and the hectarage allocation. The results indicate that a 1 percentage change in the

price of tobacco stimulates a proportionate 0.09 percentage change in hectareage allocation to tobacco the next crop season.

The dummy variable for exchange rate deregulation is not statistically significant in the tobacco hectareage. For the cotton hectareage equation at 5 percent it is statistically significant and also has the expected positive sign. This implies that the deregulation of the exchange rate in 1991, boosted agricultural exports and trickled down to both tobacco and cotton farmers by stimulating an increase in their hectareage allocation to export crops though more significantly in cotton. This is consistent with economic theory that devaluation tends to boost exports.

In both these hectareage equations, previous hectareage cultivated is statistically significant at 5 percent. This indicates that it exerts significant influence on current hectareage allocation in both tobacco and cotton, and they also have the expected positive sign. From Table 5.1 it is evident that a 1 percentage change in the current hectareage allocation will induce a 0.43 percent and a 0.52 percentage change in the next crop season's hectareage allocation to tobacco and cotton respectively¹¹. Thus farmers mostly allocate land to various export crops basing on their previous allocation to respective export crops. This is a reasonable finding in recognition of the fact that due to land scarcity and other factors, crop rotation is not common amongst farmers in Malawi.

5.2.3 Output Estimation Results and Interpretation

The following table presents regression results of the output equations for the three crops which are equations (4.5a), (4.5b), and (4.5c).

¹¹ However, this result is subject to various other constraints farmers face.

Table 5. 2 Regression Results of Output Equation

Regressors	Dependent variables					
	Tobacco production		Cotton production		Tea production	
	coefficient	t-statistic	Coefficient	t-statistic	coefficient	t-statistic
Constant	3.149520**	2.422272	-10.7062***	-2.88200	8.518198	0.697826
$\ln HA_{T,t-1}$	-0.21806***	-3.04353				
$\ln HA_C$			0.718482**	2.348886		
$\ln HA_{TE}$					-1.026358	-0.82456
$D(\ln P_{T,t-1})$	0.460179***	3.570977				
$D(\ln P_{C,t-1})$			0.819906**	2.659318		
$D(\ln PTPM_{t-1})$	-0.26977***	-3.44843				
$D(\ln PCPM_{t-1})$			-0.246775	-1.42857		
$D(\ln PCPG_{t-1})$			-0.75923***	-3.22124		
$\ln WE$	-0.162581	-1.41469	-0.052282	-0.20375	0.181347	1.148723
$\ln AGP$	0.116190*	1.883182	-0.128220	-0.87696		
$D(\ln TI)$	0.003911	0.034256	0.017326	0.063082	-0.190528	-1.15281
$\ln FERT$	0.076914	1.598744	0.306388**	2.731434		
$D(\ln RER)$	-0.362355*	-1.83155				
$D(\ln TPT)$					-1.315690	-1.23121
DEX			-0.150190	-0.97934		
$D(\ln QA_{T,t-1})$	-0.063758	-0.42957				
$D(\ln QA_{C,t-1})$			-0.38189***	-2.87648		
$D(\ln QA_{TE,t-1})$					-0.70843***	-3.02087
$\ln QA_{TE,t-2}$					-0.442421*	-1.90391
$D(\ln QA_{TE,t-3})$					-0.358311*	-1.90111
$D(\ln IPI)$	-0.039771	0.8353	-0.649716*	-1.73516	-0.547636*	-1.96776
$\ln P_{TE,t-1}$					0.228684*	1.745661
R-squared	0.628085		0.718338		0.591524	
Pr(F-statistic)	0.003436		0.000577		0.007460	

Note: *significant at 10%, ** significant at 5%, and *** significant at 1%.

These three equations have respective coefficients of determination of 0.63, 0.72, and 0.59 with the F-statistic significant at 1 percent in all the three equations indicating joint statistical significance of the explanatory variables in explaining the dependent variable. Diagnostic tests (presented earlier) also confirm that these are good fits of the models.

From Table 5.2, the relative price ratios of tobacco to maize, and that of cotton to groundnuts are significant at 1 percent, whilst that of cotton to maize is insignificant. All these price ratios have an unexpected negative sign which implies that contrary to expectation an increase in these price ratios (an increase in the price of tobacco relative to maize, and an increase in the price of cotton relative to groundnuts significantly) may precipitate a decrease in tobacco and cotton production respectively. Econometric estimation results indicate that 1 percentage increase in the relative price ratio of tobacco to maize stimulate a decrease in tobacco production by 0.26 percent, while the 1 percentage increase in relative price of cotton to groundnuts, precipitate a 0.76 percentage decrease in cotton production.

These econometric results indicate that groundnuts are a heavy competitor to cotton with an elasticity of close to unity. Taking into account this result in light of the finding of these price ratios on hectareage equations it could be deduced that, to farmers a small increase in price of non-tradables induces an increase in their production of tradables but not necessarily hectareage allocation. One possible explanation could be that a small increase in non-tradables induces an increase in productivity of tradable crops (though this is an area for further research). This could be the case as farmers are net buyers in as much as they are also net sellers of food crops.

Previously observed prices in tobacco, cotton and tea are significant at 1 percent, 5 percent and 10 percent respectively, and have the expected positive sign. This indicates that farmers' decision to grow these export crops highly takes into consideration observed prices in the past period and in the case of tobacco and cotton, that decision also takes into account relative prices of other crops like maize and groundnuts. Cotton production has short-run own price elasticity close to unit (0.82), whilst those of tobacco and tea are 0.46 and 0.23 respectively. As expected tea has the least elasticity as it is a perennial crop expected to have relatively low responsiveness in the short-run. Thus from these elasticities it can be concluded that production of these three main export crops is responsive to own price and except tea, it is also responsive to relative prices of other smallholder crops.

The amount produced the previous period is exerting a significant influence on current production in tea and cotton at 10 percent and 1 percent significance levels respectively, while it is insignificant for tobacco. For the case of cotton, empirical estimation has a negative unexpected sign implying that a percentage change in previous production influences a 0.38 percentage decrease in the current production. This shows that for cotton previous production is not a determining factor in stimulating current production. This result is consistent with economic expectation that due to collapse of the cotton processing company, David Whitehead and Sons (which was the only cotton processing company up until early this century) the more is produced in a year, prices become depressed negatively affecting production the following year. It could also be a reflection of the general decrease in world prices of cotton experienced during the period of study.

In the case of tea all the three lagged values of production are significant at 10 percent, 1 percent and 1 percent, respectively, indicating that as expected, being a perennial crop, production in the past few years significantly affects current year's production. However, this relationship is unexpectedly negative. Being a perennial crop, this low progressive productivity could be a result of old tree seedlings as noted by the Malawi Diagnostic Trade Integration Study (2002). This study (ibid) recognizes that to this effect there is gradual replacing of these old tree seedlings by higher yielding clonal varieties and also an effort to move from rain-fed tea production to irrigation.

The import penetration index is significant in cotton and tea equations at 10 percent while it is insignificant in tobacco, with the negative expected sign in these equations. This indicates that imports of agricultural produce are suppressing domestic production of export crops an indication that during the period of study one factor that led to the collapse of domestic production of exports was influx of imported products.

5.2.5 Agriculture Sector Estimation Results and Interpretation

The following table presents regression results and interpretation of the aggregate agriculture exports equation, which is equation (4.6).

Table 5.3 Regression Results of Aggregate Export Equation

Regressors	Dependent variable: Agricultural export	
	Coefficient	t-statistic
Constant	1.092315*	2.025115
$D(\ln EX_{t-1})$	-0.075369	-0.552083
$D(\ln WA)$	-0.124139	-1.387239
$D(\ln TI)$	0.076201	0.701244
$\ln FERT$	-0.088582*	-1.889685
$D(\ln RER)$	0.594630***	3.257723
$D(\ln TPT)$	1.117822	1.466698
$D(\ln IPI)$	0.482085**	2.775209
DCL	0.001854	0.029609
R-squared	0.665847	
Pr(F-statistic)	0.000187	

Note: *significant at 10%, ** significant at 5%, and *** significant at 1%.

Results from this table indicate that the coefficient of determination has a value of 0.67 with a significant F-statistic at 1 percent. This in addition to diagnostic test reported earlier show that this is also a good fit of the model.

From this table depicting the aggregate agriculture exports equation, fertilizer variable is significant at 10 percent reflecting the reliance of Malawi agriculture produce on fertilizer. This implies that fertilizer availability for crop production is one major factor influencing export performance for the country. Fertilizer has an elasticity of 0.09, indicating that agricultural exports are relatively fertilizer inelastic. This could be an indication that fertilizer imports are mostly used for food crop production in the wake of food security and declining performance of export crops. There have been fertilizer subsidies concentrated on food crop production which may explain the fertilizer inelasticity of agricultural exports.

The real exchange rate variable is highly significant indicating that government policy on real exchange rate management has had significant influence on aggregate agricultural exports. The real exchange rate variable has the expected positive sign consistent with economic theory that an increase in the exchange rate (devaluation) makes our products cheaper in the international market inducing an increase in aggregate agriculture exports. The dummy for crop liberalization is not significant, indicating insignificance of this government policy in stimulating agricultural exports.

The import penetration index is significant at 5 percent and has an elasticity of 0.48 indicating that agricultural exports are relatively elastic to overall imports into the country. This variable has a positive sign which implies that as more imports are circulated in the local markets, domestic production becomes more oriented towards the export market. This is consistent with findings by the United Nations in the cotton sector being more export oriented as reviewed in chapter two.

CHAPTER SIX

CONCLUSION AND POLICY IMPLICATIONS

1.1 Summary, Conclusion and Policy Implications

In this study, quantitative effects of price and non-price incentive structures, and policy incentives were examined to attain an overall objective of analyzing the impact of price and non-price incentives on supply of Malawi's main export crops over the period 1970-2005. Quantitative effects of own prices and relative prices of resource-competing crops like maize and groundnuts, and quantitative effects of non-price incentives like transport network, real exchange rate policy, fertilizer import incentives, and crop liberalization policy, were examined. Other variables examined for their impact on supply of export crops include foreign income, weather, and the extent of imports into the country. Export crops whose supply responses have been examined are tobacco, tea, and cotton applying the unrestricted Nerlovean supply response modeling technique. In this methodology in addition to estimating the output responses, hectareage responses of respective output crops and aggregate export responses are also estimated. Diagnostic tests conducted confirmed that each of the regression equations explains the model well and is well specified.

Econometric results from the study indicate that own price of tobacco exerts independent and significant (at 5 percent) positive effects on tobacco hectareage cultivation with an elasticity of 0.09. The price ratios (relative price of tobacco to maize, and the relative price of tobacco to groundnuts) have had positive but insignificant effect on land allocation to tobacco. Own hectareage elasticities of tobacco and cotton were found to be statistically significant at 5 percent, indicating a significant effect on land allocation to the two crops. The respective own hectareage elasticities were found to be 0.43 and 0.52 for tobacco and cotton suggesting that farmers mostly allocate land to export crops on the basis of their previous allocation.

The study shows that the own prices of these export crops are elastic. For instance a 10 percent increase in own price stimulates an 8.2, 4.6 and 2.3 percentage change in cotton, tobacco and tea production, respectively. Overall in export production it was also found that relative prices of a respective tradable crop to non-tradable do not exert significant influence on production of the tradable crop. This result together with the previous one implies that farmers currently are not allocating land resources basing on relative price profitability of a crop but basing on their previous allocation pattern. It suggests that farmers have more or less a traditional pattern of crops cultivation basing or have other factors they consider in land allocation.

Weather (estimated by average annual rainfall) and foreign income (trade-weighted income) were found insignificant in impacting influence in production of agricultural export crops but the import penetration index was found to be significant. This implies that foreign income Malawi receives in exports of agricultural produce has not been a significant demand factor influencing domestic supply. This could be a result of the perceived discrepancy between domestic agricultural prices to which farmers respond and the international prices to which middlemen in agricultural marketing trade respond. Government policy in agricultural marketing has currently started addressing this problem by setting minimum local prices of some agricultural products like tobacco and cotton.

In overall agricultural exports the following non-price incentive structures were found to exert significant influence in export performance; fertilizer availability, import penetration index and the real exchange rate. Agricultural wage had a negative impact on agricultural exports whilst foreign income had a positive impact although both were found to be statistically insignificant.

In light of the above findings the overall conclusion made is that in the short-run farmers are responsive to price and non-price incentive structures and that the key challenge is to identify key non-price incentive structures per respective crop to effectively stimulate export production. Offering good prices for agricultural produce in both domestic and

world markets is key to resuscitating the agricultural sector and economic growth through improved exports, which requires efficient operation in the global economy. The current national drive of re-offering producers (farmers) price incentives to induce domestic supply will have to be substantiated by effective incorporation of Malawi products in the world trade. Such induced supply will also be to cater for domestic markets, a trend towards re-tackling import substitution.

Based on these findings the following policy implications are drawn. Firstly that to diversify the export base for the economy, farmers need to adopt or develop value-adding processes to attract better prices for their produce in the market and integrate the international market. To this respect government needs to invest in low cost value-adding technologies amongst farmers by investing in research and development. This should be complimented by developing and implementing national policies that effectively diversify agricultural production and integrate international markets without exposing farmers to unfair international competition. Farmers being responsive to own prices imply that technologies enabling their produce to attract better prices will be most likely appreciated and adopted to improve their income.

Secondly, the finding that trade weighted income (a proxy on international demand for local exports) is insignificant in stimulating the country's exports, is an indication that more needs to be done to enhance competitiveness of local exports. For instance government has to develop policies, and infrastructure (communication) to enable local value-adding processes and exports to meet international standards. This should go along with strengthening Malawi's team in international trade negotiations and agreements, as literature (chapter two) showed that international trade agreements Malawi enters offers the nation favorable market opportunities for its produce (especially the AGOA, and Malawi-South Africa bilateral agreement). Supply-side constraints the nation faces are eroding the potential to fully benefit from these trade arrangements. As such there is need to strengthen the institutional capacity of Malawi Investment Promotion Agency (MIPA) and the Ministry of Trade and Private Sector Development, to attract, encourage and facilitate local and foreign investors in domestic production. Strengthening the

institutional capacity will provide the much needed support in terms of investment capital, technical skills development in extension services and offering market to the responsive farmers. Vibrant institutional setup and effective crop farmer association as well as a well developed private stakeholder capacity will enable the nation to effectively lobby and negotiate for better prices and favorable trade agreements in international trade rendering creating demand in world trade.

The result that farmers allocate land to a respective crop mainly basing on previous allocation, more or less habitual hectareage allocation, calls for government policy on farmer sensitization through extension services to initiate land allocation based on relative profitability of agricultural crops. Just as farmers are responsive to crops own price, they should envisage the profit motive in their farming activities disseminated by strengthened government extension workers. This profit motive will be inline with the farmer's initiative of re-orienting domestic production towards the export market.

1.2 Limitations of the Study

The study set out to analyze supply responses for four crops tobacco, sugar, tea, and cotton. But in the course of research due to data limitations the crop sugar was dropped. This implies the study was not able to assess the export response of the second most important export crop (in terms of commanded export share) for the nation. However the third and fourth ranking crops are examined in this study, whose data quality as explained earlier was verified by three or more different sources.

1.3 Area of Further Study

Due to results and interpretations in the study the following area of further research is suggested to complement the findings in this study on modeling farmer behavior in agriculture; the effect of an increase in the own price of tradable crops to farmer productivity. Results form this study pointed out to a possibility that own price increases in tradable crops induce productivity.

APPENDICES

Appendix I References

- Abrar, S., Morrissey O., and Rayner, T., (2004) "Aggregate agricultural Supply Response in Ethiopia: A Farm Level Analysis" *Journal of International Development* J. Int. Dev. 16, 605-620
- Action Aid, (2004) *The WTO Agreement on Agriculture*, Action Aid Alliance
- Bond, M., (1983) "Agricultural Responses to Sub-Saharan Countries" *IMF Staff Papers* Vol. 30 No. 4, pp 703-726.
- Behrman, J., (1968) *Supply Response in Underdeveloped Agriculture: A case study of four major crops in Thailand. 1937-1963* Amsterdam, North Holland in Sadoulet, E., and de Janvry., (1995) *Quantitative Development Analysis*, The John Hopkins University Press, Baltimore and London.
- Brulke, M., (1982) "A note on the Nerlove Model of Agricultural Supply Response" *International Economic Review*, Vol. 21 No 1. pp 214-244, p241
- Brandow, G. E., (1958) "A note on the Nerlove Estimate of Supply Elasticity" *Journal of Farm Economics* Vol 40, No 3. pp 719-722, p722
- Chilowa, W., (1993) *The significance of Tobacco in the Economy of Malawi* University of Malawi, Centre for Social Research, p.9
- Chilowa, W., (1994) *Report of the Proceedings of the Regional Seminar on the Integration of Poverty Alleviation Strategies into Economic Policies*, University of Malawi, Centre for Social Research, p.71
- Chilowa, W., (1998) *The Impact of Agricultural Liberalization on Food Security in Malawi* Centre for Socail research, University of Malawi, Zomba Malawi in *Food and Policy*, vol. 23, No. 6 pp 553-569
- Chirwa, E., and Zakeyo, C., (2003) *Impact of Economic and Trade Policy Reforms on Food Security in Malawi*, Report submitted to the Food and Agriculture Organization (FAO) and the African Economic Research Consortium (AERC) in Chirwa, E. (2004) *Macroeconomic Policies and Poverty reduction in Malawi:*

- Can we Infer from Panel Data*, University of Malawi, Chancellor College, Paper WC/04/04, September 2004.
- Danielson, A., (2002) *Agricultural Supply Response in Tanzania: Has Adjustment Really Worked?* Blackwell Publishers, Africa Development Bank, Oxford p.98
- Diagnostic Trade Integration Study, (2002) *Malawi Diagnostic Trade Integration Study* Draft copy, Lilongwe.
- Economic Commission for Africa (2005) *Economic Report on Africa 2005: Meeting the Challenges of Unemployment and poverty in Africa*, Addis Ababa, Ethiopia.
- Gbtenkom, D and Khan, S.A.(2002) *Determinants of Agricultural Exports: The Case of Cameroon* African Economic Research Consortium Research Paper 120, Nairobi, Kenya.
- Goldstein, M., and Khan, M.S., (1978) "The Supply and Demand for Exports: A Simultaneous Approach" *The Review of Economics and Statistics* Vol. 60, No. 2, Apr. 1978, pp 275-286.
- Government of Malawi (1995) *Agricultural and Livestock Production Strategies Action Plan*, Ministry of Agriculture and Livestock Development, Lilongwe, Malawi in Kachule R.N. (2000), *ibid*, p.6
- Government of Malawi (1995b) *Policy Framework for Poverty Alleviation Programme* Ministry of Economic Planning and Development, Lilongwe, Oct 1995, p22
- Government of Malawi, (2002), *Qualitative Impact Monitoring (QIM) of the Poverty Alleviation Projects and Programs in Malawi*, National Economic Council, April 2002, Vol. 1, Survey Findings. P 70
- Government of Malawi, (2005b), *Integrated Household Survey 2004-2005, Volume I, Household Socio-economic Characteristics*, National Statistical Office, p 138-139.
- Government of Malawi (2006), *Malawi Growth and Development Strategy*, Main Report, March 2006, Volume 1
- Griffith, M. and Boyd, S., (2007) *Much to loose, little to gain; assessing EPAs from the perspective of Malawi*, Tearfund
- Gujarati, D., (2003) *Basic Econometrics*, fourth ed, McGraw-Hill, London

- Hartley, M.J., Nerlove, M., and Kyles Peter, R., (1987) *An Analysis of Rubber Supply in Sri-Lanka*, American Journal of Agricultural Economics, Vol 69, No.4
- Jaeger, W., (1990), *The Impact of Policy on African Agriculture: An Empirical Investigation* Washington DC, World Bank in Schiff, M., and Montenegro, C.E., “Aggregate Agricultural Supply Response in Developing Countries: A Survey of Selected Issues” *Economic Development and Cultural Change* Vol 5. No 2. Jan 1997
- Just, R.E. (1975) *Risk Response Models and their use in Agricultural Policy Evaluation*, American Journal of Agricultural Economics Vol.,57, No.5 pp 836-843.
- Kachule, R.N., (2000) *Agricultural Market Liberalization in Malawi: Agenda for Increased Efficiency and Competitiveness* Bunda College of Agriculture. p.2
- Kwanashie, M., Ajilima, I., and Garba, A.G., (1998) *The Nigerian Economy: Response of Agriculture to Adjustment Policies*, AERC Research Paper, No. 78 African Economic Research Consortium, Nairobi, Kenya.
- Kydd, J., (1985) *Forces Facing Malawi Agriculture in the 1980s: The Challenge of Macroeconomic Disequilibrium*, University of London, Wye College, p.2.
- Malawi Confederation of Chambers of Commerce and Industry, MCCCCI, (2006)
http://www.mccci.org/business_opportunities.asp
- Madola M.V., (1999) *The Real Exchange Rate and Malawi's Agricultural Exports*, Unpublished Master of Arts (economics) Thesis, University of Malawi - Chancellor College.
- Malawi National Strategy Team (2005), *Growing out of poverty- a strategic direction in the agricultural sector*, a paper contributed by the Malawi National Strategy Team p.3
- Mandindi, H. (2006) *Study on Mainstreaming trade into national development strategies in Africa; the case of Malawi*, workshop presentation
- Mangani, R., (2003) *Econometric Modeling for Central Bankers, Module 4: Development s in Single Equation Models*, University of Malawi, Chancellor College
 Department of Economics, Zomba, p26.
- Mbekeani, K., (2005), *MALAWI: Studies on Past Industrial Trade Reforms Experience and Economic Implications* Botswana Institute for Development Policy Analysis.

- Mkandawire, L. (1997) *Determinants of Current Account in Malawi Balance of Payments*, unpublished MA(economics) Thesis, Chancellor College.
- Mnenula, M. J., (1999), *The Traditional Smallholder Tobacco Producer Price Response in Malawi (1968-1997)*, University of Malawi Chancellor College (unpublished thesis), p. 9.
- Morrisey, O., and Mold, A., (2004) *Explaining Africa's Performance: Taking a New Look*, Institute of World Economics and International Management (IWIM).
- National Statistical Office, *Monthly Statistical Bulletin*, various issues, NSO, Zomba, Malawi
- Newey, N., and West, S., (1998) "EViews Quantitative Micro Software," *Institute of Social Studies*, in Chambukira, M., (2005) *Demand for Imports: The case of Malawi, 1964-2003*, Unpublished MA(Economics) Thesis University of Malawi-Chancellor College.
- Oxfam (2002) *Cultivating Poverty: The Impact of US Cotton Subsidies on Africa*, Oxfam Briefing Paper No. 30. Oxfam International in UN/UNCTAD (2003)
- Phiri, D.D., (2006) *International Trade and Economic Development*, in The Nation Newspaper of 16th October, 2006.
- Pope, R.D., (1981) *Supply Response and the Dispersion of Price Expectations*, American Journal of Agricultural economics, vol 63, No.1, pp 161-163.
- Pryor, F. L., (1990) *Malawi and Madagascar: The Political Economy of Poverty, Equity and Growth*, A World Bank Comparative Study, Oxford University Press
- Reserve Bank of Malawi, *Financial and Economic Reviews* Lilongwe, Malawi. Various Issues
- Sadoulet, E., and de Janvry, A., (1995) *Quantitative Development Policy Analysis* The John Hopkins University Press, Baltimore and London p. 97
- The Africa Trade Insurance Agency, (nd) *Economic Overview: Malawi*.
<http://www.africa-eca.com/malawi.asp>
- World Trade Organization (nd), Trade Policy Review Body: Malawi, the Secretariat's Report Summary, http://www.wto.org/english/tratop_e/tpr_e/tp188_e.htm, p.1
- UNCTAD (2003) *Economic Development in Africa: Trade Performance and Commodity Dependence* United Nations, New York and Geneva

UNCTAD (2006) *Malawi and the Multilateral Trading System: The Impact of WTO Agreements, Negotiations and Implementation* United Nations, New York and Geneva.

USAID (2005), *Economic Performance Assessment: Malawi*, April 2005, Nathan Associates, United States.

World Bank (1994) "Malawi Agricultural Sector Memorandum: Strategy Options in the 1990s. Vol. II Main Report, in Kachule R. N., (2000) *ibid*, p.4

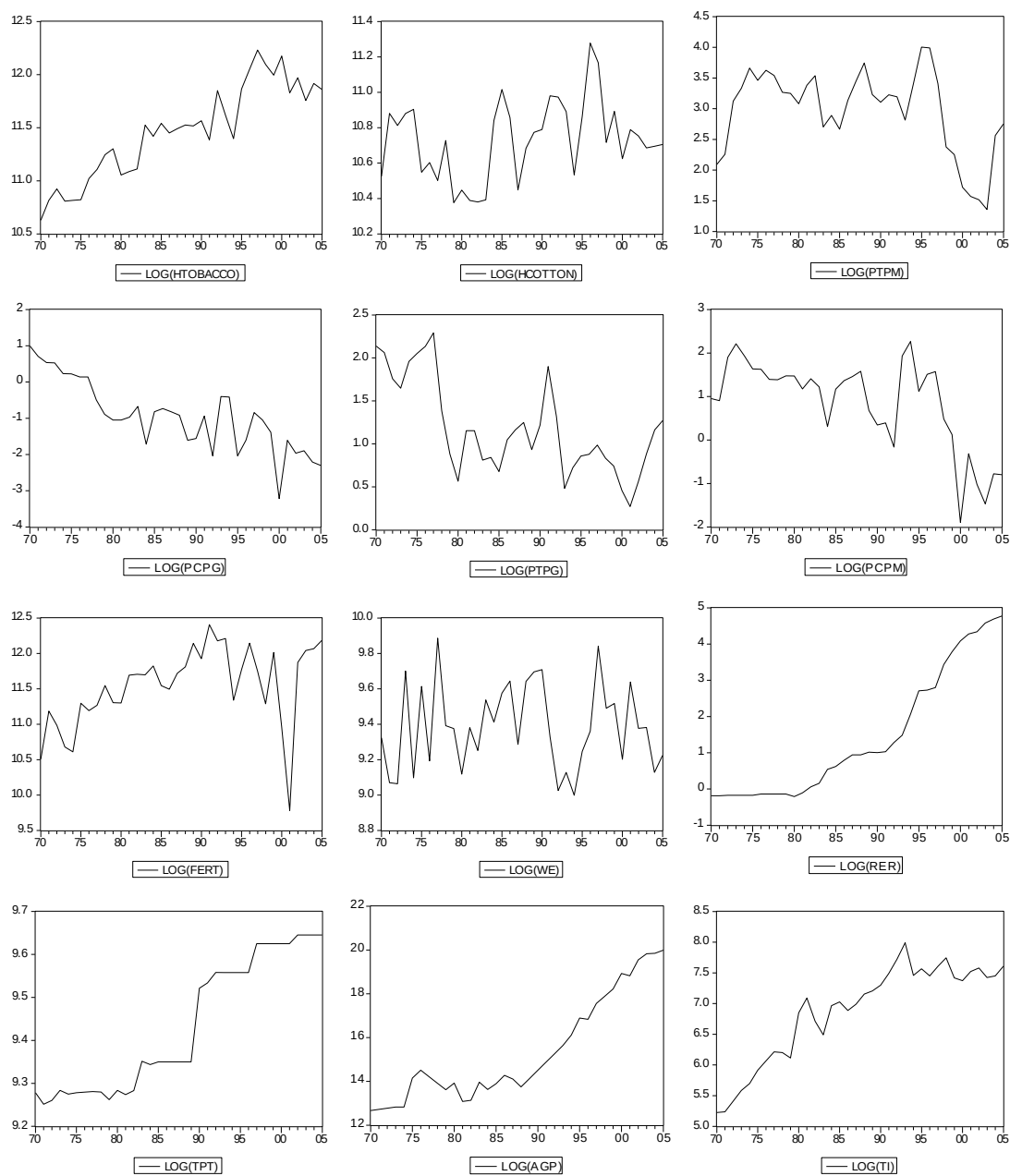
World Bank (nd) *Economics of Tobacco in Malawi*,
<http://www1.worldbank.org/tobacco/pdf/country%20briefs/malawi.doc>

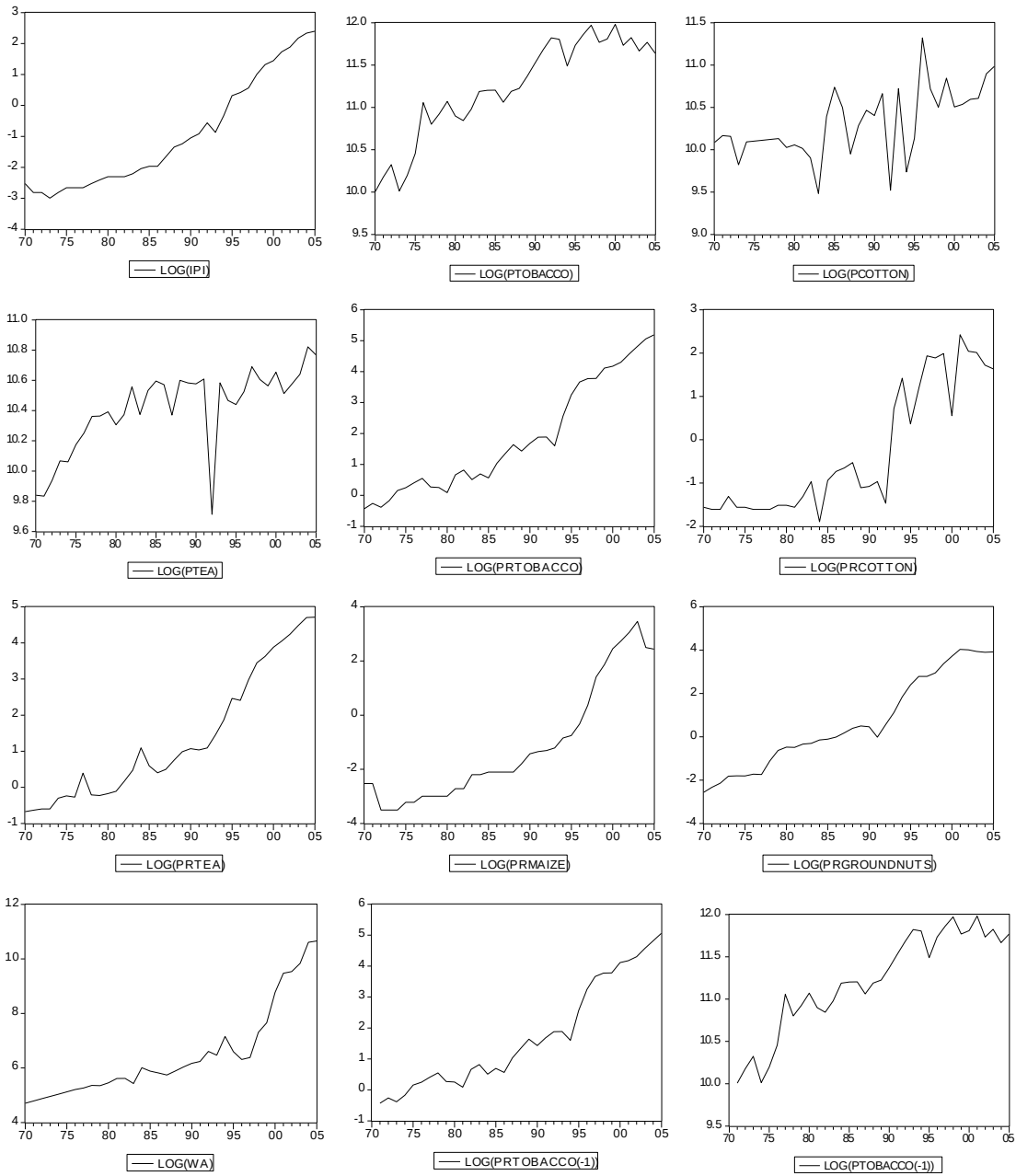
Appendix II Data Used in the Study

YEAR	Hectarage			PTPM	PTPG	PCPM	PCPG	FERT	WE	RER	TPT	AGP
	htobacco	hcotton	htea (^{'000})									
1970	41310	37211	15400	8.11	8.48	2.59	2.71	36569	11199	0.83	10703	318566
1971	49815	53159	15400	9.57	7.86	2.47	2.03	72087	8685	0.83	10419	336087
1972	55485	49618	15800	22.71	5.80	6.70	1.71	58953	8635	0.84	10514	354572
1973	49410	53125	16200	28.01	5.20	9.13	1.69	43412	16323	0.84	10762	374235
1974	49815	54372	16600	38.93	7.09	6.91	1.26	40548	8928	0.84	10668	374235
1975	50100	38139	17000	31.90	7.79	5.13	1.25	80504	14974	0.84	10702	1397962
1976	61100	40266	17400	37.53	8.46	5.08	1.15	72504	9829	0.87	10717	2001653
1977	66600	36388	17400	34.53	9.89	4.03	1.15	78278	19663	0.87	10731	1487654
1978	76500	45607	17800	26.26	3.99	3.99	0.61	103398	11986	0.87	10719	1105327
1979	80900	32087	18200	25.81	2.42	4.37	0.41	81225	11798	0.87	10530	821258
1980	63200	34451	18300	21.80	1.76	4.36	0.35	80800	9118	0.81	10763	1109071
1981	65300	32488	18400	29.45	3.17	3.24	0.35	119672	11860	0.90	10655	480137
1982	66900	32218	18500	34.36	3.17	4.08	0.38	121144	10415	1.06	10755	508016
1983	101100	32597	18500	14.91	2.25	3.39	0.51	120186	13866	1.17	11515	1157134
1984	91000	51059	18600	18.02	2.32	1.36	0.18	136277	12235	1.72	11429	829729
1985	102800	60824	18600	14.40	1.97	3.22	0.44	103223	14407	1.86	11499	1084487
1986	93900	51910	18800	23.02	2.85	3.91	0.48	98064	15432	2.21	11499	1585229
1987	97800	34504	18800	31.45	3.20	4.30	0.44	122870	10783	2.56	11499	1339957
1988	101200	43642	18800	42.30	3.49	4.85	0.40	134561	15392	2.56	11499	934078
1989	100300	47741	18500	25.26	2.54	1.97	0.20	187439	16246	2.76	11499	1363754
1990	105400	48516	18300	22.34	3.38	1.41	0.21	150985	16453	2.73	13648	1991081
1991	88000	58691	18300	25.22	6.69	1.48	0.39	244558	11252	2.80	13819	2906978
1992	140000	58281	18600	24.39	3.74	0.85	0.13	194353	8312	3.60	14161	4244188
1993	111000	53691	18900	16.69	1.62	6.89	0.67	200951	9206	4.40	14157	6196514
1994	89000	37552	18700	30.19	2.06	9.64	0.66	83900	8089	7.90	14157	9958907
1995	142000	52237	18700	54.81	2.36	3.06	0.13	129500	10366	15.00	14157	21681309
1996	171000	79073	18800	54.11	2.41	4.52	0.20	188100	11626	15.30	14157	20422418
1997	205000	70734	18800	30.24	2.68	4.82	0.43	126600	18776	16.44	15137	42191409
1998	179000	45077	18800	10.76	2.30	1.62	0.35	79900	13228	31.07	15137	58604090
1999	162000	53766	18800	9.50	2.10	1.13	0.25	165000	13593	44.09	15137	81650074
2000	194000	41135	18800	5.59	1.58	0.15	0.04	57300	9913	59.54	15137	165882089
2001	137000	48481	18800	4.81	1.31	0.73	0.20	17700	15342	72.20	15137	149545791
2002	158000	46773	18800	4.56	1.75	0.36	0.14	143100	11813	76.69	15451	308120058
2003	127521	43706	18800	3.89	2.42	0.23	0.15	169500	11870	97.50	15451	408793408
2004	149701	44143	18800	12.97	3.20	0.46	0.11	173800	9210	109.00	15451	416892487
2005	141527	44584	18800	15.67	3.57	0.45	0.10	195498	10131	118.40	15451	481897329

TI	IPI	Production			Prices					WA	EX	DEX	DCL
		tobacco	cotton	tea	tobacco	cotton	tea	maize	g/nuts				
186	0.08	22177	24042	18771	0.65	0.21	0.51	0.080	0.077	111	40577	0	0
188	0.06	26305	26027	18654	0.77	0.20	0.53	0.080	0.097	120	49577	0	0
224	0.06	30479	25814	20682	0.68	0.20	0.55	0.030	0.117	131	55142	0	0
266	0.05	22289	18438	23553	0.84	0.27	0.55	0.030	0.162	142	68802	0	0
298	0.06	26836	24157	23408	1.17	0.21	0.74	0.030	0.165	154	89534	0	0
370	0.07	34717	24399	26237	1.28	0.21	0.79	0.040	0.164	168	106283	0	0
431	0.07	63390	24643	28306	1.50	0.20	0.76	0.040	0.178	183	141030	0	0
500	0.07	49091	24889	31628	1.73	0.20	1.48	0.050	0.175	194	171970	0	0
494	0.08	55465	25138	31690	1.31	0.20	0.81	0.050	0.329	213	148781	0	0
452	0.09	64312	22636	32609	1.29	0.22	0.80	0.050	0.534	211	176305	0	0
942	0.10	54121	23345	29915	1.09	0.22	0.84	0.050	0.619	234	218307	0	0
1201	0.10	51231	22391	31965	1.94	0.21	0.90	0.066	0.613	274	245954	0	0
823	0.10	58626	20013	38484	2.27	0.27	1.19	0.066	0.715	276	247886	0	0
658	0.11	72243	13134	32011	1.66	0.38	1.60	0.111	0.736	228	273741	0	0
1059	0.13	73329	32600	37530	2.00	0.15	2.98	0.111	0.861	408	430751	0	0
1128	0.14	73379	46106	39954	1.76	0.39	1.81	0.122	0.893	360	410769	0	0
979	0.14	63661	36235	39000	2.81	0.48	1.50	0.122	0.984	336	449067	0	0
1085	0.19	72387	20957	31900	3.84	0.52	1.64	0.122	1.201	312	602488	0	0
1278	0.26	74997	29286	40157	5.16	0.59	2.12	0.122	1.480	360	742031	0	0
1346	0.29	86599	35106	39469	4.19	0.33	2.68	0.166	1.652	418	730169	0	0
1479	0.35	101403	33026	39218	5.36	0.34	2.92	0.240	1.587	477	1097906	0	0
1790	0.40	118439	42780	40500	6.56	0.38	2.82	0.260	0.980	511	1299330	1	0
2260	0.57	136230	13632	16536	6.58	0.23	2.98	0.270	1.760	739	1408282	1	0
2951	0.42	133846	45339	39497	4.96	2.05	4.26	0.297	3.050	647	1252661	1	0
1737	0.72	97669	16936	35141	12.98	4.14	6.43	0.430	6.300	1285	2722366	1	0
1932	1.37	124667	25197	34181	25.76	1.44	11.72	0.470	10.925	734	5995517	1	0
1723	1.52	141700	82591	37232	38.96	3.26	11.11	0.720	16.190	550	7268888	1	1
2013	1.76	158100	45122	43930	43.54	6.94	19.61	1.440	16.235	592	8260300	1	1
2308	2.74	129200	36381	40363	43.90	6.61	31.43	4.080	19.065	1491	15702400	1	1
1668	3.74	134400	51321	38696	61.20	7.30	37.63	6.440	29.075	2116	17581800	1	1
1592	4.25	159800	36527	42388	64.93	1.74	48.42	11.61	41.075	6431	32195000	1	1
1850	5.65	124700	37622	36769	74.04	11.27	57.38	15.39	56.570	12996	30932000	1	1
1958	6.60	136600	39992	39185	96.88	7.71	69.37	21.25	55.415	13804	29444400	1	1
1676	8.79	116600	40446	41795	123.77	7.48	88.30	31.84	51.215	18720	41584600	1	1
1721	10.32	129056	54000	50090	157.77	5.58	110.3	12.16	49.365	40548	50507800	1	1
2017	10.99	113487	59000	47505	179.38	5.14	111.3	11.45	50.300	42515	58306100	1	1

Appendix III Line Graphs of Variables Used in Logs and Log Differences





Appendix IV Unit Root Test Results

VARIABLE	ADF test			Phillip-Perron Test		
	Levels	1 st difference	Order	Levels	1 st difference	Order
ln(HTTOB)	-3.65		I(0)	-3.67		I(0)
ln(PTPM)	-2.17	-3.56	I(1)	-2.89	-4.75	I(1)
ln(PTPG)	-2.42	-4.23	I(1)	-2.45	-4.94	I(1)
ln(WE)	-5.25		I(0)	-5.25		I(0)
ln(TI)	-2.02	-6.27	I(1)	-1.66	-7.56	I(1)
ln(FERT)	-3.90		I(0)	-3.90		I(0)
ln(AGP)	-1.20	-5.96	I(1)	-1.20	-5.964	I(1)
ln(PCPM)	-3.29	-7.27	I(1)	-3.31	-7.50	I(1)
ln(PCPG)	-5.00		I(0)	-5.00		I(0)
ln(IPI)	-2.51	-6.55	I(1)	-2.71	-6.96	I(1)
ln(RER)	-1.81	-4.21	I(1)	-1.65	-4.17	I(1)
ln(TPT)	-2.49	-6.08	I(1)	-2.52	-6.10	I(1)
ln(HTTOB(-1))	-3.87		I(0)	-3.86		I(0)
ln(prmai)	-2.36	-4.41	I(1)	-2.36	-4.46	I(1)
ln(prtob(-1))	6.13		I(0)	-1.45	-5.64	I(1)
ln(WA)	-0.27	-5.68	I(1)	-0.29	-5.68	I(1)
ln(PDFOB)	-2.31	-6.93	I(1)	-2.08	-7.59	I(1)
ln(PDFOB(-1))	-2.65	-6.75	I(1)	-2.50	-7.40	I(1)
ln(PRTTEA(-1))	-1.30	-6.40	I(1)	-1.45	-6.43	I(1)

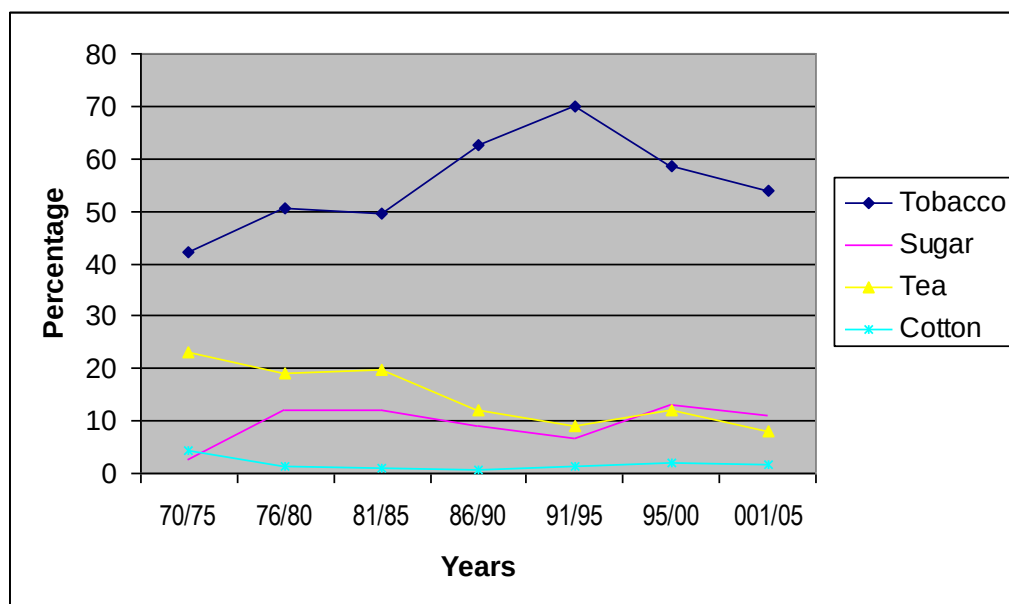
The MacKinnon critical values for the rejection of a unit root of the AD/ADF test statistics are: 1% = -4.2412, 5% = -3.5426, 10% = -3.2032

Appendix V Diagnostic Test Results (F-statistic values)

Equation	Ramsey Reset Test	Breusch-Godfrey Serial Correlation LM Test	Whites Heteroskedasticity Test	JB Test Statistic
Equation 4.4a	1.192 (0.286)	1.391 (0.269)	1.173 (0.373)	1.200 (0.550)
Equation 4.4b	1.130 (0.300)	0.425 (0.659)	1.366 (0.269)	0.733 (0.692)
Equation 4.5a	0.052 (0.821)	1.911 (0.172)	0.927 (0.566)	2.933 (0.231)
Equation 4.5b	0.028 (0.870)	0.394 (0.680)	1.750 (0.159)	0.472 (0.780)
Equation 4.5c	0.092 (0.764)	1.096 (0.353)	1.245 (0.349)	11.221 (0.060)
Equation 4.6	0.430 (0.518)	2.199 (0.134)	0.379 (0.968)	1.156 (0.561)

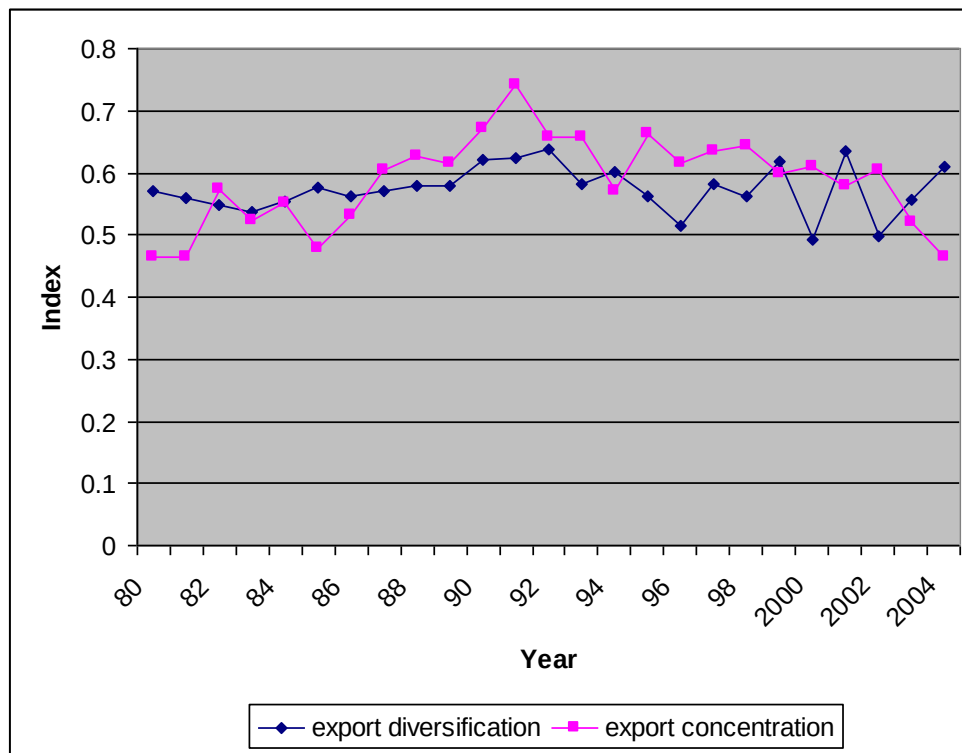
Note: Numbers in parenthesis are probability values for the F-statistic and the JB test statistic.

Appendix VI Commodity Composition of Exports



Source: Calculated from Reserve Bank of Malawi *Financial and Economic Reviews* Various Issues

Appendix VII Diversification and Concentration Indices



Source: UNCTAD, Handbook of Statistics, 2005, online.

Appendix VIII Domestic Exports by Main Commodities

Year	Tobacco		Tea		Cotton		TOTAL EXPORTS	TOTAL IMPORTS
	Tons	Value ('000)	Tons	Value ('000)	Tons	Value ('000)		
1970	17382	16592	17700	10916	5859	2777	40577	71367
1971	20913	22066	18200	11905	4820	2547	49577	89750
1972	24583	24968	19900	12022	4787	2567	55142	102913
1973	27464	30259	22700	13721	2470	1951	68802	114651
1974	27349	39269	23800	17220	2491	2720	89534	157726
1975	29568	51132	24900	21730	2192	1932	106283	218663
1976	33724	64930	29400	26431	1973	2348	141030	188480
1977	37702	86651	29800	41626	1776	2435	171970	209764
1978	38424	86146	30583	29098	1598	704	148781	284747
1979	54519	98638	30995	30590	1437	844	176305	324838
1980	60311	100796	31274	29751	3013	4517	218307	357294
1981	39314	99391	31018	30579	1031	1470	245954	312443
1982	43334	145777	36418	45253	500	333	247886	322729
1983	47084	136743	35833	55866	21	6	273741	352868
1984	67616	229932	37141	113109	1851	2977	430751	381705
1985	59891	187416	37400	87699	7260	12981	410769	506192
1986	58832	244347	40200	68413	2156	2066	449067	477972
1987	61417	373702	33400	60990	634	786	602488	653939
1988	59941	474925	37000	88970	2381	550	742031	1080151
1989	57874	458286	38200	101234	2900	16644	730169	1398803
1990	89066	769569	43000	127432	3881	10871	1097906	1575002
1991	57192	982059	41200	103808	4600	33301	1299330	1975800
1992	97316	1029820	37100	106726	2800	16624	1408282	2592000
1993	96702	938012	38300	157726	3200	15341	1252661	2404800
1994	98466	1688936	33576	261240	2581	14951	2722366	4214000
1995	99500	3915079	35878	414264	2100	57714	5995517	7254900
1996	106700	4595187	36700	693643	10300	227520	7268888	9544800
1997	116700	5426600	49400	1485200	20600	260400	8260300	12846800
1998	128900	10306000	40500	1734600	4381	155900	15702400	19792000
1999	120300	10348700	42800	2200000	5000	235000	17581800	30758000
2000	126900	12606500	42400	3126800	8517	332700	32195000	32282700
2001	130300	18636300	36500	2461100	6100	316400	30932000	39480100
2002	105000	17887500	42600	2932400	4147	409400	29444400	51652900
2003	109400	22544500	45879	3226400	4953	483900	41584600	68298900
2004	103700	22303400	46465	5132400	15491	222410	50507800	101554900
2005	121970	9493900	37200	3142300	17040	71700	58306100	65453800

Source: Reserve Bank of Malawi, *Financial and economic Reviews*, various years