THE POTENTIAL IMPACT OF TRADE POLICY CHANGES ON CARIBBEAN SUGAR

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Science

in

The Department of Agricultural Economics & Agribusiness

by
Delroy Anthony Armstrong
B.S., Louisiana State University, 2000
August 2004

ACKNOWLEDGEMENTS

The success of this paper would not have been possible without the input of a number of individuals. These include, Dr. Sung C. No, Assistant Professor of the College of Business, Southern University. Dr. No assisted me with his expertise in policy analysis and his vast experience in econometric procedures. Secondly, Dr. Michael E. Salassi my Graduate Advisor and Committee Chairperson; without Dr. Salassi's input this paper would not have being possible, he provided me with expert guidance and exercised tremendous patience and gave a huge amount of his time in order to see the successful completion of this paper. Dr. P. Lynn Kennedy and Dr. Steve Henning, my other committee members both gave their critical analyses and support throughout the duration of this work.

It is with humility that I express my gratitude, to these individuals and all other members of the Agricultural Economics and Agribusiness Department of the Louisiana State University that somehow contributed to the preparation of this document.

Finally, it would be remiss of me if I neglect to mention my finance Philippa, and family, particularly my dad Kerold Armstrong, whose continuous encouragement, love and support provided me the motivation to remain focused during difficult times.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study of the Caribbean Sugar Industry summarizes its sugar trading activities and evaluates the potential impact of changes in preferential trading arrangements with the European Union (EU) on the six countries that make up the Sugar Association of the Caribbean, namely: Jamaica, Barbados, Belize, Guyana, St. Kitts-Nevis, and Trinidad & Tobago. The trading policies that govern sugar trade between these countries and developed countries such as the EU, the United States of America (US) and to a limited extent trade among them is discussed. The report briefly describes how the Caribbean sugar industry is organized, including supply and demand determinants, marketing of its sugar via the EU Sugar Protocol, and the US tariff rate quota system, and safeguards within the Caribbean Common Market (Caricom) from extra-regional sugar producers. The study then analyses the impact of price changes based on different price scenarios that may occur after preferential prices disappear. Data and estimated model specifications are described, elasticities of dependent variables responses to independent variables changes are calculated, and these results, in addition to different price simulations are presented. The analysis shows that modest decreases in prices to Caribbean sugar producers would not result in huge changes in the structure of the Caribbean sugar industry since responses of production, consumption, imports and exports are inelastic to prices changes in the short-run. This could be due of asset fixity within the industry. This industry requires huge capital investments; thus, after these investments are made producer are forced to operate at full capacity to minimize fix costs. Secondly, the industry within this region is a mass employer of labor and a huge

contributor to their country's Gross Domestic Product (GDP); therefore, any major changes with this industry could result in massive social instability.

Keywords: International Sugar Trade, Caribbean Sugar Industry, Simulation Model, Production, exports, Imports, Consumption.

CHAPTER 1

INTRODUCTION

It has been suggested that sugar cane was first cultivated over 2000 years ago. Christopher Columbus introduced it in the Caribbean around the late fifteenth century. Sugar cane is a perennial grass that is produced in tropical and subtropical zones. It matures in 12 to 16 months and each plant yields ratoons annually. Once the cane is harvested the sucrose, which is the most important component, starts breaking down. This sucrose is converted into raw sugar in sugar mills, and then later refined by the removal of molasses and impurities, that surrounds the sugar crystal in refineries. Within the Caribbean region there are six major sugar-producing territories (excluding Cuba). These include Barbados, Belize, Guyana, Jamaica, St. Kitts-Nevis, and Trinidad & Tobago (in no particular order). These six countries form the Sugar Association of the Caribbean.

Many people, when thinking about the early days of the Caribbean sugar industry, conjure up images of pirates, or the incredible impact of slavery and indentured labor on the sugar industry. The sugar industry is the oldest continually operating industry in most Caribbean territories. In Jamaica, this industry generates the third largest foreign exchange earnings. It is the largest employer of labor, directly employing over 50,000 workers in this country alone. This is also the case when one looks at Guyana's economy, where the industry directly employs over 25,000 people. Other territories (aforementioned) are less dependent on sugar. This is, however, due to the limitations in factors such as suitable landmass due to competition with other industries such as tourism, capital and/or labor.

Raw and refined sugar, are two distinct products and both are traded internationally. The six most important sugar exporters in the world market are, the European Union (EU), Brazil,

Australia, Thailand, Cuba, and the Ukraine. These accounted for 73% of global exports from 1997-2001. On the other side of the coin, demand is less concentrated than supply. The share of the eight most important sugar importing countries and regions, are the EU, Russia, China, the United States (U.S.), Japan, Korea, Indonesia, and Canada, which equal 46% of total world sugar imports from 1997-2001. The EU imports sugar under the Lomé convention (an agreement signed between the European Commission (EC) and the African, Caribbean, and Pacific (ACP) countries in Togo in 1975), it is required to import sugar under preferential terms (discussed later) from certain ACP countries. However, these EU imports are based on a quota system, (Koo, W.; et al, 2002).

Generally speaking the "ACP states" are a group of former United Kingdom (UK) colonies eligible for preferential treatment under various EU arrangements. The current 77 ACP countries represent a total of more than 500 million people. Of the global volume of international development aid received by developing countries, more than half is provided by EU citizens, and 15% of this is administered by the European Commission. Much of this has been governed through the so-called Lomé Convention, (Allen, T.; 2002).

Traditional trade relations have existed since the beginning of the century with sugar-exporting countries of the Commonwealth and in 1950 the Commonwealth Sugar Agreement (CSA) came into force. Currently, trade is governed via a Sugar Protocol laid down in the Convention of Lomé, which has been an established instrument of commodity policy for close to 30 years. The basic rule is, the EU imports, at guaranteed prices, agreed quantities of sugar from ACP countries for an indefinite duration, (Herrmann, R.; et al, 1995).

This protocol which has encountered numerous reformations over the years in response to changes in economic and market conditions, (the last been 1995) is an agreement between

governments, under which the EU Member States guarantee to buy and import agreed quantities of sugar which the ACP Signatory State undertake to sell.

In most years, over 70% of world sugar production is consumed domestically, implying that only a small proportion of production is traded internationally. A significant share of this trade takes place under bilateral long-term agreements, or on preferential terms (as mentioned above) such as under the U.S. tariff-rate sugar quota system, or the EU's Lomé Agreement. Since only a small amount is traded freely, small changes in production or government policies tend to have large effects on the world sugar markets, and sugar prices are among the most unstable commodity prices in international trade, (Benirshka M.; et al, 1996).

The Caribbean raw sugar price is usually considered to be the world market price for this commodity, while the U.S. import price including duties, is the price that U.S. refineries pay for imported raw sugar. Except in years with high world market prices, there is a significant wedge between the U.S. import prices (fluctuating between US$0.22 and US$0.29 per pound), and world markets prices (ranging between US$0.06 and US$0.13 per pound). Thus, when world market prices are low, U.S. sugar producers enjoy considerable protection from sugar imports, (Benirshka M.; et al, 1996). Both real Caribbean raw sugar prices and U.S. raw sugar import prices have long-term downward trends.

During the 1980s, the EU self-sufficiency ratio for sugar stayed on average well above 120%, meaning it is capable of supporting itself with this commodity, thus making the community an important (subsidizing) exporter on international sugar markets. Given this background, it might seem surprising at first glance that the EU offers preferential import conditions for sugar within the Sugar Protocol, (Herrmann, R.; et al, 1995).

When the UK intended to become a member of the EU, the problem emerged that favorable trade relations within the CSA were incompatible with the protective EU foreign trade regulations. About 60% of the traditional Commonwealth sugar exports were threatened, with considerable loss of export earnings for the developing countries joining the CSA, (MacGregor, A; 1978).

In fact, the inclusion of the Sugar Protocol in the Lomé Convention was the result of political bargaining in the context of the EU-UK membership negotiations. Contrary to the rest of the EU, the UK has always been a net importer of sugar. Within this preferential agreement, the UK guarantee purchases of specified quantities of sugar from the commonwealth countries for a "negotiated" price, which exceeded the normal world market price by about 165% in the period 1951-73, (Herrmann, R.; et al, 1995).

Currently, 18 ACP countries plus India participate in the Sugar Protocol. Because of oversupply in the EU, the total annual preferential quota has never been raised since 1975 and amounts to 1.3 million tons, (expressed in metric tons of white sugar). During the period from 1975-1991, total sugar export earnings of all beneficiary countries under the Sugar Protocol amounted to14.4 billion euros. Significantly lower export earnings, to the magnitude of 10.9 billion euro, would have been realized in a hypothetical situation without the protocol. The remarkable 3.5 billion euros is the accumulated transfer benefit due to the Sugar Protocol and can be interpreted as a welfare gain for the ACP countries and India. The preference margin of 3.5 billion euros as a share of total sugar export earnings amounted to 25%. Put differently, sugar export earnings of the user countries have been increased by 32% in the preferential situation compared to a non-preference scenario, (Lal Das, B; 1998).

This non-preference scenario however, will become reality in another few years for these ACP territories because of the WTO's Agriculture Agreement that was negotiated in the 1986-94 Uruguay Round that is a significant first step towards fairer competition and a less distorted sector. It includes specific commitments by WTO member governments to improve market access and reduce trade distortion subsidies in agriculture. Commitments of members are in the fields of (i) market access, i.e. tariff and import restrictions, (ii) domestic support to producers, and (iii) export competition, i.e. export subsidy, etc. These commitments are being implemented over a six-year period (10 years for developing countries) that began in 1995 (Lal Das, B; 1998).

1.1 Problem Statement

Seventy-seven ACP countries benefit from preferential access to the EU market (more than 80% of African exports enter the EU at preferential or zero rate). The EU has also concluded free trade agreements with a number of developing countries. This preferential access is reflected in the much higher level of export from these countries to the EU, compared to other trading blocks, (Trade in Agriculture, 2002).

However, based on the World Trade Organization (WTO) ruling, preferential treatment arrangements between its member states goes against its general principles. The GATT/WTO principle is non-discriminatory, while the EU's preferential accords are, by definition, discriminatory. There is provision in the WTO for developing countries to be treated differently from developed states in various regards. These include the provision by developed countries trade preference in favor of developing states. In other words, developed states may discriminate against other developed countries in their trade policy, provided that it benefits developing countries. The main problem for an EU attempt to justify any of its preferential accords other

than the standard Generalized System of Preference (GSP) in this way, is that they don't cover all developing countries (Stevens C., 2002). In this respect, therefore, the arrangement derived through Cotonou is thus anti-WTO.

The resolution of this problem between the EU and complainants to the WTO was resolved by the implementation of a waiver. This decision, agreed at the Fourth Session of the Ministerial Conference is as follows:

Taking note of the request of the European Communities (EC) and the Government of the ACP States which are also WTO members (hereinafter also the "Parties of the Agreement") for a waiver from the obligations of the European Communities under paragraph 1 of article1 of the General Agreement with respect to the granting of preferential tariff treatment for products originating in ACP States as required by Article 36.3, Annex V and its Protocols of the ACP-EC Partnership Agreement (hereafter also referred to as "the Agreement");

Considering that, in the field of trade, the provision of the ACP-EC Partnership Agreement requires preferential tariff treatment by the EC of exports of products originating in the ACP States;

Considering that the Agreement is aimed at improving the standard of living and economic development of the ACP States, including the least developed among them;

Considering also that the preferential tariff treatment for products originating in ACP States as required by article 36.3, Annex V and its Protocols of the Agreement is designed to promote the expansion of trade and economic development of beneficiaries in a manner consistent with the objectives of the WTO and with trade, financial and development needs of the beneficiaries and not to raise undue barriers or to create undue difficulties for the trade of other members;

Considering that the Agreement establishes a preparatory period extending until 31 December 2006, by the end of which new trading arrangements shall be concluded between the Parties to the Agreement, (WTO Ministerial Conference; 2001).

Based on this waiver, ACP countries have until the year 2006 to enjoy this preferential treatment, and in the meantime prepare themselves to trade in a world market environment. Based on this arrangement, after the waiver is exhausted ACP countries will be exposed to competitive forces within the sugar market that they weren't previously or on a limited basis exposed to. Therefore, prices will become more volatile, market share may fluctuate (in the future since for the moment quotas will remain as is) if selling prices aren't competitive, and a number of other market variables such as marketing strategy will come into play.

Because of these factors it is imperative that Caribbean territories improve areas such as production, consumption of locally produced sugar and other variables that lower production cost in order to improve trading competitiveness. An econometric analysis of these variables would provide players within the Caribbean Sugar Industry valuable information on the possible situation that the industry may face in the near future. With this information strategies can be developed to counteract unfavorable factors to further enhance favorable ones.

1.2 Review of Literature

Not much work has been done in analyzing the Caribbean sugar industry, or an econometric simulation of sugar policies except for work carried out by Benirschka, M., Koo, W., and Lou J. of the North Dakota State University. In their paper, titled *World Sugar Policy Simulation: Description and Computer Program Documentation,* they developed a dynamic partial equilibrium net trade model. It distinguishes 18 countries and regions, and sugar is assumed to be a homogenous commodity, with no distinction made between raw and refined

sugar. The model is designed to evaluate the effects on the world sugar economy of farm and trade policy by simulating production, consumption, stock, and trade for sugar over a 10-15 year period. In every year the model is solved for an equilibrium price such that world supply equals world demand, (Benirschka, M.; et al, 1996).

Sugar supply and demand for each region is estimated econometrically. Estimation sometimes was difficult because of data problems, while at other times equations performed poorly in simulations. Therefore, some tuning of the model was necessary, and the final simulation model was a hybrid between an econometric model and a synthetic model. Empirical estimates were used whenever possible, but selected parameters were based on expert advice and personal judgment. Each country's sub-models included behavioral equations for area harvested, yield, production, domestic consumption, and carry-out stocks. In the model, all quantities are expressed in raw sugar equivalents, (Benirschka, M.; et al, 1996).

Sugar supply is proportional to the total sugar cane and/or sugar beets produced. However, in some countries the link between cane production and sugar production is weak, since not all cane is used for the production of refined sugar. In some countries substantial amounts of sugarcane are used for the production of ethanol or non-centrifugal sugar. For these countries, explicit sugar production equations are specified. Sugar demand comprises demand for domestic consumption, carry-out stocks, and net exports. The model specifies behavioral equations for domestic consumption and for carry-out stocks, while net exports are the difference between domestic sugar supply and demand. World market prices are converted into domestic prices using the official exchange rate to derive price linkage. If available, domestic sugar beet, sugarcane, and sugar wholesale prices are used to estimate the behavioral equations. The sugar wholesale price is linked to the world market price of sugar in domestic currency. Prices were

converted to real prices using the GDP deflator. However, for some countries nominal US dollar prices were used rather than real prices in domestic currency, (Benirschka, M.; et al, 1996).

Area harvested depends on expected prices and alternative crops. As a proxy variable for price expectations, lagged prices are included in the acreage equation, in addition to commodity prices, the acreage and a trend variable. Sugar beet and sugarcane yields depend on lagged yields and a time trend. Total production is the sum of cane sugar production and beet sugar production. In countries where sugarcane acreage and sugar production are not closely related because a significant proportion of sugarcane harvested is used for purposes other than centrifugal sugar production, a function of lagged sugar production, lagged sugar price, and a time trend is used. Sugar demand comprises demand for domestic consumption (which is a function of price, income, and time trend), carry-out stocks (that is classified as stocks held as a precaution against unexpected supply shortfall, these are related to level of domestic sugar consumption and are a function of carry-in stocks, domestic consumption, and sugar price), and net exports (that is the difference between domestic supply and demand). Behavioral equations of the model are calibrated to a base period. This ensures that the model replicates base period sugar supply and demand conditions. To calibrate the behavioral equations the terms are computed such that base period values are generated for the endogenous variables if the exogenous variables are set to the base period value, (Benirschka, M.; et al, 1996).

An article by Bert Wilkinson titled *Caribbean: Sugar Makers Scramble to Become Competitive* looks at the current situation of the Caribbean sugar industry and the current implications that will be evident in this industry when the preferential treatment expires. Wilkinson talks about the sugar being the linchpin of economic life in several Caribbean countries for more than 400 years, and also the largest single employer. This situation, he points

out, is being threatened by the deregulation of the EU sugar market at the beginning of the year 2007. Because of this " there are clear signs industry players are panicking mainly because the regional product may not be able to compete with cheaper and much larger producers like Thailand and Brazil", (Wilkinson, B.; 2002).

A flurry of activities in recent weeks has led to a call on factory managers throughout the Caribbean to cut production costs by as much as 70% or face the prospect of closure. "We have lost on volume and price in major market (the EU). If we are to stay in the market we will have to cut production cost", declared the chairman of the Sugar Association of the Caribbean. This is because of the EU decision to take away 75,000 tons from Caribbean and other Third World countries and hand the allocation to nearly 50 of the world's least developed countries. The Caribbean sells a half million tons to EU annually, the remaining 300,000 tons are sold to the United States, Portugal and other countries under a special sugar protocol, (Wilkinson, B.; 2002).

It is estimated that Caribbean producers need to cut costs to around 10 U.S. cents per pound. This is necessary to keep pace with the rest of the world and other key market prices. "Jamaica, the region's second largest manufacturer after Guyana, is producing a pound of raw sugar at 32 US cents, Guyana at just under 20 US cents, while Barbados is somewhere between the two. The EU pays 20 cents per pound for sugar exported under the special quota system compared to 11cents on the world market, hence the importance of trade to the Caribbean" (Wilkinson, B.; 2002).

The industry is in such bad shape in Trinidad & Tobago that only a letter of comfort from the government is keeping the factory wheels turning. According to the Barbados Nation Newspaper, debts are running at 130 million dollars. Jamaican officials have just raised 90 million dollars to keep factories grinding there. In the last four years the government has given

the industry another 124 million to modernize. Barbados is likely to miss its vital EU quota by at least 7,000 tons this year. In Guyana, the government has just secured more than 100 million dollars to build a modern factory. Apart from producing value added products, the factory would be more efficient and would help push national production to around 450,000 tons compared to the recent annual average of 300,000. The new factory could be in place in 2005, (Wilkinson, B.; 2002).

Pressure by the World Bank on Guyana to close several inefficient estates and abandon expansion plans has being met with resistance. Officials say the new funding is clear proof that even though deregulation threatens the sugar industry, it cannot be closed or marginalized because it is the country's largest foreign exchange earner and has links to the rum and molasses industries, among others (Wilkinson, B.; 2002).

1.3 Project Objectives

The main objective of this thesis, is to evaluate the impact that preferential treatment arrangement changes will have on Caribbean territories being a part of the ACP group of countries after 2006, by projecting variables such as production, consumption, stocks and trade.

1.4 Specific Objectives

1) Review existing trade policies concerning Caribbean and world sugar trade.
2) Evaluate and adapt the World Sugar Simulation Model if possible, for use in analyzing individual Caribbean territories.
3) Evaluate the effects of farm and trade policies on the Caribbean sugar economy by simulating estimates for production, consumption, stocks, and trade of sugar over a 10 years period econometrically.

4) Based on results from objective (1) and (3), an evaluation of how Caribbean territories will fair under various price related simulated scenarios.

1.5 Research Methodology and Procedures

Sugar supply and demand and other exogenous variables for the region will be estimated econometrically using the Statistical Analysis Software (SAS) package. Models will be tuned to compensate for data problems and the correction of poorly performing estimated equations in the simulation. Final simulation models will be a hybrid between an econometric model and a synthetic model, as is done in the World Sugar Simulation Model.

Different countries sub-models will include behavioral equations for area harvested, yield, production, domestic consumption, and stock changes. In these models sugar is assumed to be a homogenous commodity i.e., no distinction is made between raw and refined sugar, thus all quantities will be expressed in raw sugar equivalents. Scenarios relating to possible price movements will be assumed and evaluated to theorize what impact policy changes will have on the variables within the models.

1.6 Specific Objective 1. Review existing trade policies concerning Caribbean and world sugar trade.

A thorough literature review of the trade polices relating to Caribbean territories and major sugar importers such as the European Union, the United States, and among Caribbean countries themselves will be carried out. This will be done in order to provide an understanding of the history, creation and significance of the Caribbean Sugar Industry on the world stage. Previous work done in this area will be sourced. These will include research on this topic, trade negotiations and other agreements, including the current sugar protocol, which will probably

expire by the end of 2006, the quota system with the United States and Portugal, and other countries within the Caribbean community itself.

1.7 Specific Objective 2. Adapt the World Sugar Simulation Model for use, in analyzing individual Caribbean territories.

This work will be based on the World Sugar Policy Simulation Model developed by Martin Benirschka, et al. In this model they developed a dynamic, partial equilibrium, net trade model. It distinguishes 18 countries and regions, and sugar is assumed to be a homogenous commodity, thus no distinction is made between raw and refined sugar. The model is designed to evaluate the effects on the world sugar economy of farm and trade policy by simulating production, consumption, stock, and trade for sugar over a 10-15 year period. In each year the model is solved for an equilibrium price such that world supply equals world demand. Sugar supply and demand for each region is estimated econometrically, each country's sub-models include behavioral equations for area harvested, yield, production, domestic consumption, and carry-out stocks. In the model all quantities are expressed in raw sugar equivalents.

It must be pointed out that a number of these countries are producers of beet sugar. This type of sugar is not produced in the Caribbean; therefore, model modification and possible re-specification will be analyzed to compensate for these changes. Secondly, in this world simulation model, the Caribbean is treated as one group with the rest of the world. Therefore this paper will break down this group in smaller subsets that represents the territories mentioned. Finally, the World Sugar Simulation Model is solved so that supply equals demand this produces a closed system. However, since supply at no time equals demand in the Caribbean this system will be open ended.

1.8 **Specific Objective 3**. Evaluate the effects of trade policies on the Caribbean sugar economy by simulating estimates for production, consumption, stocks, and trade of sugar over a 10 years period econometrically.

Based on the work carried out in (2), these estimated econometric models will be used to forecast future sugar production, which will be based on demand as a consequence of policies in existence. Consumption refers to local (producing region) annual commodity usage. The issue of population growth rate and projected growth rate will play a major role in this area. Stocks will be based on the trend over previous years. The population factor may also affect this variable since if this is positive (as is the norm) then we expect this is also increased in the same magnitude. Trade will be based on whatever market arrangements are currently in place and are not expected to be expiring shortly. From these results tentative conclusions can be derived. This will form the basis for policy analysis in the next section.

1.9 **Specific Objective 4.** Based on results from objective (1) and (3), an evaluation of how Caribbean territories will fair under various price simulated scenarios will be carried out, since this is the only variable at this time that will be significantly impacted by this policy change.

A comparison of the results obtained from the econometric analysis of different price scenarios for each Caribbean territory will be evaluated. This is important, since the survivability of the Caribbean sugar industry is very important to the economies in which they operated. The responsiveness of supply and demand to these price changes will provide a clear picture of the impact of this policy change on the Caribbean sugar industry. These scenarios could provide valuable information for players involved in Caribbean sugar since it could indicate where these countries may remain net exporters or become net importers.

CHAPTER 2

CARIBBEAN SUGAR AND TRADING POLICIES

2.1 European Union (EU) Sugar Trade Policy

The EU sugar policy embraces the fifteen Member States of the Union, including the French Overseas Departments, and the ACP states, which are signatories of the Sugar Protocol to the extent undertakings contained in the Protocol and the Special Preferential Sugar (SPS) Agreement. The scope of the EU sugar policy also embraces both beet and cane sugar production, both small and large farmers (working from arctic to tropical climates), small and large factories and mills, and both large and small sugar companies (the largest of which produces more than 3,000,000 tonnes of sugar, the smallest less than 10,000 tonnes), (ACP Sugar Group, 2001).

The EU sugar policy is part of the Common Agricultural Policy (CAP), which is a collection of market management mechanisms covering most of European agriculture. It includes a set of legislation and practices adopted by the member states of the European Union in order to provide a common, unified policy on agriculture. The CAP is the most integrated of the Community-wide policies implemented by the EU. It aims to ensure that agriculture can be maintained over the long-term at the heart of a living countryside. This means that the policy is targeted not just at agricultural products but also at the wider rural population, consumers and society as a whole, (the EU's approach to the WTO agricultural negotiations 2001). The CAP policies are administered by the European Commission based on the decisions of the Agriculture Council of the EU (comprised of EU Ministers of Agriculture), (ACP Sugar Group, 2001).

The EU sugar policy strives to achieve the objectives of the CAP set out in article 39 of the treaty of Rome; these are:

1. to increase agricultural productivity
2. to ensure a fair standard of living for the agricultural community
3. to stabilize markets
4. to assure availability of supplies
5. to ensure that supplies reach consumers at reasonable prices

In practical terms, the aims and principles underlying the EU sugar policy are achieved by means of:

- common market intervention price for bulk white sugar, ex-factory, loaded onto a means of transport;
- protection from world market by means of fixed import duties bound in GATT and additional duties under the special safeguard clause (Article 5 of the WTO Agricultural Agreement);
- a system of export refunds on sugar containing products designed to bridge the gap between internal and external prices;
- a system of production quotas which limits price support to a maximum quantity of sugar production and which is also used to administer the self-financing of the policy (the costs of export subsidies are passed directly back to farmers and processors by means of production levies). The policy ensures that ACP and EU sugar producers can benefit from Community support in terms of the amount they produce within the quotas. However, the revenue to be derived from quota production varies in line with the cost of exporting surplus quota sugar;
- a raw sugar policy covering cane sugar production in the French overseas departments (Reunion and French Antilles), and providing for reduced duty and

duty-free imports from ACP countries (under tariff quotas), to meet the supply needs of EU cane sugar refiners, (ACP Sugar Group, 2001).

This EU sugar policy has been adapted many times since 1968 in response to changing economic and market conditions; the policy was most recently reformed in 1995 in order:

(a) to ensure compliance with the EU's WTO Uruguay Round (UR) commitments while retaining the principle instruments of the policy, namely the production quota and self-financing systems; and

(b) to implements a new raw sugar policy further to the conclusions of the Commission's report on the situation of the EU refining industry.

The principal amendments to the policy were enacted by means of two European Council regulations, nos. 3290/94 and 1101/95, which brought about the following changes:

- a new import policy to comply with the EU's UR commitments (3290/94)
- a new export policy, to provide for the administration of the UR limits in terms of the quantity and value of export subsidies (3290/94)
- a new method of cutting production and refining quotas, if necessary, to ensure the EU can meet its UR commitments in respect of export subsidies (1101/95); this is not applicable to Sugar Protocol quotas;
- the phasing out of Italian and Spanish national aids to their sugar industries(1101/95);
- a new arrangement governing the import of raw sugar for refining which provides certain assurance to the EU refineries in terms of their access to raw sugar for refining, and which anticipates the Special Preferential Sugar (SPS) Agreement. The quantities of raw sugar for refining are determined by means of national quotas (properly called "maximum supply needs", "MSNs") and a EU balance sheet of estimated supplies

("bilan") (1101/95). In order to meet the refineries' MSNs, raw sugar is supplied and imported under the following hierarchy of preference: French Overseas Department (DOM) cane raw sugar and, if available, domestically produced beet raw sugar; ACP Sugar Protocol and Indian preferential sugar; SPS sugar; and MFN (Most Favored Nation) sugar, (ACP Sugar Group, 2001).

This Special Preferential Sugar came into being at the time of the accession of Portugal and Spain to the EU in 1986, the ACP formulated a request to supply the raw sugar deficit of the Portuguese sugar refineries, and in August 1992, the Commission's services drafted a proposal for a regulation on supplies to the Portuguese sugar refineries in what became known as the 'non-paper', (ACP Sugar Group, 2001).

The non-paper first brought to light the idea of maximum supply needs (MSNs), for the Community's refineries. It also introduced the idea of a 'hierarchy of preference': from domestic (DOM and EU beets raw) suppliers, to ACP under the protocol, third country suppliers, for Cuba, and Brazil, and finally additional ACP quantities. It also envisaged that third country suppliers to Portugal, if required to meet the deficit, would receive no preference. New EU legislation on raw cane sugar for refining was enacted as part of the 1995 reform of the regime, (ACP Sugar Group, 2001).

2.1.1 The Sugar Protocol

The Sugar Protocol (SP) is a government-to-government agreement covering individual quantities of cane sugar for each ACP party to it. The Protocol states that, "the European Community undertakes for an indefinite period to purchase and import, at guaranteed prices, specific quantities of cane sugar, raw or white, which originate in the ACP states and which these States undertakes to deliver to it" (article 1 of the ACP/EU Sugar Protocol) "Subject to Article

7, these quantities may not be reduced without the consent of the individual states concerned" (article 3(2) of the ACP/EU Sugar Protocol), (ACP Sugar Group, 2001).

The EU regulation on the common organization of the markets in the sugar sector (No. 2038/1999) ensures that the Protocol quantities are irreducible even in cases where the Community has to reduce other production quotas on account of its Uruguay Round commitments. Further, Article 1 of ACP/EU Sugar Protocol is reflected in the ACP/EU Partnership Agreement ("Cotonou Agreement") which states that: "In accordance with Article 25 of the ACP-EC Convention of Lomé signed on 28 February 1975 and with Protocol 3 annexed thereto, the Community has undertaken for an indefinite period…to purchase and import, at guaranteed prices, specific quantities of cane sugar, raw or white, which originates in the ACP States producing and exporting cane sugar and which those states has undertaken to deliver it." (article 13 of Annex V: Trade Regime Applicable During the Preparatory Period). This underlines the indefinite nature of the Protocol, since economic or other difficulties in the EU, which might lead to a modification of the arrangements under the Convention, cannot lead to, nor cannot be invoked to justify, any modification of the indefinite nature of the commitments under the Sugar Protocol, (ACP Sugar Group, 2001).

Guaranteed prices for ACP white and raw sugar, apply to bulk sugar cost, insurance and freight paid (CIF) to European ports delivered under the Sugar Protocol. These prices are negotiated annually between the EU and ACP states signatory to the Sugar Protocol, "within the price range obtaining in the Community, taking into account all relevant economic factors". (article 5(4) of the ACP/EU Sugar Protocol) , (ACP Sugar Group, 2001).

In practice, the ACP states receive the same price as Community sugar producers. This is because the Community has always linked the guaranteed price for ACP raw sugar to the

intervention price for EU produced raw sugar, and the guaranteed price of white sugar to the derived intervention price in the UK. The level of guaranteed price is that at which, "the Community undertakes to purchase, within the agreed quantities, preferential sugar which cannot be marketed in the Community at a price equivalent to or in excess of the guaranteed price". (article 5(3) of the ACP/EU Sugar Protocol), (ACP Sugar Group, 2001).

The term "indefinite duration" was included in Article 1 of the Protocol to give a precise legal guarantee to ACP sugar supplying states, reflecting the guarantees that had preceded the protocol in the Common Wealth Sugar Agreement, and the obligations of the European Community in the Treaties. The provisions of the Sugar Protocol, the Lomé Convention(s) and the new Cotonou Agreement, to which the Sugar Protocol has been attached for institutional convenience, were carefully drafted so as to reflect this commitment and the independence of the Sugar Protocol and the mechanism for its continued implementation should the Cotonou Agreement cease to exist.

The legal aspects of the Sugar Protocol were contained in the various clauses of the Protocol itself and in Article 213 of the IVth Lomé Convention and in the Cotonou Agreement, (ACP Sugar Group, 2001).

In any trade agreement, one would expect there to be mutual benefits. The Sugar Protocol and Special Preferential Sugar (SPS) enable the EU port refineries to be supplied reliably and predictably, and therefore the maintenance of a EU cane refining industry, which is a valuable complement to the beet industry. This importance was recognized in the council Regulation (EC) No. 1101/95 as follows:

"Whereas refining is an important activity both the sugar sector in general in the Community, and in particular in refineries for conversion of raw sugar into white sugar; whereas, from a

technical point of view, refining produces high-quality products from sugar cane that can meet market requirements; whereas, moreover, these refineries are located in areas of high consumption; whereas the port-related refining industry is accordingly, for the community, a valuable complement to the beet processing industry, in particular in Finland, main land Portugal, the United Kingdom and southern and western France;".

However, ACP sugar is more than simply a matter of trade; because the agreements encompass mutual political and economic rights and obligations that extend well beyond the confines of sugar refining. For example, ACP sugar is an integral part of the EU sugar regime. In the jargon, ACP sugar is one of the "pillars" of the regime. The ACP therefore feels that it is "their" regime just as it belongs to other stakeholders, for example, European beet growers (135,000 directly related jobs), European beet processors (52,000 directly related jobs and 100,000 indirect jobs in beet transport) and European consumers. This then highlights the commonality of interest since sugar represents a high proportion of total agricultural production and is a primary agricultural export for ACP states. The EU is a major outlet for ACP sugar production. In industrialized countries, even those selling to the world market, many social benefits are made available by the state, whereas in the ACP countries, housing, health care, education, recreation, and other such benefits are more often than not, provided by sugar producers. Moreover, this tends not to be the case in other non-ACP sugar producing developing countries, (ACP Sugar Group; 2001).

2.2 The United States (US) Sugar Trade Policy

Currently, the United States Department of Agriculture (USDA) issues sugar quotas under the Tariff Rate Quota (TRQ) system on a country-by-country basis. Under this system raw

sugar is allowed into the US duty free. The amount of raw cane sugar allocated to beneficiary countries in 1999-2000 was 1.135 million metric tons, (GuySuCo, 2003).

Previous to the TRQ, the US sugar policy was described as complex, from as far back in June 1952 by Stanford University Professor Boris C. Swerling in his paper, " *A Sugar Policy for the United States"*. He further states that sugar, like wool, is a highly political commodity and a sensitive indicator of American commercial practice. By preferential trading arrangements, private foreign investment, and ties of economic and political history, sugar links the United States with exporting countries in Latin America and the Orient (Swerling, B.; 1952).

Sugar protectionism is firmly established in the United States. The sugar policy initiated in 1934, and not violated in principle even during wartime has five main features;

1. total consumption requirements are determined each year by the Secretary of Agriculture in accordance with prescribed criteria.
2. the global figure, essentially an aggregate marketing quota, is precisely apportioned among continental, offshore American, and foreign producing areas.
3. an import-quota system thereby becomes the main instrument for protecting domestic producers and supporting market price, although the tariff has not been completely eliminated.
4. when conditions warrant, individual acreage allotments to domestic growers may also be assigned, but at the secretary's discretion and not by grower referendum.
5. Mainland and domestic offshore growers of sugar beets and sugar cane receive "conditional payments," direct subsidies financed by an excise tax on all sugar marketed in continental United States.

At the agricultural end, successive sugar programs have typically provided domestic growers with a floor rather than an umbrella, protecting their crop from heavy market pressure but not precluding all adjustments of output or every reduction in receipts. As a consequence, sugar beets in particular have served as something of an income hedge. Acreage tends to increase when other farm prices are unpromising but then decline when farm conditions are generally favorable. Further more, the quota system has not frozen the regional pattern of mainland production, (Swerling, B.; 1952).

The current US sugar program for domestic farmers which was established by the Food and Agricultural Act of 1981 has had several modifications by the Food Security Act of 1985; the Food, Agriculture, Conservation, and Trade Act of 1990; the Federal Agriculture Improvement and Reform Act of 1996; and the Farm Security and Rural Investment (FSRI) act of 2002, (Koo W., et al, 2000).

The core policy tools in the program are the loan program and import restrictions. The main purpose of the loan program is to maintain a minimum market price for US producers. Processors use sugar as collateral for loans from the US Department of Agriculture (USDA). The program permits processors to store the sugar rather than sell it for lower than desired prices. Loans can be taken for up to nine months. Processors pay growers for delivered beets and cane, typically about 60% of the loan. Final payments are made and the loan is repaid after the sugar is sold, (Koo W., et al, 2000).

A General Agreement on Trade and Tariff (GATT) dispute between Australia and the US was resolved by converting the absolute quota into TRQs. The Uruguay Round Agreement (URA) on agriculture made these minor adjustments for US sugar trade. US import quotas on

sugar were converted into TRQs, implying that a specified amount of sugar can be imported at the lower of two alternative duty rates, (Skully, D.; 2001).

2.2.1 US Sugar and Tariff Rate Quotas

By definition, a tariff rate quota is a two-tiered tariff. In a given period, a lower in-quota tariff (t) is applied to the first Q units of imports and a higher over-quota tariff (T) is applied to all subsequent imports. Tariff quotas are not considered quantitative restrictions because they don't limit import quantities. One may always import by paying the over-quota tariff. This opportunity is not available under a regular quota. If an over-quota tariff makes imports prohibitively expensive, it yields the same import volume as a traditional quota. If the difference between domestic and international prices exceeds the over-quota tariff, a tariff rate quota results in a different volume in trade than does a standard quota. Importers profit despite paying the over-quota tariff. Were a standard quota in place, expanding the volume of imports over the restricted quantity would be impossible. Because of this frequently slight difference, a tariff rate quota is in theory less restrictive than a standard quota, (Skully, D.; 2001).

The US TRQ is administered under the quasi-market method based on historical allocation. The minimum low-duty imports for raw and refined sugar in the US add up to 1.256 million metric short tons raw value of sugar per year. The high duty is imposed on the amount of sugar imported over the import quota. The first-tier duty range from zero to 0.625 cents per pound, (Koo W.; et al, 2000).

2.2.2 US Historical Allocation

The US sugar quota has been allocated among more than 40 quota-holding countries, allowing imports of specific quantities of sugar at first tier duty rates. The quota allocation is

based on historical exports to the United States for the 1975 to 1981 period, (Koo W., et al, 2000).

Subsequent to this, various economic or political shock that altered the structure of the sugar market prompted major change to exporter shares of the quota for US sugar that was first allocated in 1934 on the basis of trade volumes in 1931-33. Save for wartime controls, the allocation was essentially unchanged until 1948. Legislation in 1948 and 1956 made minor adjustments to the shares of the two major suppliers, Cuba and the Philippines, (Skully, D.; 2001).

The trade embargo on Cuba after the Cuban Revolution forced a reassignment of the large Cuban share in 1961. It was formally reallocated in 1965 to countries other than the Philippines in proportion to their shares of the trade in 1963 and 1964. This allocation remained until 1974 when the 1948 quota was renewed; imports were no longer limited by quota. A binding quota was re-imposed in 1982 on the basis of trade share during 1975-81. This allocation was transferred unaltered into the TRQ in 1995 and remains in effect, (Skully, D.; 2001).
This was a period (1975-81) of exceptionally high world sugar prices. So high, in fact, that in 1975, the US removed the quantitative import restriction that had been in place since 1934. During several months of the base period, 1975-1981, the world price of sugar exceeded 30 cents per pound. At this price, virtually everyone was an inframarginal supplier. The market shares of US imports during this period included suppliers who were inframarginal for a few months, but were extramarginal under ordinary market conditions, (Skully, D.; 2001).

2.2.3 Trade and Quota Holders

The requirement that sugar imported under the TRQ is that this sugar must be produced in the country allocated the quota rights. This restriction induces costly transactions. Countries

with tariff quota rights generally exercise this right by fulfilling their quota requirements then purchase sugar to satisfy shortfall requirements for domestic consumption from other sources. This however, in the case of Taiwan and the Philippines, could be less costly had it not been for this requirement. It would be more efficient if these quota holders procured sugar shipments from producers closer to the US to fulfill their allotments than transporting it from that country. In this case the ability to resell quota rights would improve international factor allocation, because the revenue from resale or arbitrage, could fund compensation or fund investments. The resale would not have major domestic political repercussions, (Skully, D.; 2001).

This is not the case for all current sugar TRQ holders. In the Caribbean for example, even with quota rent income, sugar production is at best barely a viable economic activity. However, because sugar accounts for a large share of domestic employment, and sugar workers are well organized, the sale of quota rights would likely precipitate mass layoffs and cause political problems. Thus these governments will retain quota rights to preserve the domestic status quo. This in itself highlights the importance of the US sugar market to Caribbean sugar producers.

2.3 Sugar Trade within the Caribbean Community

In 1968 the Caribbean Free Trade Area (CARIFTA) was established with the aim of eliminating tariffs and other measures that restrict trade among Caribbean territories. Further, in 1973, at the signing of the treaty of Chaguaramas, the Caribbean Community and Common Market (CARICOM) was established with the intent of fostering deeper market and economic integration, simultaneously a Common External Tariff (CET) was also established. The common market at the time entailed 12 member states. However, Suriname and Haiti were later added to the membership to create a potential market of approximately 14 million people, (Hylton A.; 1999).

Under CARICOM, the CET was established to protect certain products (including sugar) produced in the region. In the case of brown (raw) cane sugar, a 40% duty is imposed on brown sugar from extra-regional sources. This duty in effect, allows sugar-producing countries in the region that have surplus sugar available (after satisfying exports commitments) within the Common Market to assist with meeting the intra-regional domestic requirements at competitive prices, (GuySuCo, 2003).

For refined sugar this CET of 40% is only triggered once the region produces at least 75% of its own requirements (total CARICOM consumption of refined sugar is 175,000 tonnes of which 75% is 130,000 tonnes), (Green Paper #3, SIA 2003). Thus, as is the case for raw cane sugar this CET acts as a protection mechanism. In this case, though, it only comes into effect after a certain production point is achieved.

With these measures in place, the extent to which trade has grown among member states is somewhat discouraging. This is due to a number of factors, such as the lack of implementation of decisions by member states both singly and collectively.

The general consensus among various theories that look at this issue implies that these developing countries tend to have similar endowments (labor). Thus, it is more favorable to trade with states that have vast capital endowments such as developed countries, as is alluded to by the Heckscher-Ohlin theorem.

CHAPTER 3

ECONOMIC MODEL AND ECONOMETRIC PROCEDURES

Economic models are used to structure economic relationships in the market. Structural econometric models through statistical estimation serves as a model validation tool. This chapter provides an economic model of the Caribbean Sugar Market with associated econometric procedures. An economic model is developed specifying supply and demand functions for Caribbean sugar, it concentrates on the recent time period, 1961-2000. Data sources are considered and the models fitted by OLS and SURE procedures, with the use of elasticities for explanatory purposes and to evaluate variable significance.

3.1 Economic Model for the Caribbean Sugar Market

The generalization of economic relationships among sugar market variables is based on theory and obtained from knowledge of economic and institutional characteristics of the market. This research considers a recursive supply-demand structure that approximates the dynamics of demand and supply in the Caribbean sugar market. These recursive flows are illustrated in a conceptual model in Figure 3.1. (below). Endogenous variables are contained in boxes, while exogenous variables are in circles. Arrows indicate the unidirectional flow by causation in terms of economic logic.

The supply section of the model is considered to be predetermined, because supplies available during a particular marketing year are to an extent known and fixed at the beginning of the marketing year. This model is composed of independent sub-models that contains in the supply section harvested hectares and yield equations for territories involved. The demand section includes relationships for domestic use, exports, imports, and ending stock.

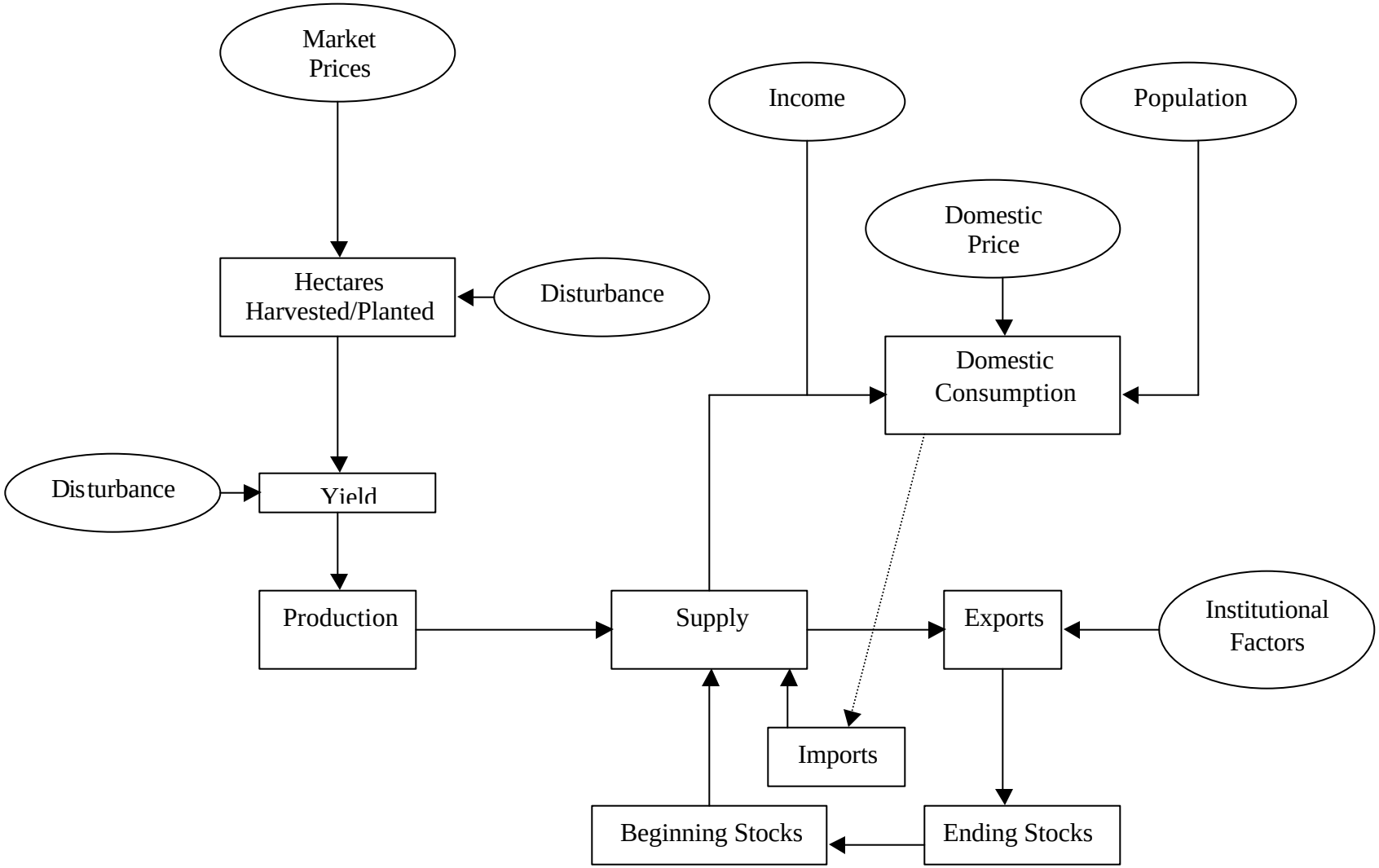

Figure 3.1. Recursive Supply-Demand Structure for the Caribbean Sugar Market Model

In the system, the sugar producer's planting decision for each territory is based in part by expectations on prevailing sugar prices in the EU, US and world sugar markets in the previous marketing year, along with the historical hectares planted. Other exogenous factors such as weather and water supply for irrigation purpose in turn affects yields. Subsequently, hectares planted and yield largely determines production at time *t*. Production is equal to harvested hectares times yield, with this in mind equations are formulated separately for hectares harvested and yield. It must be pointed out that often times hectares planted is not necessarily hectares harvested in sugar cane production since cane can be used for other purposes. However, the data shows that there are minimal differences between these two variables for the Caribbean countries under consideration. Since there seems to be nothing else except planted hectares that determines harvested hectares, hectares harvested is estimated directly in the model, rather than transformed from planted hectares. Total quantity supplied is the sum of the quantity produced in the current year and the ending stock of the previous year plus sugar import to satisfy domestic consumption.

3.1.1 Supply Section Economic Theory and Econometric Models

These models include hectares harvested and yield models. The product of these two variables represents annual production. The summation of production with beginning stock (last year's ending stock) and imports forms this year's supply for each country. However, only production will be considered in the supply section of the model, other variables are driven by demand.

3.1.1.1 Hectares Harvested

Economic theory suggests that hectares harvested is a function of the expected price of sugar, the price of competing crops, input prices, the previous year's hectares harvested, the state

of technology, weather and pest, and government programs (Tomek W.; et al., 1981). The hectares harvested also depend on the amount of stocks carried over from the previous year.

In supply analysis, it is important to know whether changes in output occur as a result of movement along a static supply schedule (change in quantity supplied) or because of shifts in the supply curve. If hectares harvested is assumed to determine the quantity supplied, the market price of sugar affects movements along the supply curve, while other factors shift the location and slope of the supply curve. Hectares harvested is assumed to be influenced by the price the producer expects to receive for each crop. A rational producer who anticipates a price above normal for his crop will expand his hectares to increase total revenue. On the other hand, if the producer expects a price below normal he will produce less. Producers estimate the expected price from different sources; these include, the price that EU beet producers receive, US producer's cane sugar prices and world market sugar prices. Area planted is also hypothesized to respond to expected costs of production.

Conceptually, a change in the price of a factor is treated as a supply shifter; an increase in factor prices, other variables constant, shifts the cost curve of each producer, and hence the supply curve to the left, and vice versa. If a producer anticipates higher input prices in relation to the expected price of sugar, he will reduce the hectares to be planted. A common practice is to include the ratio of the price of output to the price of the principal input. A producer will plant less if his capital resources available at the planting time are limited, even when the two prices rise proportionally. Also, in statistical analyses of supply, using separate variables for these prices sometimes yield more satisfactory results than using the price ratio as a single variable (Tomek W.; et al., 1981).

Also, the hectares of sugar cane cultivated can be considered as an habitual practice of producers. The producer may develop a preference for growing sugar cane because of natural disposition, already acquired knowledge and skill, or restraints brought about by soil quality and/or available water for irrigation. In this study, since producers operate under the preferential pricing mechanism, prices tend not to be the most important factor since they are most times significantly higher than US or world market prices. Thus if operational expenses are minimized the producer will at least break even because of these preferred prices. In determining the number of hectares to plant/replant, other variables such the timely availability of key inputs such machinery and other variables mentioned earlier are the key factors.

Ending stocks tend not to be a significant factor in hectares planted since all territories fail to fulfill their allotted quota annually thus for the period under consideration there is never and abundance of sugar in storage. Sugar in storage is always for national security purposes. The price of other crops tend not to be a factor since the biological nature of sugar cane does not encourage the cultivation of this crop on a short term basis. Therefore, once lands go into production they tend to remain that way for sometime.

Improvements in technology are important causes of long-term shifts in production supply function. Such improvements may include not only the development of high-yielding varieties which increases yields, but mechanization which makes it possible to plant and harvest more with a fixed amount of labor. The effects of these changes are well known, but it is often difficult to directly measure "changes in technology". The most common proxy is a trend variable, (Watanabe S.; et al, 1990). However, since the specification of a trend variable would appear to be inconsistent with the actual trend in the hectares of sugar cane harvested, the concept of "change in technology" was omitted from the hectares harvested model.

Therefore, the resulting econometric model is:

$$hh_t = f(hh_{t-1}, rp_{t-1}, g),$$

where hh_t represents hectares harvested at time t, which is a function of hh_{t-1} which represents last year's hectares harvested (lagged hectares harvested), rp_{t-1} which represents last year's real sugar prices (lagged sugar price) and g which represents government policies.

3.1.1.2 Yield

In contrast to hectares harvested, yield may be influenced by factors over which producers have no control (moisture, temperature, pests, etc.). Some factors, like level of fertility, can be controlled, but yield equations are typically difficult to specify, and they frequently exhibit strong underlying trends (Tomek W.; et al., 1981).

It is hypothesized that there is an inverse relationship between yield and hectares planted. As more land is brought into production, the yield per hectare is expected to decrease. This could be the result of the inclusion of less productive land in the total hectares planted, as well as the wider distribution of managerial effort over larger areas, (Watanabe S.; et al, 1990). Since sugar cane is a ratooning crop only a percentage of each producing area is replanted annually, therefore the previous year's yield will significantly impact upon the current year's yield for all ratooning plants.

Economic theory suggests that yields are influenced by the expected price for sugar. When producers anticipate a higher price for their sugar crop, they seem to be keener with their agronomic and processing practices, to gain these higher profits. However, in the Caribbean this point is arguable as there is little or no evidence of this, inputs tend to be constant across periods.

With this in mind, the econometric model:

$$y_t = f(y_{t-1}, hh, rp, t)$$

which represents yield (y_t) at time *t*. This is a function of y_{t-1} which represents last year's yield (lagged yield), hh which represents the current hectares harvested, rp which is current real sugar price and t represents yield past trends.

3.1.1.3 Production

The Caribbean sugar production is a summation of the individual sugar producing states production. Production is equal to hectares harvested times yield. At the aggregate level the production identity equation is represented by:

$$pdsc = y * hh,$$

where pdsc represents current sugar production, y represents current yield and hh represents current hectares harvested.

3.1.2 Demand Section Economic Theory and Econometric Models

The demand section of the model considers domestic use, exports, imports, and stock change a proxy for ending stocks. Total demand is the sum of quantities for domestic use, exports, imports and a change in ending stock. Specifically, direct-food use, and process-food use is the main channel for domestic consumption. This study is concerned mainly with demand for Caribbean sugar in the export market since domestic consumption annually does not constitute a large percentage of domestic production.

3.1.2.1 Domestic Demand

Economic theory of demand indicates that, given consumer's tastes and preferences, the quantity taken is influenced by its own price. It further suggests an inverse relationship between price and quantity consumers are willing and able to buy, other factors remaining constant; when sugar price falls (rises) the quantity demanded rises (falls). Caribbean domestic sugar prices are related to world sugar prices since sugar produced in the Caribbean are generally used for export

purposes because of preferential prices and sugar for local consumption is purchased at a cheaper price on the world market. Therefore world market prices are used for this analysis.

While changes in quantity demanded are shown as movements along a demand curve, changes in demand are represented by shifts in the level of the demand curve. The major factors influencing the level of demand are categorized into four groups: (1) consumer income and its distribution, (2) population size and its distribution by age, geographic area, etc. (3) prices and availability of substitutes and/or complements, and (4) consumer tastes and preferences (Tomek W.; et al. 1981).

An increase in income has a positive effects on the amount purchased for most commodities, suggesting an increase in per capita disposable income, prices remaining constant, is an indication that the consumer is able to buy more sugar. Thus it is expected that the quantity of sugar bought will vary directly with income. Annual gross domestic product (GDP) in constant 1995 US$ is used as a proxy for per capita disposable income in this analysis since data representing income for any of these countries were not available.

Changes in population have a direct influence on market demand relations. Average per capita sugar consumption of sugar, shows a tendency to trend upward especially in the Caribbean since it has little or no substitutes. It is therefore expected that as population increases more sugar will be demanded. Because income and population are often highly correlated, the population variable is taken into account by putting the quantity and income variable on a per capita basis.

For this study it is reasonable to assume that there is no changes in taste and preference since in the Caribbean there isn't much substitutes for sugar since these substitutes aren't produced locally and if imported, attracts huge duties, thus this is not encouraged. However,

consumer's habit of consuming sugar generally is a consequence of past behavior. To account for this lagged response of sugar consumption, the quantity of domestic sugar use lagged one year was included as an independent variable in the model.

The econometric model derived is:

$$cqpsu = f(cqpsu_{t-1}, realdomp, rpci),$$

where cqpsu represents current per capita sugar consumption, which is a function of $cqpsu_{t-1}$ which represents lasted years sugar consumption (lagged sugar consumption), realdomp which represents real domestic sugar prices, and rpci which represents real per capita income. Total annual sugar consumption here, is the product of per capita sugar consumption and population. This identity is represented by:

$$sc = cqpsu * pop,$$

where sc represents current annual sugar consumption, cqpsu current per capita consumption, and pop the country's population

3.1.2.2 Exports

The quantity of Caribbean sugar demanded in the export market is dependent on government policies, which currently, is based on a quota system (discussed in chapter 2) with the EU, US, and to a lesser extent Portugal that is now a member of the EU group. Currently, "trade is governed via a Sugar Protocol laid down in the Convention of Lomé, which has been an established instrument of commodity policy for the Caribbean producer and the EU. The basic rule is, that the EU imports at guaranteed prices, agreed quantities of sugar from Caribbean countries for an indefinite duration" (Herrmann, R. and Weiss, D. 1995), for the US, trade is governed by a tariff-rate quota system (both policies discussed in chapter 2).

Due to the situation of oversupply in the EU, the total annual preferential quota has never been raised since 1975. Of the approximately 750,000 metric tons of sugar exported by the region annually, 70 % goes to the EU, with the remainder fulfill other quota commitments. Because of the preferential prices received by Caribbean sugar producers, the quantity of sugar on the domestic market for consumption does not impact exports. As the supply of sugar increases more is exported, since only on a few occasions over the last number of 30 years has any of these countries been able to completely fulfill its quota requirement particularly to the EU. Thus, most if not all locally produced sugar is generally exported and supplies for local consumption is sourced from other producers at lower prices.

The econometric model derived for exports is:

$$qx = f(hh, y, g),$$

where qx represents exports, which is a function of hh, which represents current hectares harvested, y which represents current sugar yields (which together determines production), and g which represents government policies relating to exports.

3.1.2.3 Imports

The domestic demand for sugar by both the manufacturing sector and the consumer are for both raw and refined sugar. Imports for the manufacturing sector includes both raw and refined sugar with the greater percentage (90%) being refined sugar, which is used in the drinks, confectionery, and the baking industries. Household consumption (end consumers) is primarily of raw sugar (85%) and the remainder (15%) refined sugar. It must be pointed out that per capita consumption varies from one country to another, when a comparison is made among Caribbean countries. Jamaica's consumption is at times 15-75% less than other territories with the exception of Guyana. Additionally, per capita consumption has been falling in Jamaica. Within

the last five years of the 1990's being 10% less than the previous five years[1], (Green paper, 2003).

As mentioned earlier domestic production of sugar generally, doesn't satisfy both domestic and export requirements. Therefore, domestic requirements are obtained on the world market or from CARICOM partners (though seldom) if available, as is the case in the last two years when Jamaica obtained some supplies from Guyana and Belize.[2] Also, imports are impacted by exports since the level of export is based on production, which in most cases isn't adequate to satisfy total demand. Ending stocks wasn't factored into the import equation since in most countries volumes are generally low, thus does not necessarily significantly impact supply.

Therefore, the econometric model derived is:

$$qm = f(qx, y, hh, sc),$$

where qm represents current sugar imports, which is a function of qx, which represents current sugar exports, y which represents current yields, hh which represents current hectares harvested (the product of y and hh determines current production), and sc which represents current sugar consumption.

3.1.2.4 Ending Stocks

The quantity of ending stocks is dependent on consumption and import prices. Since Caribbean sugar production is mainly used to satisfy export commitments (because of higher market prices), and production in most cases isn't adequate to satisfy total demand, ending stock is generally a function of exports.

[1] It could be that the estimates for Jamaica's sugar consumption are low due to the possible lack of reporting at the point of entry into the country.

[2] Imports from CARICOM are partly facilitated by the imposition of a Common External Tariff (CET) of 40% on imports from outside the region. Additionally, the Sugar industry Authority is sole importer of raw sugar. The price at which it distributes this sugar is included and weighted in the price to be paid to the factory. As raw sugar is sold locally at a higher price than that which is received from exports the industry could be said to be subsidized in part by the domestic consumers (Green Paper # 3, SIA 2003).

The quantity of sugar supplied in the domestic market may influence ending stocks. Economic theory tells us that as supply increases ending stocks become larger unless more sugar is demanded both in the domestic and export market to an extent large enough to absorb the increase in supply. Therefore, yield and hectares harvested, which represents production were included in the model. As prices in the export market rises, other things being equal, the Caribbean producer will make additional effort to fulfill his export commitment, this will negatively impact ending stocks, thus an inverse relationship.

On the other hand if prices in the export markets are depressed, producers may chose to reduce production by reducing hectares harvested, thus eliminating processing cost in order to minimize operational expenses. In this case imports will have a direct relationship with ending stock, as this will satisfy local consumption.

Because of data problems, "stock change" data was used as a proxy for ending stocks, this occurred since ending stock data was very difficult to source and in cases where it was available, there was a high level of inconsistency with the data in most cases. The resulting econometric model is:

$$qs = f(y, hh, qm, qx, sc),$$

where qs represents stock changes, which is a function of current production which is represented in the model by yield (y) and hectares harvested (hh), qm which represents current imports, qx which represents current exports and sc which represents current consumption.

3.2 The Data and Sources

In order to measure the variables included in the model, secondary data was obtained from a number of sources. These include: *"Food and Agriculture Organization of the United Nation website (www.fao.org)"*, and the *"Economics and Statistics Unit, Sugar Industry*

Research Institute, Jamaica", both provided demand and supply data. Macroeconomic data (historical population, exchange rates, consumer price indices) were obtained from the "*International Financial Statistics 2002 CD-Rom*". The "*Sugar Industry Authority of Jamaica*" provided sugar prices. The data obtained can at best be described as rough. A number of proxies (as mentioned earlier) had to be used in cases where the actual data did not make sense or was not available.

The time period for the analysis was from 1961 through 2000 for both supply and demand sections. The time unit of observation is one year since sugar is produced annually. The number of observations for each variable is 40. These were used for two reasons; firstly, it was felt that this series was adequate to derive reasonable estimates of the coefficients, and secondly, data availability. Supply and demand data aggregation is at the national level for all countries.

3.3 Descriptive Statistics

Tables 3.1 through 3.12 show the descriptive statistics for each country. Consumer price index (CPI) and real per capita income is report in terms of 1995 US$. There are two sets of tables for each country, one provides the correlation coefficient value between variables while the other refers to other statistics such as mean (average), standard deviation (which represents variability of each value around the mean), the maximum and minimum values, and the coefficient of variation (which measures relative variability). This is a more precise measure of variability than standard deviation.

3.3.1 Supply Section Variables

The data shows that of the six countries in the study, Jamaica produces the most sugar on average annually. Jamaica's production has a maximum of 508,247 tonnes, at an average of 302,970 tonnes annually, with a relative variability of 0.35 (35%) for the period 1961 to 2000.

Guyana follows with its maximum being 394,540 tonnes and an annual average 282,350 tonnes, but with a smaller relative variability of 0.20 (20%). This means that, Guyana has a more consistent production pattern when compared to Jamaica (see tables 3.1 and 3.4). For hectares harvested, Jamaica have a maximum of 81,800 hectares at an annual average of 49,920 hectares followed by Guyana with a maximum of 67,217 hectares at an average of 46,847 hectares, again Guyana's coefficient of variation is smaller than that of Jamaica, being 0.15 and 0.24 respectively. Trinidad & Tobago, Belize, Barbados and St. Kitts-Nevis then follows in this order. Barbados enjoys the best yields for this period when compared to all other countries. Its maximum yield is 10.37 tonnes sugar per hectares (ts/h) and a mean of 6.99 ts/h, with a relative variability of 0.18 (18%). Other countries such as St. Kitts-Nevis experiences comparable yields, Jamaica and Guyana yields tends to fluctuate at an average of 6.00 ts/h annually.

Table 3.1. Descriptive Statistics, Jamaica, 1961-2000[3]

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Coefficient of Variation
hh (ha)	40	49920.23	11870.74	35612.00	81800.00	0.24
qp (tonnes)	40	302970.05	106446.10	179251.00	508247.00	0.35
y (ts/ha)	40	5.96	1.01	4.44	8.34	0.17
qm (tonnes)	40	34005.10	31802.19	737.00	103811.00	0.94
qx (tonnes)	40	227946.63	101159.22	121284.00	431548.00	0.44
sc (tonnes)	40	108415.45	21592.48	64657.00	139219.00	0.20
qs (tonnes)	40	613.08	18324.04	-29084.00	52800.00	29.89
p (US $)	40	9.15	6.28	1.86	29.99	0.67
pop ('000)	40	2152.98	298.91	1652.00	2633.00	0.14
exrate (J$/US$)	40	9.55	13.91	0.71	42.70	1.46
cpi	40	30.21	51.18	0.61	172.58	1.69
rp (US$)	40	9.87	6.61	2.75	34.60	0.67
rpci (US$)	40	1733.54	201.18	1399.20	2255.70	0.12
realdomp (J$)	40	454.32	314.16	160.29	1829.90	0.69

[3] Hectares Harvested (hh), Production (qp), Yield (y), Imports (qm), Exports (qx), Consumption (sc), Stock Change (qs), World Sugar Prices (p), Population (pop), Domestic Exchange Rates (exrate), Consumer Price index (cpi), Real World Sugar Prices (rp), Real Per Capita Income (rpci) Real Domestic Sugar Prices (realdomp)

Table 3.2. Descriptive Statistics, Barbados, 1961-2000[4]

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Coefficient of Variation
hh (ha)	40	14850.35	4405.79	7900.00	21043.00	0.30
qp (tonnes)	40	107119.28	45928.46	38500.00	204000.00	0.43
y (ts/ha)	40	6.99	1.22	4.74	10.37	0.18
qm (tonnes)	40	4686.15	5441.30	706.00	17971.00	1.16
qx (tonnes)	40	90000.15	44980.39	31156.00	183157.00	0.50
sc (tonnes)	40	20919.48	6415.84	12779.00	42710.00	0.31
qs (tonnes)	40	885.88	5278.82	-7810.00	19986.00	5.96
p (US$)	40	9.15	6.28	1.86	29.99	0.67
pop (‘000)	40	249.63	10.92	232.00	267.00	0.04
exrate (B$/US$)	40	1.95	0.11	1.71	2.05	0.06
cpi	40	54.08	37.21	8.84	113.27	0.69
rp (US$)	40	9.87	6.61	2.75	34.60	0.67
rpci (US$)	40	5975.01	1418.22	3136.70	8282.00	0.24
realdomp (B$)	40	49.86	45.80	11.28	241.42	0.92

Table 3.3. Descriptive Statistics, Belize, 1961-2000 [5]

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Coefficient of Variation
hh (ha)	40	19007.00	7257.02	4320.00	26304.00	0.38
qp (tonnes)	40	85238.45	28780.88	26000.00	125990.00	0.34
y (ts/ha)	40	4.72	0.79	2.93	6.36	0.17
qm (tonnes)	40	874.15	1262.82	115.00	7894.00	1.44
qx (tonnes)	40	78014.05	25859.17	24639.00	110870.00	0.33
sc (tonnes)	40	8031.55	3214.44	2649.00	13639.00	0.40
qs (tonnes)	40	67.00	3831.20	-9038.00	10037.00	57.18
p (US$)	40	9.15	6.28	1.86	29.99	0.69
pop (‘000)	40	155.13	41.20	94.00	240.00	0.27
exrate (EC$/US$)	40	1.85	0.27	1.43	2.23	0.15
cpi	40	71.28	21.71	40.71	107.51	0.30
rp (US$)	40	9.87	6.61	2.75	34.60	0.67
rpci (US$)	40	1900.53	685.88	990.01	3140.60	0.36
realdomp (EC$)	40	25.12	20.93	5.71	97.56	0.83

[4] Hectares Harvested (hh), Production (qp), Yield (y), Imports (qm), Exports (qx), Consumption (sc), Stock Change (qs), World Sugar Prices (p), Population (pop), Domestic Exchange Rates (exrate), Consumer Price index (cpi), Real World Sugar Prices (rp), Real Per Capita Income (rpci) Real Domestic Sugar Prices (realdomp)

[5] Hectares Harvested (hh), Production (qp), Yield (y), Imports (qm), Exports (qx), Consumption (sc), Stock Change (qs), World Sugar Prices (p), Population (pop), Domestic Exchange Rates (exrate), Consumer Price index (cpi), Real World Sugar Prices (rp), Real Per Capita Income (rpci) Real Domestic Sugar Prices (realdomp)

Table 3.4. Descriptive Statistics, Guyana, 1961-2000[6]

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Coefficient of Variation
hh (ha)	40	46847.65	6917.06	37000.00	67217.00	0.15
qp(tonnes)	40	282350.13	57827.24	132005.00	394540.00	0.20
y (ts/ha)	40	6.06	1.18	3.30	8.21	0.19
qm (tonnes)	40	4387.48	7679.22	148.00	29541.00	1.75
qx(tonnes)	40	254249.08	53468.05	129347.00	355601.00	0.21
sc (tonnes)	40	32180.65	5909.09	21293.00	46387.00	0.18
qs (tonnes)	40	307.88	12648.72	-28887.00	26512.00	41.08
p (US$)	40	9.15	6.28	1.86	29.99	0.69
pop (‘000)	40	721.03	47.27	585.00	762.00	0.07
exrate (G$/US$)	40	39.67	62.18	1.71	182.43	1.57
rp (US$)	40	9.87	6.61	2.75	34.60	0.67
rpci (US$)	40	754.16	103.86	580.94	953.56	0.14
realdomp	40	915.33	627.54	185.67	2999.42	0.69

Table 3.5. Descriptive Statistics, St. Kitts-Nevis, 1961-2000[7]

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Coefficient of Variation
hh (ha)	40	4218.08	541.70	3327.00	5104.00	0.13
qp (tonnes)	40	30357.53	8430.82	16300.00	47346.00	0.28
y (ts/ha)	40	7.11	1.36	4.53	9.50	0.19
qm (tonnes)	40	775.50	721.39	23.00	2524.00	0.93
qx (tonnes)	40	27458.30	8112.26	12758.00	45500.00	0.30
sc (tonnes)	40	3674.70	1469.58	2116.00	8088.00	0.40
qs(tonnes)	40	0.03	693.38	-1956.00	1087.00	23112.67
p (US$)	40	9.15	6.28	1.86	29.99	0.69
pop (‘000)	40	44.28	3.00	41.00	51.00	0.07
exrate (EC$/US$)	40	2.39	0.41	1.71	2.70	0.17
cpi	40	66.53	28.29	33.85	120.00	0.43
rp (US$)	40	9.87	6.61	2.75	34.60	0.67
realgdp (US$)	40	95.80	95.88	12.48	314.08	1.00
realdomp (EC $)	40	35.97	29.85	9.40	151.92	0.83

[6] Hectares Harvested (hh), Production (qp),Yield (y), Imports (qm), Exports (qx), Consumption (sc), Stock Change (qs), World Sugar Prices (p), Population (pop), Domestic Exchange Rates (exrate), Consumer Price index (cpi), Real World Sugar Prices (rp), Real Per Capita Income (rpci) Real Domestic Sugar Prices (realdomp)

[7] Hectares Harvested (hh), Production (qp), Yield (y), Imports (qm), Exports (qx), Consumption (sc), Stock Change (qs), World Sugar Prices (p), Population (pop), Domestic Exchange Rates (exrate), Consumer Price index (cpi), Real World Sugar Prices (rp), Real Per Capita Income (rpci) Real Domestic Sugar Prices (realdomp)

Table 3.6. Descriptive Statistics, Trinidad & Tobago, 1961-2000[8]

Variable	N	Mean	Standard Deviation	Minimum	Maximum	Coefficient of Variation
hh (ha)	40	28900.38	7648.00	13820.00	40065.00	0.26
qp (tonnes)	40	149739.20	63443.30	64700.00	254608.00	0.42
y (ts/ha)	40	5.10	1.25	2.84	7.42	0.25
qm (tonnes)	40	18647.18	21672.96	587.00	77005.00	1.16
qx (tonnes)	40	116463.93	56923.55	49200.00	218749.00	0.49
sc (tonnes)	40	52140.20	10187.27	32741.00	68096.00	0.19
qs (tonnes)	40	-217.75	11514.29	-38220.00	40623.00	-52.87
p (US$)	40	9.16	6.28	1.86	29.99	0.69
pop ('000)	40	1092.58	142.31	858.00	1301.00	0.13
exrate (TT$/US$)	40	3.22	1.63	1.71	6.30	0.51
cpi	40	42.18	38.61	5.54	121.22	0.92
rp (US$)	40	9.87	6.61	2.75	34.60	0.67
rpci (US$)	40	3742.51	950.17	2117.40	5146.40	0.25
realdomp (TT$)	40	108.96	96.68	22.05	529.21	0.89

Table 3.7. Correlation Coefficients for Variables in Jamaica's Sugar Market: 1961-2000

	hh	qp	y	qm	qx	sc	qs	p	pop	exrate	cpi	rp	rpci	realdomp
hh	1.00													
qp	0.88	1.00												
y	0.47	0.83	1.00											
qm	-0.79	-0.79	-0.56	1.00										
qx	0.84	0.97	0.80	-0.68	1.00									
sc	-0.83	-0.87	-0.63	0.71	-0.89	1.00								
qs	0.07	0.12	0.16	0.05	-0.02	-0.11	1.00							
p	-0.17	-0.32	-0.38	0.04	-0.42	0.41	0.05	1.00						
pop	-0.89	-0.90	-0.63	0.88	-0.87	0.90	0.01	0.28	1.00					
exrate	-0.55	-0.51	-0.29	0.75	-0.44	0.58	0.08	0.10	0.79	1.00				
cpi	-0.50	-0.48	-0.28	0.75	-0.38	0.53	0.03	0.08	0.74	0.98	1.00			
rp	-0.01	-0.15	-0.26	-0.12	-0.26	0.24	0.06	0.97	0.09	-0.07	-0.08	1.00		
rpci	-0.11	-0.11	-0.03	0.09	-0.17	0.34	0.09	0.27	0.25	0.32	0.28	0.21	1.00	
realdomp	0.27	0.18	0.03	-0.36	0.08	-0.09	0.10	0.80	-0.22	-0.26	-0.27	0.91	0.24	1.00

[8] Hectares Harvested (hh), Production (qp), Yield (y), Imports (qm), Exports (qx), Consumption (sc), Stock Change (qs), World Sugar Prices (p), Population (pop), Domestic Exchange Rates (exrate), Consumer Price index (cpi), Real World Sugar Prices (rp), Real Per Capita Income (rpci) Real Domestic Sugar Prices (realdomp)

Table 3.8 Correlation Coefficients for Variables in Barbados' Sugar Market: 1961-2000

	hh	qp	y	qm	qx	sc	qs	p	pop	exrate	cpi	rp	rpci	realdomp
hh	1.00													
qp	0.93	1.00												
y	0.64	0.87	1.00											
qm	-0.76	-0.67	-0.49	1.00										
qx	0.89	0.98	0.86	-0.57	1.00									
sc	-0.04	-0.13	-0.14	-0.31	-0.30	1.00								
qs	-0.20	-0.18	-0.15	0.40	-0.23	-0.11	1.00							
p	-0.30	-0.37	-0.34	0.10	-0.40	0.24	0.04	1.00						
pop	-0.97	-0.94	-0.69	0.75	-0.91	0.12	0.19	0.30	1.00					
exrate	-0.58	-0.74	-0.72	0.30	-0.78	0.36	0.06	0.46	0.67	1.00				
cpi	-0.98	-0.90	-0.61	0.74	-0.87	0.12	0.18	0.23	0.98	0.57	1.00			
rp	-0.13	-0.20	-0.20	-0.05	-0.24	0.21	-0.00	0.97	0.11	0.33	0.05	1.00		
rpci	-0.87	-0.89	-0.67	0.54	-0.89	0.28	0.08	0.35	0.93	0.79	0.89	0.16	1.00	
realdomp	0.44	0.35	0.19	-0.39	0.34	-0.10	-0.12	0.60	-0.46	-0.10	-0.53	0.75	-0.42	1.00

Table 3.9 Correlation Coefficients for Variables in Belize's Sugar Market: 1961-2000

	hh	qp	y	qm	qx	sc	qs	p	pop	exrate	cpi	rp	rpci	realdomp
hh	1.00													
qp	0.93	1.00												
y	-0.79	-0.53	1.00											
qm	-0.15	-0.15	0.05	1.00										
qx	0.92	0.98	-0.54	-0.08	1.00									
sc	0.83	0.89	-0.46	-0.21	0.84	1.00								
qs	0.01	0.07	0.07	-0.13	-0.08	0.08	1.00							
p	0.43	0.40	-0.32	-0.11	0.39	0.36	0.08	1.00						
pop	0.80	0.83	-0.46	-0.15	0.81	0.94	-0.09	0.21	1.00					
exrate	0.95	0.88	-0.78	-0.13	0.87	0.76	0.01	0.50	0.72	1.00				
cpi	0.81	0.83	-0.48	-0.14	0.81	0.93	-0.06	0.26	0.99	0.74	1.00			
rp	0.25	0.23	-0.21	-0.07	0.21	0.17	0.10	0.97	0.02	0.35	0.01	1.00		
rpci	0.83	0.84	-0.49	-0.22	0.81	0.96	-0.06	0.34	0.98	0.75	0.97	0.15	1.00	
realdomp	0.24	0.22	-0.22	-0.07	0.21	0.11	0.09	0.95	-0.05	0.36	-0.06	0.98	0.08	1.00

Table 3.10 Correlation Coefficients for Variables in Guyana's Sugar Market: 1961-2000

	hh	qp	y	qm	qx	sc	qs	p	pop	exrate	rp	rpci	realdomp
hh	1.00												
qp	0.46	1.00											
y	-0.21	0.76	1.00										
qm	-0.33	-0.65	-0.52	1.00									
qx	0.36	0.96	0.79	-0.55	1.00								
sc	0.44	-0.17	-0.50	-0.21	-0.32	1.00							
qs	0.16	0.20	0.07	0.03	0.02	0.01	1.00						
p	0.22	-0.09	-0.27	0.14	-0.14	0.27	0.13	1.00					
pop	0.39	-0.33	-0.67	0.22	-0.42	0.58	0.14	0.43	1.00				
exrate	-0.18	-0.28	-0.20	0.53	-0.20	-0.35	0.04	0.09	0.33	1.00			
rp	0.20	-0.01	-0.16	0.04	-0.06	0.24	0.16	0.97	0.27	-0.07	1.00		
rpci	0.42	0.37	0.08	-0.06	0.37	0.07	0.06	0.33	0.43	0.50	0.22	1.00	
realdomp	0.22	-0.09	-0.27	0.14	-0.14	0.27	0.13	1.00	0.43	0.09	0.97	0.33	1.00

Table 3.11 Correlation Coefficients for Variables in the St. Kitts-Nevis' Sugar Market: 1961-2000

	hh	qp	y	qm	qx	sc	qs	p	pop	exrate	cpi	rp	realgdp	realdomp
hh	1.00													
qp	0.81	1.00												
y	0.51	0.92	1.00											
qm	-0.56	-0.62	-0.56	1.00										
qx	0.80	0.98	0.88	-0.54	1.00									
sc	-0.07	0.00	0.06	-0.05	-0.18	1.00								
qs	0.04	0.08	0.10	-0.02	-0.01	0.04	1.00							
p	-0.39	-0.28	-0.13	-0.04	-0.28	-0.14	0.07	1.00						
pop	0.74	0.80	0.66	-0.54	0.79	-0.07	0.08	-0.39	1.00					
exrate	-0.44	-0.51	-0.43	0.32	-0.51	0.07	-0.08	0.34	-0.84	1.00				
cpi	-0.57	-0.70	-0.64	0.76	-0.64	-0.04	-0.05	0.18	-0.82	0.82	1.00			
rp	-0.27	-0.15	-0.02	-0.18	-0.15	-0.15	0.07	0.97	-0.21	0.17	-0.00	1.00		
realgdp	-0.62	-0.70	-0.63	0.90	-0.63	-0.09	-0.03	0.15	-0.75	0.63	0.95	-0.03	1.00	
realdomp	-0.21	-0.05	0.09	-0.32	-0.08	-0.06	0.05	0.93	-0.14	0.09	-0.15	0.98	-0.17	1.00

Table 3.12 Correlation Coefficients for Variables in Trinidad & Tobago's Sugar Market: 1961-2000

	hh	qp	y	qm	qx	sc	qs	p	pop	exrate	cpi	rp	rpci	realdomp
hh	1.00													
qp	0.82	1.00												
y	0.35	0.81	1.00											
qm	-0.72	-0.77	-0.59	1.00										
qx	0.73	0.94	0.77	-0.57	1.00									
sc	-0.66	-0.79	-0.57	0.45	-0.89	1.00								
qs	0.17	0.11	0.05	0.05	-0.06	0.02	1.00							
p	0.10	-0.26	-0.47	0.07	-0.39	0.36	0.32	1.00						
pop	-0.78	-0.89	-0.69	0.69	-0.85	0.77	-0.11	0.26	1.00					
exrate	-0.59	-0.66	-0.54	0.57	-0.57	0.47	-0.17	0.17	0.88	1.00				
cpi	-0.69	-0.75	-0.58	0.66	-0.65	0.54	-0.16	0.15	0.93	0.98	1.00			
rp	0.22	-0.10	-0.33	-0.06	-0.24	0.22	0.33	0.97	0.07	-0.01	-0.03	1.00		
rpci	-0.71	-0.92	-0.77	0.77	-0.88	0.79	0.04	0.32	0.86	0.61	0.69	0.16	1.00	
realdomp	0.57	0.35	0.06	-0.35	0.24	-0.21	0.27	0.73	-0.37	-0.36	-0.41	0.85	-0.29	1.00

The linear correlation between pairs of variables in each series is reported in Table 3.7 through table 3.12 for each country. The expected high correlation between hectares harvested (hh), yields (y), and production (qp) is evident. Barbados and Belize had a correlation coefficient of 0.93 for the variables production (qp) and hectares harvested (hh). St. Kitts-Nevis showed the highest correlation coefficient between the variables yield (y), and production (qp), 0.92. All other countries showed a high correlation between these variables, except for Belize.

3.3.2 Demand Section Variables

The data shows that, on average Guyana exported the most sugar, this figure stands at 254,249.08 tonnes annually. Jamaica follows with an average of 227,946 tonnes annually, then Trinidad & Tobago, Barbados, Belize and St. Kitts-Nevis. Of all these countries, Trinidad & Tobago's export shows the most variability with a coefficient of variation value of 0.49. As expected, Jamaica has the largest volume of imports and consumption annually. This is because it has the largest population and confectionery industry. This figure stands at an average of 34,005.10 tonnes annually over the 40 years period with a maximum of 103,811 tonnes for imports, and an average of 108,415.45 tonnes with a maximum of 139,219 tonnes for consumption. Stock change seems to be most volatile in St. Kitts-Nevis. This variable is calculated by summing imports and production (supply) then subtracting the sum of exports and consumption (demand). This is the closest we could come to deriving any credible proxy for ending stocks.

Exogenous variables are also represented in the tables, as alluded earlier Jamaica maximum population count stands at 2,633,000 pupil, followed by Trinidad & Tobago with a population of 1,301,000 pupil, followed by Guyana, Barbados, Belize, then St. Kitts-Nevis. Exchange rates for St. Kitts-Nevis, Barbados, and Belize are fixed to the US$ and are thus less volatile. However, Jamaica, Guyana and Trinidad & Tobago have floating exchange rate system. As can be seen from the tables these countries' rates to the US$ are very volatile. Guyana's coefficient of variation stands at 1.57, which is just a bit higher that of Jamaica's. Among these countries, Barbados enjoys the highest rate of real per capita income, followed by Trinidad & Tobago, Belize and Jamaica.

The expected high correlation between real per capita income and population is evident in all data sets except Guyana, which is the poorest of these nations. It is interesting to note that there is a high negative correlation between consumer price index (cpi) and production (qp). This may be explained as most inputs such as herbicides, fertilizers and machinery are imported into these countries. Thus, an increase in inflation would obviously negatively impact production.

3.4 Deflators

Economic theory suggests that decision-making is derived from the relative price rather than the actual prices. That is, if all prices increase or decrease by the same percentage, demand as well as supply remains constant. Demand is influenced more by relative prices and real purchasing power than by nominal prices and income. On the supply side, such price ratios as those between competing products and between output and inputs are more important in determining the quantity to be produced, (Watanabe S.; et al, 1990). In this model therefore, all prices and income variables are deflated. The general level of all prices tends to change over time due to forces operating in the economy, such as government policies, management of money supply, and international conditions. This suggests that when studying the price for a particular commodity, it is necessary to recognize two sets of market forces, those operating in the economy at large and those specific to the commodity, (Watanabe S.; et al, 1990). The most common practice to remove the effect of general economic forces is to deflate prices by an appropriate price index.

The Consumer Price Index (CPI, 1995=100) was used to deflate nominal prices. The CPI data series for most countries were somewhat complete. In some cases there were a few missing values for some years. These missing values were extrapolated from the available data except for Guyana, where there were too many years missing. In this case the local currency exchange rate

to the US dollar was used as a proxy for CPI. This was justified by examining the correlation coefficient between the exchange rate and CPI for Jamaica and Trinidad & Tobago. These countries operate a floating exchange rate system similar to Guyana. The result yielded a correlation coefficient of 0.98 between the two series for both countries (see table 3.7 and 3.12), all other countries operate a fixed exchange rate system. Based on this evidence it was concluded that this proxy was appropriate for the analysis.[9] Per capita Gross Domestic Product (GDP) constant 1995 US$ was used as a proxy for personal income because of data unavailability.

3.5 Estimation Results

The supply section of the model was considered independent of the demand section because supplies available during a particular marketing year are known and fixed at the beginning of the crop year. Consequently, the coefficients of the supply section were estimated separately from those of the demand section. Each section of the model consists of independent equations and therefore, ordinary least squares (OLS) techniques were used to estimate the coefficients. After the independent variables were estimated for each equation using OLS, the seemingly unrelated regression equations (SURE) technique was applied to the demand set of equations to find if there were correlations among random components in the disturbance term of each equation since demand variables tends to be more interrelated supply variables.

All of the supply and demand equations were specified in a linear form, not only because the linear equation is the simplest and most common specification, but also because the linear relationship is considered to reflect actual economic behavior in the real world. Even if the relationship is not truly linear, a linear form of estimation can approximate the relationship and

[9] There was not enough CPI data available for Guyana to examine the correlation coefficient between that series and the country's exchange rate.

capture the general direction of movement of economic activity. The linear specification has proved applicable to a rather large number of problems, (Tomek W.; et al. 1981).

The supply and demand equations estimated by OLS were evaluated based on the following criteria: (1) the sign and magnitudes of the coefficients, (2) the t-statistic to determine statistical significance of the coefficients, (3) the coefficient of multiple determination (R^2), to measure the degree of association between the observed and expected values of the dependent variable, (4) the Godfrey LM statistic to test for higher-order autocorrelation in residuals, and (5) the Goldfeld-Quandt test for heteroskedasticity. The residuals of each equation were analyzed by visual inspection to examine how well the equation fits the data, whether the residuals have systematic patterns of behavior, and whether any exceptionally large residuals (outliners) exist.

The SURE models were evaluated based on the same criteria as that of OLS, in order to ascertain if there was gains in efficiency yielded by the SURE over OLS, since if this is the case there would be correlation among components in the disturbance terms of the set of equations. The estimation results by OLS are given in the tables below, (table 3.13 to 3.18), with definition and units for each country following in tables 3.19 to 3.24.

The results were obtained via SAS indicate that SURE (can be seen in the appendix), weren't much different from that of OLS, except that in some cases there were slightly higher t-value ratios. Therefore, for the sake of simplicity only the OLS procedure was used to carry out all further analysis.

These OLS equations are considered to provide the best estimates of the coefficients. The equations estimated by OLS will be used for the policy analysis for both the demand and supply section. The t-ratio associated with each estimated coefficient is shown in parentheses in the tables.

Table 3.13 Empirical Estimation Results for OLS Models, Jamaica

Supply

Sugarcane Yield

$y = 4.4606 + 0.5610y_{t-1} - 0.000016hh - 0.0149rp - 0.0423t$

(3.01) (4.24) (-0.82) (-0.92) (-2.22) t-values

n = 40, $R^2 = 0.67$ Godfrey LM = 0.05357

Sugarcane Hectares Harvested

$hh = 25286 + 0.5468hh_{t-1} + 265.3193rp_{t-1} - 9399g$

(4.47) (5.85) (2.20) (-3.69) t-values

n = 40, $R^2 = 0.87$ Godfrey LM = 0.0941

Sugar Production:

pdsc = y * hh

Demand

Per Capita Sugar Consumption

$cqpsu = 11.4050 + 0.7247cqpsu_{t-1} + 0.001060realdomp + 0.001232rpci$

(2.04) (7.13) (0.63) (0.46) t-values

$e_t = 0.250371e_{t-1} + v_t$

(1.51) t-value

n = 40, $R^2 = 0.52$ Godfrey LM = 0.2065

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -243051 + 47073y + 4.6845hh + 0.9324qm - 0.8393qx - 1.0246sc$

(-10.65) (18.54) (16.84) (15.36) (-19.04) (-10.32) t-values

n = 40, $R^2 = 0.92$ Godfrey LM = 0.1369

Sugar Exports

$qx = -134799 + 3.7687hh + 35872y - 59245g$

(-1.99) (5.66) (5.74) (-2.92) t-values

$e_t = -0.349286e_{t-1} + v_t$

(-2.21) t-value

n = 40, $R^2 = 0.95$ Godfrey LM = 0.0103

Sugar Import

$qm = 214041 + 0.4378qx - 27149y - 3.4361hh + 0.4934sc$

(4.10) (4.47) (-5.05) (-6.71) (1.87) t-values

n = 40, $R^2 = 0.79$ Godfrey LM = 0.1111

Table 3.14 Empirical Estimation Results for OLS Model, Barbados

Supply

Sugarcane Yield

$y = 8.6229 + 0.2551y_{t-1} - 0.000096hh - 0.0206rp - 0.0871t$

(2.42) (1.47) (-0.65) (-0.86) (-1.54) t-values

n = 40, $R^2 = 0.49$ Godfrey LM = 0.0560

Sugarcane Hectares Harvested

$hh = 482.0680 + 0.9637hh_{t-1} + 3.5330rp_{t-1} - 384.5761g$

(0.54) (21.25) (0.17) (-0.85) t-values

$e_t = 0.340681e_{t-1} + v_t$

(2.11) t-value

n = 40, $R^2 = 0.96$ Godfrey LM = 0.7521

Sugar Production:

pdsc = y * hh

Demand

Per Capita Sugar Consumption

$cqpsu = 5.0305 + 0.8743cqpsu_{t-1} + 0.0892realdomp + 0.000219rpci$

(0.36) (9.77) (1.63) (0.12) t-values

$e_t = 0.333491e_{t-1} + v_t$

(2.06) t-value

n = 40, $R^2 = 0.60$ Godfrey LM = 0.2020

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

qs = -73151 + 10194y + 4.3934hh + 1.1295qm – 0.5994qx – 0.6581sc

(-6.63) (6.41) (7.04) (6.02) (-6.90) (-4.54) t-values

n = 40, $R^2 = 0.67$ Godfrey LM = 0.7253

Sugar Exports

qx = -61638 + 3.4135hh + 17156y – 29082g

(-4.75) (6.11) (11.87) (-6.05) t-values

n = 40, $R^2 = 0.97$ Godfrey LM = 0.4183

Sugar Import

qm = 31634 + 0.0985qx – 1757y – 1.4923hh – 0.0667sc

(4.76) (1.50) (-1.51) (-3.46) (-0.54) t-values

$e_t = -0.286920e_{t-1} + v_t$

(-1.75) t-value

n = 40, $R^2 = 0.77$ Godfrey LM = 0.0727

Table 3.15 Empirical Estimation Results for OLS, Belize

Supply

Sugarcane Yield

$y = 5.5582 + 0.1519y_{t-1} - 0.000139hh + 0.0122rp + 0.0461t$

(5.88) (1.08) (-4.70) (1.04) (2.98) t-values

$e_t = -0.272167e_{t-1} + v_t$

(-1.62) t-value

n = 40, $R^2 = 0.74$ Godfrey LM = 0.0032

Sugarcane Hectares Harvested

$hh = 2159 + 0.8839hh_{t-1} + 48.6940rp_{t-1} + 1297g$

(2.16) (9.81) (1.24) (0.93) t-values

n = 40, $R^2 = 0.96$ Godfrey LM = 0.6672

Sugar Production:

pdsc = y * hh

Demand

Per Capita Sugar Consumption

$cqpsu = 8.8815 + 0.7631cqpsu_{t-1} + 0.0310realdomp + 0.001499rpci$

(2.49) (7.42) (0.79) (1.00) t-values

n = 40, $R^2 = 0.82$ Godfrey LM = 0.8031

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -73498 + 12922y + 3.3876hh + 0.5901qm - 0.6196qx - 0.5003sc$

(-5.60) (5.79) (5.70) (1.47) (-6.30) (-1.12) t-values

$e_t = -0.321786e_{t-1} + v_t$

(-1.95) t-value

n = 40, $R^2 = 0.52$ Godfrey LM = 0.0735

Sugar Exports

$qx = -92183 + 5.1909hh + 16281y - 8096g$

(-7.46) (14.38) (8.62) (-1.62) t-values

n = 40, $R^2 = 0.95$ Godfrey LM = 0.2937

Sugar Import

$qm = 12016 + 0.0957qx - 0.5164hh - 1914y + 0.0289sc$

(2.50) (2.71) (-2.46) (-2.29) (0.21) t-values

n = 40, $R^2 = 0.21$ Godfrey LM = 0.7168

Table 3.16 Empirical Estimation Results for OLS, Guyana

Supply

Sugarcane Yield

$y = 4.4866 + 0.6119\ y_{t-1} - 0.000037hh + 0.003317rp - 0.0235t$

(3.45) (4.69) (-2.14) (0.18) (-1.73) t-values

n = 40, $R^2 = 0.66$ Godfrey LM = 0.7955

Sugarcane Hectares Harvested

$hh = 17815 + 0.5912hh_{t-1} + 217.0391rp + 1046g$

(2.93) (4.43) (1.45) (0.54) t-values

$e_t = 0.189550e_{t-1} + v_t$

(1.13) t-value

n = 40, $R^2 = 0.32$ Godfrey LM = 0.1003

Sugar Production:

pdsc = y * hh

Demand

Per Capita Sugar Consumption

$cqpsu = 5.9246 + 0.7658cqdsu_{t-1} - 0.000427realdomp + 0.006480rpci$

(0.65) (6.26) (-0.31) (0.79) t-values

n = 40, $R^2 = 0.55$ Godfrey LM = 0.3292

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -237130 + 38370y + 4.5313hh + 1.4081qm - 0.7919qx - 0.3824sc$

(-8.41) (9.55) (9.64) (5.63) (-9.30) (-1.32) t-values

n = 40, $R^2 = 0.74$ Godfrey LM = 0.4300

Sugar Exports

$qx = -179737 + 4.2336hh + 39414y - 5072g$

(-5.69) (11.05) (12.40) (-0.66) t-values

n = 40, $R^2 = 0.92$ Godfrey LM = 0.6789

Sugar Import

$qm = 89390 + 0.1173qx - 9779y - 0.8721hh - 0.4567sc$

(7.69) (2.17) (-4.54) (-3.10) (-2.55) t-values

n = 40, $R^2 = 0.67$ Godfrey LM = 0.3011

Table 3.17 Empirical Estimation Results for OLS, St. Kitts-Nevis

Supply

Sugarcane Yield

$y = 3.3912 + 0.5584\ y_{t-1} + 0.0000461hh + 0.0115rp - 0.0308t$

(1.73) (3.89) (0.13) (0.52) (-1.70) t-values

n = 40, $R^2 = 0.61$ Godfrey LM = 0.9641

Sugarcane Hectares Harvested

$hh = 1166 + 0.7310hh_{t-1} - 6.3986rp_{t-1} - 2.2846g$

(1.98) (5.87) (0.66) (-0.02) t-values

n = 40, $R^2 = 0.58$ Godfrey LM = 0.3497

Sugar Production:

$pdsc = y * hh$

Demand

Per Capita Sugar Consumption

$cqpsu = 53.5600 + 0.4518cqdsu_{t-1} - 0.1986realdomp + 0.7534rpci$

(2.95) (2.33) (-1.04) (0.32) t-values

n = 40, $R^2 = 0.14$ Godfrey LM = 0.1748

Sugar Consumption

$sc = cqpsu * pop$

Sugar Stock Change

$qs = -18879 + 2580y + 4.3188hh + 0.8709qm - 0.5894qx - 0.5912sc$

(-7.58) (7.79) (7.46) (5.25) (-7.75) (-6.40) t-values

n = 40, $R^2 = 0.64$ Godfrey LM = 0.4967

Sugar Exports

$qx = -29351 + 7.2178hh + 3747y - 405.3711g$

(-7.76) (8.72) (11.50) (-0.40) t-values

$e_t = -0.381016e_{t-1} + v_t$

(-2.44) t-value

n = 40, $R^2 = 0.95$ Godfrey LM = 0.2353

Sugar Import

$qm = 11521 + 0.2870qx - 2.3937hh - 1344y + 0.2797sc$

(7.09) (4.75) (-5.59) (-5.39) (3.44) t-values

n = 40, $R^2 = 0.65$ Godfrey LM = 0.0515

Table 3.18 Empirical Estimation Results for OLS, Trinidad & Tobago

Supply

Sugarcane Yield

$y = 5.7610 + 0.3989y_{t-1} - 0.000047hh - 0.0112rp - 0.0627t$

(3.95) (2.44) (-1.73) (-0.47) (-3.04) t-values

n = 40, $R^2 = 0.62$ Godfrey LM = 0.7831

Sugarcane Hectares Harvested

$hh = 4903 + 0.9018hh_{t-1} - 145.5414rp_{t-1} - 1314g$

(1.49) (9.07) (-1.49) (-0.77) t-values

n = 40, $R^2 = 0.88$ Godfrey LM = 0.0527

Sugar Production:

pdsc = y * hh

Demand

Per Capita Sugar Consumption

$cqpsu = 17.9720 + 0.5162cqpsu_{t-1} + 0.006596realdomp + 0.001196rpci$

(2.93) (3.73) (0.84) (1.31) t-values

n = 40, $R^2 = 0.41$ Godfrey LM = 0.6516

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -107214 + 21347y + 3.7981hh + 0.8638qm - 0.6958qx - 0.8835sc$

(-6.36) (11.15) (12.01) (10.19) (-10.60) (-4.49) t-values

n = 40, $R^2 = 0.82$ Godfrey LM = 0.7092

Sugar Exports

$qx = -15283 + 2.4546hh + 17438y - 41024g$

(-0.35) (2.73) (5.17) (-2.61) t-values

$e_t = -0.569615e_{t-1} + v_t$

(-4.10) t-value

n = 40, $R^2 = 0.92$ Godfrey LM = 0.2133

Sugar Import

$qm = 123529 + 0.4168qx - 16676y - 3.0298hh + 0.3583sc$

(4.69) (3.78) (-6.48) (-8.23) (0.92) t-values

n = 40, $R^2 = 0.79$ Godfrey LM = 0.4319

Table 3.19 Variables Definition and Units, Jamaica

Name	Definition	Units
	Endogenous Variables	
hh	hectares harvested	hectares
hh_{t-1}	lagged hectares harvested	hectares
y	sugar cane yield	tonnes sugar / hectares
y_{t-1}	lagged sugar cane yield	tonnes sugar / hectares
cqpsu	per capita sugar consumption	tonnes
$cqpsu_{t-1}$	lagged per capita sugar consumption	tonnes
qs	stock change	tonnes
qm	imports	tonnes
qx	exports	tonnes
sc	domestic sugar consumption	tonnes
t	trend	
	Exogenous Variables	
pop	population	thousands
exrate	exchange rate	Jamaican dollar/U.S. dollar
rpci	real per capita income	million U.S. dollars, 1995 prices
rp	real Caribbean sugar price	U.S. dollars/pound
rp_{t-1}	lagged real Caribbean sugar price	U.S. dollars/pound
realdomp	real domestic prices	Jamaican dollars/pound, 1995 prices
g	government policy	

Table 3.20 Variables Definition and Units, Barbados

Name	Definition	Units
	Endogenous Variables	
hh	hectares harvested	hectares
hh_{t-1}	lagged hectares harvested	hectares
y	sugar cane yield	tonnes sugar / hectares
y_{t-1}	lagged sugar cane yield	tonnes sugar / hectares
cqpsu	per capita sugar consumption	tonnes
$cqpsu_{t-1}$	lagged per capita sugar consumption	tonnes
qs	stock change	tonnes
qm	imports	tonnes
qx	exports	tonnes
sc	domestic sugar consumption	tonnes
t	trend	
	Exogenous Variables	
pop	population	thousands
exrate	exchange rate	Barbadian dollar/U.S. dollar
rpci	real per capita income	million U.S. dollars, 1995 prices
rp	real Caribbean sugar price	U.S. dollars/pound
rp_{t-1}	lagged real Caribbean sugar price	U.S. dollars/pound
realdomp	real domestic prices	Barbadian dollars/pound, 1995 prices
g	government policy	

Table 3.21 Variable Definitions and Units, Belize

Name	Definition	Units
	Endogenous Variables	
hh	hectares harvested	hectares
hh_{t-1}	lagged hectares harvested	hectares
y	sugar cane yield	tonnes sugar / hectares
y_{t-1}	lagged sugar cane yield	tonnes sugar / hectares
cqpsu	per capita sugar consumption	tonnes
$cqpsu_{t-1}$	lagged per capita sugar consumption	tonnes
qs	stock change	tonnes
qm	imports	tonnes
qx	exports	tonnes
sc	domestic sugar consumption	tonnes
t	trend	
	Exogenous Variables	
pop	population	thousands
exrate	exchange rate	Belize dollar/U.S. dollar
rpci	real per capita income	million U.S. dollars, 1995 prices
rp	real Caribbean sugar price	U.S. dollars/pound
rp_{t-1}	lagged real Caribbean sugar price	U.S. dollars/pound
realdomp	real domestic prices	Belize dollars/pound, 1995 prices
g	government policy	

Table 3.22 Variables Definition and Units, Guyana

Name	Definition	Units
	Endogenous Variables	
hh	hectares harvested	hectares
hh_{t-1}	lagged hectares harvested	hectares
y	sugar cane yield	tonnes sugar / hectares
y_{t-1}	lagged sugar cane yield	tonnes sugar / hectares
cqpsu	per capita sugar consumption	tonnes
$cqpsu_{t-1}$	lagged per capita sugar consumption	tonnes
qs	stock change	tonnes
qm	imports	tonnes
qx	exports	tonnes
sc	domestic sugar consumption	tonnes
t	trend	
	Exogenous Variables	
pop	population	thousands
exrate	exchange rate	Guyanese dollar/U.S. dollar
rpci	real per capita income	million U.S. dollars, 1995 prices
rp	real Caribbean sugar price	U.S. dollars/pound
rp_{t-1}	lagged real Caribbean sugar price	U.S. dollars/pound
realdomp	real domestic prices	Guyanese dollars/pound, 1995 prices
g	government policy	

Table 3.23 Variables Definition and Units, St. Kitts-Nevis

Name	Definition	Units
	Endogenous Variables	
hh	hectares harvested	hectares
hh_{t-1}	lagged hectares harvested	hectares
y	sugar cane yield	tonnes sugar / hectares
y_{t-1}	lagged sugar cane yield	tonnes sugar / hectares
cqpsu	per capita sugar consumption	tonnes
$cqpsu_{t-1}$	lagged per capita sugar consumption	tonnes
qs	stock change	tonnes
qm	imports	tonnes
qx	exports	tonnes
sc	domestic sugar consumption	tonnes
t	trend	
	Exogenous Variables	
pop	population	thousands
exrate	exchange rate	E.C. dollar/U.S. dollar
rpci	real per capita income	million U.S. dollars, 1995 prices
rp	real Caribbean sugar price	U.S. dollars/pound
rp_{t-1}	lagged real Caribbean sugar price	U.S. dollars/pound
realdomp	real domestic prices	EC dollars/pound, 1995 prices
g	government policy	

Table 3.24 Variables Definitions and Units, Trinidad & Tobago

Name	Definition	Units
	Endogenous Variables	
hh	hectares harvested	hectares
hh_{t-1}	lagged hectares harvested	hectares
y	sugar cane yield	tonnes sugar / hectares
y_{t-1}	lagged sugar cane yield	tonnes sugar / hectares
cqpsu	per capita sugar consumption	tonnes
$cqpsu_{t-1}$	lagged per capita sugar consumption	tonnes
qs	stock change	tonnes
qm	imports	tonnes
qx	exports	tonnes
sc	domestic sugar consumption	tonnes
t	trend	
	Exogenous Variables	
pop	population	thousands
exrate	exchange rate	Barbadian dollar/U.S. dollar
rpci	real per capita income	million U.S. dollars, 1995 prices
rp	real Caribbean sugar price	U.S. dollars/pound
rp_{t-1}	lagged real Caribbean sugar price	U.S. dollars/pound
realdomp	real domestic prices	TT dollars/pound, 1995 prices
g	government policy	

3.5.1 Supply Section

This section discusses the supply model results, and provides explanations for the possible signs and coefficient values.

3.5.1.1 Hectares Harvested

The hectares harvested equation, which includes, hectares harvested lagged one year, real world sugar price lagged one year, and government policy, as independent variables had acceptable statistical properties. However, expected signs weren't consistent across all territories.

In all regions the hectares harvested in the current year were positively related to the hectares harvested in the previous year. This is not surprising, because of the biological nature of this crop (ratoons). This could be a reflection of the producer/farmer's habitual practices or his preference for growing sugar cane. It could also be an indication of fixity of capital resources in sugar cane cultivation and the continuity of the services of these fixed resources in the short-run.

The farmer starts each year with a given level of machinery, equipment, and land, but he can use the machinery and equipment for longer hours while including more land in his sugar production. The farmers lagged response may also be due to government programs, risk aversion, and constraints on his management capacity. The small coefficients on the lagged hectares harvested variables imply that the farmer in these regions tend to respond more quickly to economic incentives. These results indicate that producers planting decisions in response to economic incentives may follow a partial adjustment and that, consequently, it may take more than one year for full adjustment to occur.

The market price in the previous year, unlike lagged hectares harvested, had mixed results across different countries. This was positive, as expected for most countries except St. Kitts & Nevis, and Trinidad & Tobago. On the other hand, the level of statistical significance

varied for countries in which this industry plays a more significant role in the macro economic aspects of the economy, these showed higher levels of significances.

Because government policies determine the level of market accessibility, this was included in the hectares harvested model. Again, the results were mixed. The coefficient on the government policy variable was large (except St. Kitts-Nevis) with varying signs for all countries. This implies that producers in these countries aren't very responsive to government policies, this could be due to the fact that, more often than not, these countries are incapable of taking full advantages of their export allotments.

3.5.1.2 Yield

This component of the supply model relates yield (tonnes sugar per hectare) to hectares harvested, lagged yield because of the ratooning nature of sugar cane, real world price, and trend which refers to previous yield trends. The signs were all positive and significant with small coefficient for the lagged yield variable. This implies that current yield is somewhat dependent on last years yield. An increase in hectares harvested was found to have a negative impact on yield. The signs were as expected (negative) for all countries. However, the level of statistical significance varied across the region. This could be explained by such factors as limited capital and human resources in the short-run, and/or bringing marginal land into production.

The price variable showed low levels of significance with varying signs across the different countries. It was, however, decided that this variable would not be dropped since in cases where prices are completely eroded, farmers will choose not to harvest their crops. Also, the unexpected signs and/or t-ratios could be due to lack of consistency in the data.

Trend variables in all models yield small and negative coefficients except for Belize. The t-ratios were significant for most countries. Yields thus shows a negative linear trend across the

region. This could be due to the fact that, better land in prime locations at times may be taken out of production to make way for real estate development for the tourist industry or residential settlements. Thus, less productive lands are left for production.

3.5.2 Demand Section

As is the case with the supply section this section discusses the demand model results, and provides explanations for the possible signs and coefficient values.

3.5.2.1 Per Capita Consumption

Per Capita Sugar Consumption was used in order to minimize the impact of multicollinearity between population and personal income when estimating this sub-model. The estimated coefficients had the expected sign for all coefficients, except for real domestic prices in some countries. The level of significance for each coefficient varied across different countries. Current consumption and the previous year's consumption are positively related as expected and significant across all countries. Likewise, real per capita income variable signs were positive as expected for all countries. However the levels of statistical significance vary. The positive sign indicates that as income rise, consumers tend to use more sugar or products that are manufactured using sugar, since there is more per capita disposable personal income.

Real domestic price coefficients were small, indicating that consumers were sensitive to prices. However, the sign on the coefficient varied across different countries. It was expected that this sign would be negative. This was the case for only Guyana and St. Kitts-Nevis; all other countries had positive coefficients. The positive relationship between consumption and real domestic prices could be explained since there is no readily available substitute for sugar in most regions of the Caribbean. Therefore, the consumer will still consume the same relative amounts of sugar, even if there is a small increase in prices.

3.5.2.2 Exports

This component of the demand section refers to sugar exported by the region's producers to fulfill export commitment to the EU, US and other regions. The yield and hectares harvested variables were included in the model as these represents production, also included were government policies that includes, protocol arrangements and other sugar export agreements sugar export. All estimated coefficients had the expected signs and in most cases were significant at the 5% level except for government policies. The R^2 was very high in all cases, thus the variation in the dependent variable was adequately explained by the independent variables. The results showed that yield and hectares harvested had a direct relationship with export. Thus, when production is high, export is significantly influenced, while surprisingly, government policies had a negative relationship, this was expected to be positive. However, the negative sign could be explained since these countries export under a quota system thus this negatively impacts exports. Because of preferred prices in the EU, producers aren't pressured to maximize revenues and exports aren't optimized.

3.5.2.3 Imports

Imports refer to the domestic demand for sugar, by both the manufacturing sector and household consumers, this demand is for both raw and refined sugar. Imports for the manufacturing sector includes both raw and refined sugar with the greater percentage (90%) being refined sugar, which is used in the drinks, confectionery and baking industries. Household consumption (end consumers) is primarily of raw sugar 85% and the remaining 15% refined sugar.

Imports in the Caribbean tends to be unique since local production is generally used to fulfill export commitments that fetch higher prices, while sugar for local consumption is

purchased on the world market at a cheaper price. In most cases annual production is not adequate to satisfy total demand. The variables included in this equation were exports, yield, hectares harvested and consumption. The coefficients on all variables had the expected signs and were statistically significant except for consumption, which at times had inconsistent signs and was insignificant in some cases. The R^2 ranged from a high of 0.79 to a low of 0.21 across the different countries, indicating that variation in the dependent import variable is better explained in some countries by the independent variable in this equation than others. Export has a direct relationship with import, so when exports are high, imports are high. This is consistent with the explanation given above. Conversely, yield and hectares harvested had an inverse relationship with import. This is consistent with expectations as well, when local production is high, imports tend to be low, as some percentage of local consumption is taken care of by local production. It was expected that consumption would have a direct relationship with imports. However, in the case of Barbados and Guyana, the data showed an inverse relationship. The variable ending stock was omitted from this equation because of difficulty in obtaining good quality data, low quantities of ending stock in all cases observed from what data was available, and finally, insignificant values for the proxy stock change which was evaluated instead of ending stock.

3.5.2.4 Ending Stocks (Stock Change)

This final component of the demand section was used as a proxy for ending stocks. This represents the annual change in stocks held by the governments of the respective countries from unsold quantities of the previous year or for national security between successive periods. The level of local production is more significant than imports in determining the level of stock change since imports are necessary only if production was inadequate to satisfy total demand.

The coefficient estimates had the expected signs and were significant at the 5% level. The R^2 ranged from a high of 0.92 to a low of 0.52 for the different countries across the region in this analysis. The variables yield (y), hectares harvested (hh), and imports (qm) has a direct relationship with stock change, as expected, while exports and domestic consumption displayed the expected inverse relationship. However, because of problems encountered with the data set, there isn't much confidence with the accuracy of these estimates and consequently the levels of accuracy and predictability.

3.6 Elasticities

Supply and demand elasticities were computed using the coefficient values of the OLS regression equation results for explanatory purposes in the evaluation of the impact of policy changes, as well as to make relative comparison across the regions and among their variables. These elasticities represents the measure of responsiveness of the dependent variable whether in the demand or supply section to a 1% change in the independent (determinant) variable. The responsiveness tells whether the dependent variable has an elastic (greater than1%) or inelastic (less than 1%) response to the 1% change in the independent variable.

3.6.1 Supply Elasticities

Sugar supply elasticities calculated at the means using the regression equations estimated by OLS via SAS are given in table 3.25 below.

3.6.1.1 Hectares Harvested

The present analysis found that the hectares of sugar cane harvested were not appreciably affected in terms of responsiveness by the lagged hectares harvested and deflated world prices during the period 1961-2000. The short-run elasticities of the hectares of sugarcane harvested at the means with respect to the lagged hectares harvested ranged from a low of 0.43 in Guyana to a

high of 0.95 in Barbados, with t-value statistics ranging from a low of 2.98 to a high of 15.61 (2.00 being the point of significance) for the same two countries respectively. This was expected because of the biological nature of this crop. Producers only replant a small percentage of their hectares annually. Thus ratoons make up the greater percentage of the current crop. With respect to lagged real price market prices, elasticities ranged from a low of –0.05 to a high of 0.60. However, only the estimate for Jamaica with a t-value of 2.20 showed any significance.

Table 3.25 Short Run Elasticities of Caribbean Sugar Supply

	Regions											
	Jamaica		Barbados		Belize		Guyana		St. Kitts- Nevis		T & T	
Dependent Variable- Yield (y)												
Variables	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values
lagy	0.56	**4.23**	0.26	1.47	0.27	**1.98**	0.62	**4.67**	0.57	**3.88**	0.40	**2.43**
hh	-0.14	-0.82	-0.20	-0.65	-0.47	**-4.32**	-0.29	**-2.14**	0.03	0.53	-0.27	-1.73
rp	-0.02	-0.92	-0.03	-0.86	0.01	0.59	0.005	0.18	0.03	0.52	-0.02	-0.47
t	-0.15	**-2.22**	-0.26	-1.54	0.17	**3.02**	-0.08	-1.73	-0.09	-1.70	-0.26	**-3.03**
Dependent Variable- Hectares Harvested (hh)												
Variables	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values
laghh	0.56	**5.84**	0.95	**15.61**	0.82	**9.75**	0.43	**2.98**	0.74	**5.85**	0.91	**8.99**
lagrp	0.05	**2.20**	0.01	0.60	0.02	1.24	0.05	1.40	-0.02	0.66	-0.05	-1.49
g	-0.13	**-3.68**	-0.03	-1.16	0.04	0.93	0.01	0.45	-0.0004	-0.02	-0.03	-0.77

(significant t-values bold, elast = elasticity)

This implies that prices, except for Jamaica, don't play a huge role in determining the quantity hectares harvested. This is not surprising since producers aren't able to readily respond to price changes in the short-run because of fixity of assets and capital. The variable government policy yielded elasticities that indicate that producers aren't sensitive to policy changes in the short-run; elasticities range from a low of –0.77 to a high of 0.04. Within the region Jamaica is the only country, as can be seen from the table 3.25, that yields a significant t-valve of –3.68 for this variable. This implies that most countries within the region don't readily respond to changes in government policies in the short-run. This again could be attributed to fixity of assets and capital or habits of producers.

3.6.1.2 Yield

The short-run elasticities of yield at the means with respect to lagged yields ranged from 0.26 for Barbados to a high of 0.62 for Guyana, with significant t-values for most regions. This indicates that last year's yield, though inelastic, does play a role in current yields. This again may result from the biological aspect of this crop. The results also reveal that real prices don't necessarily impact yield (this may more be an agronomic function). In other words, producers aren't keener to extract the optimum amount of sugar from cane been processed because of prevailing prices. Elasticities range from a low of –0.03 to a high of 0.03, with insignificant t-values. For hectares harvested, except for Belize, Guyana, and somewhat Trinidad & Tobago, yields aren't significantly negatively affected by the current hectares being harvested, since elasticities for this variable ranges from –0.47 to 0.03.

3.6.1.3 Production

The product of hectares harvested and yield represents production. Results from the supply elasticities indicates that the variables involved in estimation of these parameters shows inelastic response to prices and its lagged form holding other factors (such as ending stock) constant.

3.6.2 Demand Elasticities

Sugar demand elasticities calculated at the means for 1961-2000 using the regression equations estimated by OLS using SAS are given in table 3.26 below.

3.6.2.1 Per Capita Domestic Consumption

The elasticity of per capita domestic sugar consumption with respect to the lagged domestic sugar consumption, deflated local domestic prices and real per capita personal income were calculated at the means. The elasticities show inelastic responses to the variable evaluated.

Table 3.26 Short Run Elasticities of Caribbean Sugar Demand

	Regions											
	Jamaica		Barbados		Belize		Guyana		St. Kitts-Nevis		T & T	
Dependent Variable- Per Capita Consumption (cqpsu)												
Variables	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values
lagcqpsu	0.60	**5.05**	0.72	**6.33**	0.75	**7.38**	0.77	**6.22**	0.43	**2.31**	0.51	**3.72**
realdomp	0.01	0.64	0.04	1.00	0.02	0.79	-0.10	-0.31	-0.03	-1.04	0.02	0.84
rpci	0.07	0.65	0.04	0.24	0.06	1.00	0.11	0.79	0.02	0.32	0.09	1.31
Dependent Variable- Stock Change (qs)												
Variables	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values
y	457.54	0.70	80.38	1.65	701.06	0.15	755.57	0.28	733736.48	0.0003	-497.02	0.26
hh	381.44	0.70	73.65	1.66	742.97	0.15	689.50	0.28	728672.49	0.0003	-504.10	0.26
qm	51.72	0.70	5.97	1.64	7.14	0.15	20.07	0.28	27015.25	0.0003	-73.97	0.26
qx	-312.06	-0.70	-60.89	1.65	-564.77	0.15	-653.96	0.28	-647352.80	0.0003	372.16	0.26
sc	-181.20	-0.70	-15.54	1.60	-47.33	0.15	-39.97	0.28	-86899.78	0.0003	211.55	0.26
Dependent Variable- Exports (qx)												
Variables	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values
hh	0.80	**6.67**	0.56	**6.09**	1.26	**14.18**	0.78	**10.98**	1.06	**10.21**	0.61	**4.75**
y	1.07	**7.50**	1.33	**11.70**	0.98	**8.57**	0.94	**12.30**	0.99	**14.25**	0.76	**5.57**
g	-0.17	**3.54**	-0.21	**6.02**	-0.07	1.62	-0.01	0.66	-0.007	-0.43	-0.23	**3.86**
Dependent Variable- Imports (qm)												
Variables	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values	Elas.	t-values
qx	2.93	**4.26**	3.41	**2.54**	8.54	**2.35**	6.80	**2.04**	10.16	**4.35**	2.60	**3.58**
y	-4.76	**-4.74**	-4.93	**-2.56**	-10.33	**-2.06**	-13.51	**3.62**	-12.32	**-4.82**	-4.53	**-5.61**
hh	-5.04	**-6.05**	-6.19	**-4.20**	-11.23	**-2.18**	-9.31	**-2.75**	-13.02	**4.97**	-4.70	**6.64**
sc	1.57	**1.86**	-0.14	-0.27	0.26	0.21	-3.34	**-2.34**	1.33	**3.28**	1.00	0.92

(significant t-values bold, elast = elasticity)

The lagged domestic sugar consumption yielded elasticities ranging from a low of 0.43 for St. Kitts-Nevis to a high of 0.77 for Guyana. These results imply that last year's domestic consumption is a good indicator of next year's domestic consumption.

With respect to domestic prices, it was expected that responses would be inverse, however, in some cases there were direct responses. Elasticities ranged from a low of –0.10 for St. Kitts-Nevis to a high of 0.04 for Barbados, the t-statistic, however, were insignificant. For St. Kitts-Nevis this result means that a 1% increase (decrease) in domestic price will result in a 0.10% decrease (increase) in the quantity of sugar demanded on the local market. These results indicate that demand during the period under consideration is relatively stable. Factors that could

account for the unexplained direct response of domestic demand to price could be due to the lack of substitutes or due to the impact of the rapid movements in exchange rates with respect to the US$, which at times may not be readily captured by the demand data, since prices are at times artificially controlled by some governments during the period under consideration.

The income elasticities of per capita domestic sugar consumption were estimated at the means and ranges from a low of 0.02 for St. Kitts-Nevis to a high of 0.11 for Guyana. However, although t-values were insignificant, all countries show a direct response to increase in income, thus indicating that sugar within this region is considered a normal good.

3.6.2.2 Exports

The elasticity of Caribbean sugar exports with respect to hectares harvested, yield and government policy were calculated at the means. The results are mixed. Hectares harvested indicate that responses of exports to this variable are elastic for Belize and St. Kitts-Nevis. However, all other countries' responses were inelastic. The t-value ratios were very high indicating that hectares harvested, a factor in production is, as expected, very important in determining quantities exported. Elasticities ranged from a high of 1.26 for Belize to a low of 0.56 for Barbados with corresponding t-values of 14.18 and 6.09 respectively. Like hectares harvested, exports response to yield is mixed across countries. Most country's response is elastic, except for Trinidad & Tobago. T-value ratios are all significant. Thus, yield, the other component of production, is very important in determining quantities exported. The variable government policy indicates an inverse relationship to exports. Responses are inelastic for all countries. Elasticities range from a low of -0.23 for Trinidad & Tobago to a high of –0.007 for St. Kitts-Nevis. These small elasticities mean that these countries aren't very responsive to changes in government policies. These results suggest that government export policies aren't more important than domestic demand when determining the demand for Caribbean sugar.

3.6.2.3 Stock Change

These were calculated at the means of the variables yield, hectares harvested, imports, exports and consumption. However, the results show that in all cases the elasticities were very large, indicating that stock change is very responsive to these variables. The t-value results showed that these elasticities in all cases were insignificant. These poor results I assume, may be due to the poor quality of the data for this variable. No conclusion can be safely drawn from this information. Because the domestic demand for sugar is inelastic, the effect of a decreased sugar export would result in additional stocks rather than an increase in consumption on the local market.

3.6.2.4 Imports

The elasticities of import demand for Caribbean sugar with respect to export, yield, hectares harvested, and consumption were calculated at the means. The results showed elastic responses for most variables. Imports elasticities with respect to exports show a direct relationship, and range from a high of 10.16 for St. Kitts-Nevis to a low of 2.60 for Trinidad & Tobago, with t-values for all countries showing significance. These results verify the fact that when exports are high, imports are also high. On the other hand production, as is expected, exhibits an inverse relationship with imports. Imports elasticities with respect to yield, range from a high of 4.53 to13.51 (absolute value), with t-values for all countries significant. Likewise, import with respect to hectares harvested exhibits an elastic response, with elasticities ranging from 4.70 to 13.02 (absolute value) and t-values significant for all countries in the study. Import's response to consumption varies from country to country. Jamaica, Guyana and St. Kitts-Nevis showed inelastic responses with significant t-values. Barbados and Belize yielded elastic responses. However, t-values are also insignificant. Trinidad & Tobago response was unitary,

with an insignificant t-value. The inelastic response of imports to consumption could be linked to the declining consumption trend (discussed earlier) in Jamaica and Guyana, the regions two largest producers.

3.7 Economic Model and Econometric Procedures Concluding Remarks

The somewhat minor differences between the OLS and SURE technique support the fact that the sub-models, particularly for the demand section, were not mis-specified. That is, the model captured the important explanatory variables that were incorporated in the demand equations. The slight difference may be as a result of factors such as institutional and non-economic factors such as population by ethnicity, changes in consumer taste and preferences, and other activities such as promotional activities by the industry.

The supply and demand elasticities, which were derived for explanatory purposes only, in most cases seem to be reasonable, indicating that the equations for this study were estimated well enough to use the results for subsequent policy analysis.

CHAPTER 4

POLICY ANALYSIS REGARDING CHANGES IN PREFERENTIAL TREATMENT OF CARIBBEAN SUGAR BY THE EUROPEAN UNION

Affected regions see the changes in preferential treatment of ACP sugar, and by extension Caribbean sugar, as a threat to the survivability of the agricultural industry in these countries. This threat is no less more profound in any other ACP member states than those in the Caribbean, where the sugar industry is at times described as the linchpin of rural communities. A break down of the sugar industry's contribution to Agricultural Gross Domestic Product in these countries shows that, in Jamaica (the largest and most diverse of all) its contribution in the crop year 1997/98 was 22%. It was more in the remaining countries of St. Kitts-Nevis (40%), Trinidad & Tobago (45%), Guyana and Belize (30%) and Barbados (31%). These figures highlight the fact that, indeed, at this time sugar is the most important crop for these countries. The proposed change relates mainly to the prices that ACP sugar producers receive for their produce. Production quotas will be abolished gradually once the level of imports and production has stabilized after price changes, thus this change is not imminent. Currently, in the ten newly proposed EU members, the domestic price for sugar is at a much lower price than the average price pertaining to the present fifteen EU members. This situation of price differential is adding pressure to cut prices in the existing fifteen member states in order to speed up the transition process and allow the candidate countries to adopt the full provisions of the EU sugar regime as soon as possible. This attempt at price convergence in the domestic market will affect the support prices given to beet producers, which is a guaranteed or intervention price for beet sugar. This price is set at the beginning of each year and is the price paid to the ACP partners for cane sugar CIF. Further, as mentioned earlier, this pricing system is seen by WTO member states as a subsidy for domestic and external suppliers and thus distorts the sugar market. Thus it will

be abolished. The price to be paid to producers will be the result of negotiation with manufacturers. Consequently, various pricing scenarios will be evaluated to investigate the supply and demand interaction in the Caribbean sugar market at these prices.

It must be noted that with the inclusion of these new sugar producing members into the EU, it is reasonable to assume that the quantity of sugar in the EU market will significantly increase causing prices to decrease. That will force a number of beet producers out of sugar production. This negative effect on supply will positively impact prices. Depending on the price level negotiated, the European market will be less attractive for quite a large portion of exporters with high production cost. Currently the Caribbean sugar producers are known to operate at high production cost. However, because there are no substitute crop and these economies are so dependent on the industry, they are have to continue producing. With this in mind, different price scenarios will be evaluated.

4.1 Application of Model to Various Scenarios of EU Sugar Prices

In this section, the quantity of sugar that is likely to be supply and demanded at different prices is evaluated using the OLS regression equations estimated for each country (tables 4.1 to 4.6, derived in chapter 3). These equations are used for the supply and demand forecasts over a ten (10) years period (2001-2010), via SAS.

In the analysis, estimates are made: (1) at EU prices with the current policy in place. This is seen as the status quo situation and serves as a reference point for alternative options, (2) at current US prices (after the policy has expired it is considered that EU prices could fall to US producer prices), (3) at world prices, (this price is considered to be the lowest price or a worst case scenario), (4) prices 15% below the current EU prices, (this a price is arbitrarily chosen, and falls somewhere between EU and US producer prices).

Table 4.1 Empirical OLS Estimates for Jamaica

Supply

Sugarcane Yield

$y = 4.4606 + 0.5610y_{t-1} - 0.000016hh - 0.0149rp - 0.0423t$

Sugarcane Hectares Harvested

$hh = 25286 + 0.5468hh_{t-1} + 265.3193rp_{t-1} - 9399g$

Sugar Production:

$pdsc = y * hh$

Demand

Per Capita Sugar Consumption

$cqpsu = 11.4050 + 0.7247cqpsu_{t-1} + 0.001060realdomp + 0.001232rpci$

$e_t = 0.250371e_{t-1} + v_t$

Sugar Consumption:

$sc = cqpsu * pop$

Sugar Stock Change

$qs = -243051 + 47073y + 4.6845hh + 0.9324qm - 0.8393qx - 1.0246sc$

Sugar Exports

$qx = -134799 + 3.7687hh + 35872y - 59245g$

$e_t = -0.349286e_{t-1} + v_t$

Sugar Import

$qm = 214041 + 0.4378qx - 27149y - 3.4361hh + 0.4934sc$

Table 4.2 Empirical OLS Estimates for Barbados

Supply

Sugarcane Yield

$y = 8.6229 + 0.2551y_{t-1} - 0.000096hh - 0.0206rp - 0.0871t$

Sugarcane Hectares Harvested

$hh = 482.0680 + 0.9637hh_{t-1} + 3.5330rp_{t-1} - 384.5761g$

$e_t = 0.340681e_{t-1} + v_t$

Sugar Production:

$pdsc = y * hh$

Demand

Per Capita Sugar Consumption

$cqpsu = 5.0305 + 0.8743cqpsu_{t-1} + 0.0892realdomp + 0.000219rpci$

$e_t = 0.333491e_{t-1} + v_t$

Sugar Consumption:

$sc = cqpsu * pop$

Sugar Stock Change

$qs = -73151 + 10194y + 4.3934hh + 1.1295qm - 0.5994qx - 0.6581sc$

Sugar Exports

$qx = -61638 + 3.4135hh + 17156y - 29082g$

Sugar Import

$qm = 31634 + 0.0985qx - 1757y - 1.4923hh - 0.0667sc$

$e_t = -0.286920e_{t-1} + v_t$

Table 4.3 Empirical OLS Estimates for Belize

Supply

Sugarcane Yield

$y = 5.5582 + 0.1519y_{t-1} - 0.000139hh + 0.0122rp + 0.0461t$

$e_t = -0.272167e_{t-1} + v_t$

Sugarcane Hectares Harvested

$hh = 2159 + 0.8839hh_{t-1} + 48.6940rp_{t-1} + 1297g$

Sugar Production:

$pdsc = y * hh$

Demand

Per Capita Sugar Consumption

$cqpsu = 8.8815 + 0.7631cqpsu_{t-1} + 0.0310realdomp + 0.001499rpci$

Sugar Consumption:

$sc = cqpsu * pop$

Sugar Stock Change

$qs = -73498 + 12922y + 3.3876hh + 0.5901qm - 0.6196qx - 0.5003sc$

$e_t = -0.321786e_{t-1} + v_t$

Sugar Exports

$qx = -92183 + 5.1909hh + 16281y - 8096g$

Sugar Import

$qm = 12016 + 0.0957qx - 0.5164hh - 1914y + 0.0289sc$

Table 4.4 Empirical OLS Estimates for Guyana

Supply

Sugarcane Yield

$y = 4.4866 + 0.6119\ y_{t-1} - 0.000037hh + 0.003317rp - 0.0235t$

Sugarcane Hectares Harvested

$hh = 17815 + 0.5912hh_{t-1} + 217.0391rp + 1046g$

$e_t = 0.189550e_{t-1} + v_t$

Sugar Production:

$pdsc = y * hh$

Demand

Per Capita Sugar Consumption

$cqpsu = 5.9246 + 0.7658cqdsu_{t-1} - 0.000427realdomp + 0.006480rpci$

Sugar Consumption:

$sc = cqpsu * pop$

Sugar Stock Change

$qs = -237130 + 38370y + 4.5313hh + 1.4081qm - 0.7919qx - 0.3824sc$

Sugar Exports

$qx = -179737 + 4.2336hh + 39414y - 5072g$

Sugar Import

$qm = 89390 + 0.1173qx - 9779y - 0.8721hh - 0.4567sc$

Table 4.5 Empirical OLS Estimates for St. Kitts-Nevis

Supply

Sugarcane Yield

$y = 3.3912 + 0.5584\ y_{t-1} + 0.0000461hh + 0.0115rp - 0.0308t$

Sugarcane Hectares Harvested

$hh = 1166 + 0.7310hh_{t-1} - 6.3986rp_{t-1} - 2.2846g$

Sugar Production:

$pdsc = y * hh$

Demand

Per Capita Sugar Consumption

$cqpsu = 53.5600 + 0.4518cqdsu_{t-1} - 0.1986realdomp + 0.7534rpci$

Sugar Consumption

$sc = cqpsu * pop$

Sugar Stock Change

$qs = -18879 + 2580y + 4.3188hh + 0.8709qm - 0.5894qx - 0.5912sc$

Sugar Exports

$qx = -29351 + 7.2178hh + 3747y - 405.3711g$

$e_t = -0.381016e_{t-1} + v_t$

Sugar Import

$qm = 11521 + 0.2870qx - 2.3937hh - 1344y + 0.2797sc$

Table 4.6 Empirical OLS Estimates for Trinidad & Tobago

Supply

Sugarcane Yield

$y = 5.7610 + 0.3989y_{t-1} - 0.000047hh - 0.0112rp - 0.0627t$

Sugarcane Hectares Harvested

$hh = 4903 + 0.9018hh_{t-1} - 145.5414rp_{t-1} - 1314g$

Sugar Production:

$pdsc = y * hh$

Demand

Per Capita Sugar Consumption

$cqpsu = 17.9720 + 0.5162cqpsu_{t-1} + 0.006596realdomp + 0.001196rpci$

Sugar Consumption:

$sc = cqpsu * pop$

Sugar Stock Change

$qs = -107214 + 21347y + 3.7981hh + 0.8638qm - 0.6958qx - 0.8835sc$

Sugar Exports

$qx = -15283 + 2.4546hh + 17438y - 41024g$

$e_t = -0.569615e_{t-1} + v_t$

Sugar Import

$qm = 123529 + 0.4168qx - 16676y - 3.0298hh + 0.3583sc$

In each case, except the status quo, it is assumed that the policy will remain in place as planned, until December 31, 2006, after which prices will start to erode. Quotas to the EU will remain the as is irregardless of the price change in the policy, therefore, each country will still possess the opportunity to export their sugar quotas to the EU as was the case before the policy change. The prices, as well as per capita income in the analysis, are all expressed in real terms since the equations uses deflated prices. The real world sugar price that is derived in the Caribbean was deflated using an average summation of consumer price indices of the countries involved, this was done in order to set these prices at a level that would reflect each situation on the basis of past trends. It is also assumed that each country's population and real per capita income will increase linearly during the period of estimation, based on past trends.

4.1.1 Scenario 1. Forecast at EU Prices with current Policy in Place

As mentioned above, this scenario is seen as the status quo. That is, it is an extension of the current regulatory system beyond the cut-off point for preferential treatment. This represents a reference point for the alternative options. As can be seen from the data derived from the regression analysis results (tables 4.1 to 4.6), the quantity of sugar produced annually by each country continues to fluctuate somewhat for all countries. Jamaica's production, according to the model, would continue to be approximately 210,000 tonnes annually, from approximately 40,000 hectares at a ratio of 5.30 ts/h. Barbados production is trending down as can be seen from table 4.2. According to the results, production would fall by about 15,000 to 20,000 tonnes over the forecasted period. This downward trend in Barbados could be due to the fact that this country's sugar sector is relatively small and possesses the economy that is least dependent on its sugar sector when compared to other countries in the study.

Table 4.7 Jamaica's Forecast at EU Prices with Policy - Base Period 1961-2000

Period 2000 actual values

Jamaica - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	2633	2676	2702	2727	2753	2778	2804	2829	2855	2881	2906
Real Per Capita Income	1785.50	1832.10	1836.90	1841.71	1846.52	1851.33	1856.13	1860.94	1865.75	1870.56	1875.37
Exchange Rate	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7

Jamaica - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Jamaica - Real Domestic Sugar Prices (Jamaican cents/pound)

Jamaican Price	210.56	407.84	440.35	450.90	454.32	455.43	455.79	455.91	455.95	455.96	455.96

Jamaica - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	39390	39283.99	39150. 21	39262.81	39443.16	39650.44	39864.87	40075.62	40276.78	40465.11	40641.38
Yield	5.15	5.25	5.28	5.29	5.29	5.29	5.29	5.29	5.30	5.30	5.30
Production	202858.5	206094.4	206565.2	207563.5	208652.5	209809.1	211000.6	212191.7	213353.8	214457.8	215506.6

Jamaica - Sugar Supply and Utilization (tonnes, raw value)

Production	202858.5	206094.4	206565.2	207563.5	208652.5	209809.1	211000.6	212191.7	213353.8	214457.8	215506.6
Net Exports	66185	84310.19	80916.71	79171.21	78105.77	77548.02	77278.16	77183.53	77172.53	77179.49	77183.95
Exports	169996	157989.09	153395.38	151240.85	150349.14	150169.10	150383.28	150806.12	151329.92	151883.55	152441.91
Imports	103811	73678.89	72478.67	72069.64	72243.37	72621.08	73105.12	73622.59	74157.38	74704.06	75257.96
Consumption	129365	132500.91	135180.35	137373.36	139476.76	141381.21	143180.41	144877.53	146504.10	148072.96	149598.84
Stock Change	7450.0	-10716.7	-9531.9	-8981.0	-8930.0	-9120.2	-9458.0	-9869.4	-10322.8	-10794.7	-11276.2

Jamaica - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	49.13	49.51	50.03	50.37	50.67	50.89	51.06	51.20	51.31	51.40	51.48

Table 4.8 Barbados' Forecast at EU Prices with Policy - Base Period 1961-2000

Period 2000 actual values

Barbados - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	267	269	270	271	271	272	273	274	275	276	277
Real Per Capita Income	8282.00	7974.97	8054.68	8133.94	8212.77	8291.19	8369.21	8446.87	8524.16	8601.11	8677.73
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Barbados - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Barbados - Real Domestic Sugar Prices (Barbadian cents/pound)

Barbados Price	15.03	17.04	17.89	18.24	18.39	18.45	18.48	18.49	18.49	18.49	18.49

Barbados - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	9000.00	8882.43	8768.95	8674.15	8592.89	8523.61	8465.04	8415.98	8375.31	8342.01	8315.26
Yield	6.49	5.51	5.28	4.94	4.72	4.49	4.28	4.07	3.85	3.64	3.43
Production	58410.0	48979.1	46323.8	42866.1	40558.7	38273.7	36218.2	34216.0	32279.4	30374.2	28496.3

Barbados - Sugar Supply and Utilization (tonnes, raw value)

Production	58410.0	48979.1	46323.8	42866.1	40558.7	38273.7	36218.2	34216.0	32279.4	30374.2	28496.3
Net Exports	44907	27350.95	25437.49	22444.23	20427.82	18407.60	16579.65	14791.35	13057.78	11350.73	9668.45
Exports	55384	40500.81	38305.16	35446.01	33538.02	31648.55	29948.85	28293.22	26691.87	25116.44	23563.57
Imports	10477	13149.86	12867.67	13001.78	13110.20	13240.95	13369.20	13501.87	13634.09	13765.71	13895.13
Consumption	16246	17882.61	19065.24	19957.88	20637.72	21162.40	21574.59	21905.2	22177.01	22406.20	22604.74
Stock Change	-2743.0	3745.5	1821.1	464.0	-506.8	-1296.3	-1936.0	-2480.6	-2955.3	-3382.7	-3776.9

Barbados - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	60.85	66.55	70.71	73.77	76.02	77.69	78.93	79.87	80.58	81.14	81.59

Table 4.9 Belize's Forecast at EU Prices with Policy - Base Period 1961-2000

Period 2000 actual values

Belize - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population('000)	240	227	230	234	237	240	244	247	251	254	258
Real Per Capita Income	3140.60	3161.25	3227.06	3292.97	3359.00	3425.12	3491.33	3557.64	3624.03	3690.51	3757.07
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Belize - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Belize - Real Domestic Sugar Prices (EC cents/pound)

Belize Price	16.07	16.40	17.29	17.65	17.79	17.85	17.88	17.89	17.89	17.90	17.90

Belize - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23198	23280.58	23336.01	23416.69	23506.26	23601.44	23699.95	23799.87	23899.57	23997.69	24093.56
Yield	5.27	5.10	5.07	5.07	5.09	5.12	5.15	5.18	5.21	5.24	5.27
Production	122253.5	118786.6	118274.4	118748.0	119663.5	120770.4	121961.6	23190.3	124433.7	125684.9	126938.1

Belize - Sugar Supply and Utilization (tonnes, raw value)

Production	122253.5	118786.6	118274.4	118748.0	119663.5	120770.4	121961.6	123190.3	124433.7	125684.9	126938.1
Net Exports	108944	104489.47	104309.95	104923.08	105882.21	106989.96	108161.03	109356.80	110557.52	111756.13	112947.40
Exports	109324.0	105130.2	104816.7	105351.1	106257.7	107325.5	108462.9	109628.2	110799.9	111970.1	113133.0
Imports	380.00	640.77	506.75	427.99	375.49	335.55	301.88	271.40	242.38	213.99	185.62
Consumption	13297	12778	13179	13563	13933	14292	14642	14987	15328	15667	16005
Stock Change	12.5	1519.2	785.1	261.6	-151.7	-511.2	-841.6	-1153.5	-1451.8	-1738.1	-2013.8

Belize - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	55.40	56.41	57.30	58.09	58.79	59.43	60.02	60.57	61.09	61.58	62.06

Table 4.10 Guyana's Forecast at EU Prices with Policy - Base Period 1961-2000

Period 2000 actual values

Guyana - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	761	784	787	790	793	796	799	802	805	808	811
Real Per Capita Income	941.09	816.07	818.71	821.35	823.97	826.59	829.20	831.80	834.39	836.98	839.56
Exchange Rate	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43

Guyana - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Guyana - Real Domestic Sugar Prices (Guyanese cents/pound)

Caribbean Price	851.00	859.21	901.87	919.06	925.99	928.78	929.91	930.36	930.55	930.62	930.65

Guyana - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	49000	47139.34	46443.75	45760.03	45503.58	45332.49	45314.70	45356.65	45456.35	45582.57	45728.40
Yield	5.58	5.23	5.01	4.88	4.78	4.70	4.63	4.56	4.49	4.43	4.36
Production	273420.0	246443.4	232772.0	223098.7	217335.0	212930.4	209640.3	206787.1	204223.8	201758.3	199336.8

Guyana - Sugar Supply and Utilization (tonnes, raw value)

Producti on	273420.0	246443.4	232772.0	223098.7	217335.0	212930.4	209640.3	206787.1	204223.8	201758.3	199336.8
Net Exports	265469	210702.88	198786.74	190284.65	185108.8 1	181121.58	178107.97	175481.73	173118.41	170851.65	168637.448
Exports	277446	219566.79	209461.91	202259.97	197831.66	194410.81	191804.59	189527.11	187471.59	185499.84	183574.30
Imports	11977	8863.9	10675.17	11975.32	12722.86	13289.23	13696.61	14045.38	14353.19	14648.20	14936.86
Consumption	30441	32513.95	33531.43	34354.23	35030.81	35596.42	36077.33	36493.40	36859.77	37188.04	37487.09
Stock Change	-22490.0	3226.6	453.9	-1540.2	-2804.6	-3787.6	-4545.0	-5188.0	-5754.4	-6281.4	-6787.7

Guyana - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	40.00	41.48	42.61	43.49	44.17	44.71	45.14	45.49	45.77	46.00	46.20

Table 4.11 St. Kitts-Nevis' Forecast at EU Price with Policy - Base Period 1961-2000

Period 2000 values actual

St. Kitts-Nevis - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	41	40.97	40.95	40.92	40.90	40.88	40.86	40.84	40.82	40.81	40.79
Real GDP (mil 1995$)	314.08	249.61	257.11	264.62	272.12	279.62	287.13	294.63	302.13	309.64	317.14
Exchange Rate	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70

St. Kitts-Nevis - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

St. Kitts-Nevis - Real Domestic Sugar Prices (EC cents/pound)

Caribbean Price	19.15	30.99	34.13	35.51	36.12	36.38	36.50	36.55	36.57	36.58	36.59

St. Kitts-Nevis - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	3440	3633.15	3776.17	3876.24	3946.53	3995.30	4028.51	4050.54	4064.57	4072.94	4077.30
Yield	5.33	5.46	5.41	5.28	5.12	4.96	4.81	4.67	4.53	4.41	4.29
Production	18335.2	19824.2	20420.3	20468.7	20224.5	19832.9	19375.8	18896.5	18416.7	17945.9	17487.0

St. Kitts-Nevis - Sugar Supply and Utilization (tonnes, raw value)

Production	18335.2	19824.2	20420.3	20468.7	20224.5	19832.9	19375.8	18896.5	18416.7	17945.9	17487.0
Net Exports	10252	14370.47	15332.93	15422.96	15140.78	14677.16	14130.24	13551.20	12965.54	12385.03	11813.72
Exports	12758	15917.08	16867.41	16978.22	16730.62	16308.32	15805.45	15271.03	14729.46	14192.04	13662.84
Imports	2506	1546.61	1534.48	1555.26	1589.85	1631.16	1675.21	1719.82	1763.92	1807.01	1849.12
Consumption	8088	5778.13	4715.43	4228.08	4008.24	3911.49	3871.41	3857.49	3855.61	3860.19	3866.30
Stock Change	-4.8	-324.4	371.9	817.7	1075.5	1244.3	1374.1	1487.8	1595.5	1700.7	1807.0

St. Kitts-Nevis - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	197.27	141.03	115.16	103.32	98.00	95.68	94.75	94.45	94.44	94.59	94.77

Table 4.12 Trinidad & Tobago's Forecast at EU Prices with Policy-Base Period 1961-2000

Period 2000 actual values

Trinidad & Tobago - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	1301	1341	1353	1365	1377	1389	1401	1413	1426	1438	1450
Real Per Capita Income	5122.70	5157.75	5226.78	5295.82	5364.86	5433.89	5502.93	5571.96	5641.00	5710.04	5779.07
Exchange Rate	6.3	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30

Trinidad & Tobago - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Trinidad & Tobago - Real Domestic Sugar Prices (Trinidad & Tobago cents/pound)

Trinidad & Tobago Price	44.23	86.42	97.46	103.09	105.96	107.42	108.17	108.55	108.74	108.84	108.89

Trinidad & Tobago - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23000	23311.19	23633.37	23822.09	23927.16	23962.35	23938.67	23866.06	23753.49	23609.04	23438.60
Yield	4.83	3.95	3.57	3.37	3.23	3.12	3.01	2.91	2.81	2.72	2.63
Production	111090.0	92120.4	84475.7	80342.6	77344.8	74661.4	72039.7	69415.6	66784.0	64151.8	61531.6

Trinidad & Tobago - Sugar Supply and Utilization (tonnes, raw value)

Production	111090.0	92120.4	84475.7	80342.6	77344.8	74661.4	72039.7	69415.6	66784.0	64151.8	61531.6
Net Exports	24354	45585.21	32596.79	25382.36	20439.63	16445.51	12883.38	9536.17	6305.27	3137.82	8.98
Exports	90493	90189.69	80302.88	74559.95	70754.86	67947.23	65698.71	63784.04	62077.87	60503.76	59017.06
Imports	66139	44604.48	47706.09	49177.59	50315.22	51501.71	52815.33	54247.88	55772.60	57365.94	59008.08
Consumption	59549	64813.68	67402.45	69212.54	70594.80	71743.71	72766.73	73722.83	74644.34	75548.99	76446.39
Stock Change	27187.0	-18278.5	-15523.5	-14252.3	-13689.6	-13527.8	-13610.4	-13843.4	-14165.6	-14535.0	-14923.7

Trinidad & Tobago - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	45.77	48.34	49.82	50.70	51.26	51.64	51.93	52.16	52.36	52.55	52.73

Additionally, its tourism sector is at the moment thriving. Therefore, sugar hectares may be making way for infrastructure development for this sector. Exports also decline as is expected, and imports for domestic consumption increases.

Guyana's production levels according to the results tends to be declining, however, its percentage of production exported annually remains relatively constant, this indicates that this country is highly dependent on revenues from this sector since imports increases to satisfy domestic demand. St. Kitts-Nevis the smallest producer in this group production actually remains relatively stable even with slight increases in hectares. On the other hand, Trinidad & Tobago's production levels according to the results will decline over the period. All countries under this scenario remain net exporters for the period, this means that each country is capable of satisfying at least domestic demand under this scenario if no sugar imports were possible.

4.1.2 Scenario 2. Forecast at US Prices after Policy Expiration

Under this scenario the guaranteed minimum price for sugar would be abolished after December 31,2006. The price now paid would be derived through negotiations with manufacturers. It is assumed that even though the US market is technically a closed market, manufactures could use the prevailing US sugar prices as a benchmark for their negotiations with the EU. There is a significant difference between domestic and producer prices in the US sugar market, therefore if there are changes in the US sugar market structure (though unlikely) in the near future, this could bring about an increase in sugar supply in its domestic market causing falling domestic prices. Producer's price may still remain relatively stable, thus it would be more favorable for countries within closer proximity to the US to sell its sugar on the US market than the EU's if there is a significant price difference. The EU could be forced to match these prices or lose these supplies to the US. The results are shown in tables 4.13 through 4.18.

Table 4.13 Jamaica's Forecast at US Prices without Policy - Base Period 1961-2000

Period 2000 actual values

Jamaica's - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	2633	2676	2702	2727	2753	2778	2804	2829	2855	2881	2906
Real Per Capita Income	1785.50	1832.10	1836.90	1841.71	1846.52	1851.33	1856.13	1860.94	1865.75	1870.56	1875.37
Exchange Rate	42.7	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70

Jamaica - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Jamaica - Real Domestic Sugar Prices (Jamaican cents/pound)

Caribbean Price	210.56	407.84	440.35	450.90	454.32	455.43	455.79	455.91	455.95	455.96	455.96

Jamaica - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	39390	39284.01	39150.43	39263.14	39442.85	39651.23	39866.00	42476.49	44816.04	47815.11	49527.86
Yield	5.15	5.25	5.28	5.29	5.29	5.29	5.29	5.25	5.14	5.35	5.57
Production	202858.5	206095.9	206568.6	207570.5	208651.9	209814.6	211010.8	223129.5	230371.8	255775.1	275964.6

Jamaica - Sugar Supply and Utilization (tonnes, raw value)

Production	202858.5	206095.9	206568.6	207570.5	208651.9	209814.6	211010.8	223129.5	230371.8	255775.1	275964.6
Net Exports	66185	84312.92	80921.34	79180.54	78106.08	77553.83	77289.68	84236.69	104558.92	132990.93	153785.30
Exports	169996	157990.70	153398.22	151247.10	150349.24	150172.56	150390.72	167347.14	172778.84	191831.32	206973.45
Imports	103811	73677.78	72476.88	72066.56	72243.17	72618.73	73101.04	83110.45	68219.92	58840.39	53188.15
Consumption	129365	132500.91	135180.35	137373.36	139476.76	141381.21	143180.41	144877.53	146504.10	148072.96	149598.84
Stock Change	7450.0	-10717.9	-9533.1	-8983.4	-8930.9	-9120.4	-9459.3	-5984.7	-20691.2	-25288.8	-27419.5

Jamaica - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	49.13	49.51	50.03	50.37	50.67	50.89	51.06	51.20	51.31	51.40	51.48

Table 4.14 Barbados' Forecast at US Prices without Policy - Base Period 1961-2000

Period 2000 actual values

Barbados - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	267	269	270	271	271	272	273	274	275	276	277
Real Per Capita Income	8282.00	7974.97	8054.68	8133.94	8212.77	8291.19	8369.21	8446.87	8524.16	8601.11	8677.73
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Barbados - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Barbados - Real Domestic Sugar Prices (Barbadian cents/pound)

Barbados Price	15.03	17.04	17.89	18.24	18.39	18.45	18.48	18.49	18.49	18.49	18.49

Barbados - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	9000.00	8882.44	8768.99	8674.21	8592.92	8523.70	8465.17	9089.70	9674.40	10221.83	10734.26
Yield	6.49	5.51	5.28	4.94	4.72	4.49	4.28	3.93	3.52	3.09	2.66
Production	58410.0	48979.4	46324.4	42867.5	40559.4	38274.6	36219.4	35698.9	34056.0	31615.6	28595.9

Barbados - Sugar Supply and Utilization (tonnes, raw value)

Production	58410.0	48979.4	46324.4	42867.5	40559.4	38274.6	36219.4	35698.9	34056.0	31615.6	28595.9
Net Exports	44907	27351.42	25438.17	22445.65	20428.62	18408.63	16581.09	10870.55	10158.58	8711.86	6728.21
Exports	55384	40501.10	38305.64	35447.12	33538.58	31649.24	29949.86	29519.41	28160.90	26142.91	23645.91
Imports	10477	13149.68	12867.47	13001.47	13109.96	13240.61	13368.76	18648.86	18002.35	17431.04	16917.70
Consumption	16246	17882.61	19065.24	19957.88	20637.72	21162.40	21574.59	21905.29	22177.01	22406.20	22604.74
Stock Change	-2743.0	3745.4	1821.0	464.0	-506.9	-1296.5	-1936.2	2923.1	1720.4	497.5	-737.1

Barbados - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	60.85	66.55	70.71	73.77	76.02	77.69	78.93	79.87	80.58	81.14	81.59

Table 4.15 Belize Forecast at US Prices without Policy - Base Period 1961-2000

Period 2000 actual values

Belize - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	240	227	230	234	237	240	244	247	251	254	258
Real Per Capita Income	3140.60	3161.25	3227.06	3292.97	3359.00	3425.12	3491.33	3557.64	3624.03	3690.51	3757.07
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Belize - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Belize - Real Domestic Sugar Prices (EC cents/pound)

Belize Price	16.07	16.40	17.29	17.65	17.79	17.85	17.88	17.89	17.89	17.90	17.90

Belize - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23198	23280.58	23336.05	23416.75	23506.21	23601.58	23700.19	22503.69	21514.34	20697.99	20025.72
Yield	5.27	5.10	5.07	5.07	5.09	5.12	5.15	5.37	5.56	5.73	5.87
Production	122253.5	118786.0	118273.4	118747.6	119664.0	120771.2	121962.4	120854.4	119637.2	118516.8	117552.2

Belize - Sugar Supply and Utilization (tonnes, raw value)

Production	122253.5	118786.0	118273.4	118747.6	119664.0	120771.2	121962.4	120854.4	119637.2	118516.8	117552.2
Net Exports	108944	104490.63	104310.84	104924.53	105884.22	106992.61	108163.93	120330.09	118181.51	116568.29	115398.26
Exports	109324.0	105131.49	104817.62	105352.56	106259.78	107328.25	108465.89	122291.65	119983.16	118231.67	116941.02
Imports	380.00	640.86	506.78	428.03	375.56	335.64	301.96	1961.56	1801.65	1663.38	1542.75
Consumption	13297	12777.96	13179.36	13563.37	13933.01	14291.63	14642.18	14987.01	15328.01	15666.83	16004.55
Stock Change	12.5	1517.4	783.2	259.7	-153.2	-513.1	-843.7	-14462.7	-13872.3	-13718.3	-13850.6

Belize - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	55.40	56.41	57.30	58.09	58.79	59.43	60.02	60.57	61.09	61.58	62.06

Table 4.16 Guyana Forecast at US Prices without Policy - Base Period 1961-2000

Period 2000 actual values

Guyana - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	761	784	787	790	793	796	799	802	805	808	811
Real Per Capita Income	941.09	816.07	818.71	821.35	823.97	826.59	829.20	831.80	834.39	836.98	839.56
Exchange Rate	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43

Guyana - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Guyana - Real Domestic Sugar Prices (Guyanese cents/pound)

Guyanese Price	851.00	859.21	901.87	919.06	925.99	928.78	929.91	930.36	930.55	930.62	930.65

Guyana - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	49000	47138.53	46443.18	45759.37	45502.52	45332.17	45314.77	46399.27	47247.10	47911.58	48443.80
Yield	5.58	5.23	5.01	4.88	4.78	4.70	4.63	4.54	4.44	4.34	4.25
Production	273420.0	246440.6	232770.9	223097.3	217332.2	212930.7	209641.5	210465.8	209744.5	208079.6	205876.2

Guyana - Sugar Supply and Utilization (tonnes, raw value)

Production	273420.0	246440.6	232770.9	223097.3	217332.2	212930.7	209641.5	210465.8	209744.5	208079.6	205876.2
Net Exports	265469	210701.21	198786.60	190284.31	185107.44	181122.84	178110.14	191090.72	190510.90	189185.24	187444.01
Exports	277446	219565.49	209461.85	202259.72	197830.59	194411.86	191806.35	207006.12	206366.12	205124.60	203552.60
Imports	11977	8864.29	10675.25	11975.41	12723.15	13289.01	13696.21	15915.40	15855.22	15939.37	16108.59
Consumption	30441	32513.95	33531.43	34354.23	35030.81	35596.42	36077.33	36493.40	36859.78	37188.04	37487.09
Stock Change	-22490.0	3225.5	452.9	-1541.3	-2806.0	-3788.6	-4545.9	-17118.3	-17626.1	-18293.7	-19054.9

Guyana - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	40.00	41.48	42.61	43.49	44.17	44.71	45.14	45.49	45.77	46.00	46.20

Table 4.17 St. Kitts-Nevis Forecast at US Price without Policy - Base Period 1961-2000

Period 2000 - actual values

St. Kitts-Nevis - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	41	40.97	40.95	40.92	40.90	40.88	40.86	40.84	40.82	40.81	40.79
Real GDP (mil 1995$)	314.08	249.61	257.11	264.62	272.12	279.62	287.13	294.63	302.13	309.64	317.14
Exchange Rate	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70

St. Kitts-Nevis - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

St. Kitts-Nevis - Real Domestic Sugar Prices (EC cents/pound)

St. Kitts-Nevis Price	19.15	30.99	34.13	35.51	36.12	36.38	36.50	36.55	36.57	36.58	36.59

St. Kitts-Nevis - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	3440	3633.15	3776.16	3876.22	3946.53	3995.27	4028.47	4052.83	4068.59	4078.20	4083.47
Yield	5.33	5.46	5.41	5.28	5.12	4.96	4.81	4.66	4.53	4.40	4.28
Production	18335.2	19824.0	20420.1	20468.5	20224.4	19832.9	19375.7	18902.0	18422.7	17949.7	17487.9

St. Kitts-Nevis - Sugar Supply and Utilization (tonnes, raw value)

Production	18335.2	19824.0	20420.1	20468.5	20224.4	19832.9	19375.7	18902.0	18422.7	17949.7	17487.9
Net Exports	10252	14370.29	15332.68	15422.72	15140.72	14677.07	14130.22	11341.04	10759.47	10179.42	9607.16
Exports	12758	15916.91	16867.18	16978.01	16730.59	16308.25	15805.45	13173.42	12635.74	12098.83	11568.80
Imports	2506	1546.62	1534.50	1555.29	1589.87	1631.18	1675.23	1832.37	1876.27	1919.41	1961.64
Consumption	8088	5778.13	4715.43	4228.08	4008.24	3911.49	3871.41	3857.49	3855.61	3860.19	3866.30
Stock Change	-4.8	-324.4	372.0	817.7	1075.5	1244.3	1374.1	3703.5	3807.6	3910.1	4014.4

St. Kitts-Nevis - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	197.27	141.03	115.16	103.32	98.00	95.68	94.75	94.45	94.44	94.59	94.77

Table 4.18 Trinidad & Tobago's Forecast at US Prices without Policy-Base Period 1961-2000

Period 2000 actual values

Trinidad & Tobago - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	1301	1341	1353	1365	1377	1389	1401	1413	1426	1438	1450
Real Per Capita Income	5122.70	5157.75	5226.78	5295.82	5364.86	5433.89	5502.93	5571.96	5641.00	5710.04	5779.07
Exchange Rate	6.3	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30

Trinidad & Tobago - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Trinidad & Tobago - Real Domestic Sugar Prices (Trinidad & Tobago cents/pound)

Trinidad & Tobago Price	44.23	86.42	97.46	103.09	105.96	107.42	108.17	108.55	108.74	108.84	108.89

Trinidad & Tobago - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23000	23311.12	23633.12	23821.68	23927.01	23961.65	23937.62	25180.51	26254.73	27179.78	27973.93
Yield	4.83	3.95	3.57	3.37	3.23	3.12	3.01	2.86	2.71	2.56	2.42
Production	111090.0	92119.2	84473.1	80340.5	77340.9	74655.8	72034.6	72128.3	71228.2	69710.5	67767.2

Trinidad & Tobago - Sugar Supply and Utilization (tonnes, raw value)

Production	111090.0	92119.2	84473.1	80340.5	77340.9	74655.8	72034.6	72128.3	71228.2	69710.5	67767.2
Net Exports	24354	45585.40	32596.23	25382.82	20437.92	16442.40	12881.13	-3905.07	-4322.79	-5631.21	-7563.74
Exports	90493	90190.25	80303.97	74562.06	70755.91	67948.20	65700.52	65785.11	64964.22	63579.96	1807.59
Imports	66139	44604.85	47707.74	49179.24	50317.99	51505.80	52819.39	69690.18	69287.01	69211.17	69371.33
Consumption	59549	64813.68	67402.45	69212.54	70594.80	71743.71	72766.73	73722.83	74644.34	75548.99	76446.39
Stock Change	27187.0	-18279.9	-15525.6	-14254.9	-13691.8	-13530.3	-13613.2	2310.5	906.7	-207.3	-1115.4

Trinidad & Tobago - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	45.77	48.34	49.82	50.70	51.26	51.64	51.93	52.16	52.36	52.55	52.73

This scenario was evaluated at US prices using OLS (as was the case with the status quo), with dummy variables (zeros) representing the periods before the EU sugar protocol was implemented, and after it expires, and ones representing the periods the protocol was in effect.

As can be seen from the result for each country, if the price changes from current EU sugar prices to US sugar producer's price, countries with economies that are more dependent on their sugar industry seem to marginally increase their hectares in production, it thus an increase in sugar output. If one examines the data in the tables above (4.13- 4.18) and a comparison is made with the tables in scenario1 (4.7- 4.12), it shows that all countries except Belize's total annual hectares in production increases each year after the policy changed. However, according to the model, yield (ts/h) as expected, decreases for all countries except Belize, since there is an inverse relationship between yield and hectares harvested. On the other hand, where production is concerned, Trinidad & Tobago is the only country that becomes a net importer since its export levels now falls below import. The result for Barbados shows that very soon it too may also become a net importer of sugar. For Belize, though its total hectares in production decreases, the increase in yield compensates for sugar lost from those hectares. Thus, export levels remains constant, and imports increase to satisfy the domestic sugar demand for local consumption.

It is theorized that the additional hectares most of these countries brought into operation were lands that are less desirable for sugar cane production. It would be rational to think that these hectares were brought back into production in order to return revenues to the levels they were before the loss of preferred prices and to distribute fix costs and thus improving economies of scale. If this is the case, it is clear that in order for this industry to survive in this region production cost has to be reduced to levels where the industry can become competitive or at least be able to break even.

4.1.3 Scenario 3. Forecast at World Prices after Policy Expiration

This scenario looks at a worst-case situation or the most pessimistic case. It is assumed that this is the lowest possible price that ACP producers could receive since this is generally the lowest price that is offered for sugar in any of its markets. This scenario was evaluated at World prices using OLS (as was the case with the scenario 2), with dummy variables (zeros) representing the periods before the EU sugar protocol was implemented, and after it expires, and ones representing the periods the protocol was in effect.

Tables 4.19 to 4.24 (below) provide a breakdown of the changes that would takes place for the variables under consideration in each country. These results indicate that statistically there is no difference in these results when compared to the results of prices at the US sugar producer's price level. As is the case at US producer's prices, the only difference from the status quo is, changes only occur after the policy change. The variables affected are yield, hectares harvested, imports and exports. It is not at all surprising that this is the case even though these prices are less than twice what these producers are accustomed to receiving both in the EU and US markets for their exports. The elasticity results indicated inelastic responses to prices. This indicates that price isn't the variable that Caribbean sugar production responds to, since supply remains virtually unchanged at different price levels. The factors alluded to earlier, such as asset fixity and the fact that the biological nature of this crop doesn't favor short-term cultivation, may be the underlining cause why there are no changes in the aforementioned variables in the short run. Thus there may be some other factor that drives these producers. The government's activity in these regions may be very important to these producers since they tend to be very supportive of the industry.

Table 4.19 Jamaica's Forecast at World Prices without Policy- Base Period 1961-2000

Period 2000 actual values

Jamaica - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	2633	2676	2702	2727	2753	2778	2804	2829	2855	2881	2906
Real Per Capita Income	1785.50	1832.10	1836.90	1841.71	1846.52	1851.33	1856.13	1860.94	1865.75	1870.56	1875.37
Exchange Rate	42.7	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70

Jamaica - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Jamaica - Real Domestic Sugar Prices (Jamaican cents/pound)

Jamaican Price	210.56	407.84	440.35	450.90	454.32	455.43	455.79	455.91	455.95	455.96	455.96

Jamaica - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	39390	39282.96	39150.15	39263.25	39444.48	39652.36	39866.8	42475.82	44814.84	47813.77	49527.86
Yield	5.15	5.25	5.28	5.29	5.29	5.29	5.29	5.25	5.14	5.35	5.57
Production	202858.5	206089.7	206567.1	207567.5	208661.8	209823.6	211018.9	223128.9	230292.2	255765.1	275967.2

Jamaica - Sugar Supply and Utilization (tonnes, raw value)

Production	202858.5	206089.7	206567.1	207567.5	208661.8	209823.6	211018.9	223128.9	230292.2	255765.1	275967.2
Net Exports	66185	84296.75	80911.54	79168.43	78108.42	77556.67	77292.02	84224.51	104486.75	132969.43	153777.70
Exports	169996	157976.75	153389.17	151236.79	150349.10	150173.55	150391.87	167346.69	172719.15	191823.86	206975.41
Imports	103811	73680.00	72477.63	72068.36	72240.69	72616.88	73099.85	83122.18	68232.39	58854.43	53197.71
Consumption	129365	132500.91	135180.35	137373.36	139476.76	141381.21	143180.41	144877.53	146504.10	148072.96	149598.84
Stock Change	7450.0	-10707.9	-9524.8	-8974.3	-8923.4	-9114.3	-9453.6	-5973.1	-20698.7	-25277.3	-27409.3

Jamaica - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	49.13	9.51	50.03	50.37	50.67	50.89	51.06	51.20	51.31	51.40	51.48

Table 4.20 Barbados Forecast at World Prices without Policy- Base Period 1961-2000

Period 2000 actual values

Barbados - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	267	269	270	271	271	272	273	274	275	276	277
Real Per Capita Income	8282.00	7974.97	8054.68	8133.94	8212.77	8291.19	8369.21	8446.87	8524.16	8601.11	8677.73
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Barbados - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Barbados - Real Domestic Sugar Prices (Barbadian cents/pound)

Caribbean Price	15.03	17.04	17.89	18.24	18.39	18.45	18.48	18.49	18.49	18.49	18.49

Barbados - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	9000.00	8882.37	8768.93	8674.15	8592.94	8523.72	8465.18	9089.62	9674.26	10221.62	10734.07
Yield	6.49	5.51	5.28	4.94	4.72	4.49	4.28	3.93	3.52	3.09	2.66
Production	58410.0	48979.7	46324.5	42866.8	40559.3	38274.6	36219.6	35699.0	34056.2	31614.9	28596.2

Barbados - Sugar Supply and Utilization (tonnes, raw value)

Production	58410.0	48979.7	46324.5	42866.8	40559.3	38274.6	36219.6	35699.0	34056.2	31614.9	28596.2
Net Exports	44907	27351.88	25438.42	22445.25	20428.89	18409.03	16581.68	10870.96	10159.13	8711.72	6729.08
Exports	55384	40501.32	38305.72	35446.55	33538.50	31649.24	29949.99	29519.47	28161.07	26142.35	23646.16
Imports	10477	13149.44	12867.30	13001.30	13109.61	13240.21	13368.31	18648.51	18001.94	17430.64	16917.08
Consumption	16246	17882.61	19065.24	19957.88	20637.72	21162.40	21574.59	21905.29	22177.01	22406.20	22604.74
Stock Change	-2743.0	3745.2	1820.8	463.7	-507.3	-1296.9	-1936.7	2922.7	1720.1	497.0	-737.7

Barbados - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	60.85	66.55	70.71	73.77	76.02	77.69	78.93	79.87	80.58	81.14	81.59

Table 4.21 Belize Forecast at World Prices without Policy- Base Period 1961-2000

Period 2000 actual values

Belize - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	240	227	230	234	237	240	244	247	251	254	258
Real Per Capita Income	3140.60	3161.25	3227.06	3292.97	3359.00	3425.12	3491.33	3557.64	3624.03	3690.51	3757.07
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Belize - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Belize - Real Domestic Sugar Prices (EC cents/pound)

Caribbean Price	16.07	16.40	17.29	17.65	17.79	17.85	17.88	17.89	17.89	17.90	17.90

Belize - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23198	23280.55	23336.25	23417.12	23506.95	23602.36	23701.00	22503.89	21514.03	20697.27	20024.91
Yield	5.27	5.10	5.07	5.07	5.09	5.12	5.15	5.37	5.56	5.73	5.87
Production	122253.5	118787.4	118274.6	118749.6	119665.9	120773.3	121964.6	120855.6	119637.3	118516.4	117550.7

Belize - Sugar Supply and Utilization (tonnes, raw value)

Production	122253.5	118787.4	118274.6	118749.6	119665.9	120773.3	121964.6	120855.6	119637.3	118516.4	117550.7
Net Exports	108944	104490.39	104310.93	104925.53	105885.78	106994.32	108165.70	120330.23	118179.97	116565.87	115394.94
Exports	109324.0	105131.27	104817.74	105353.63	106261.42	107330.05	108467.76	122291.72	119981.49	118229.11	116937.51
Imports	380.00	640.87	506.81	428.10	375.64	335.73	302.06	1961.49	1801.52	1663.24	1542.58
Consumption	13297	12777.96	13179.36	13563.37	13933.01	14291.63	14642.18	14987.01	15328.01	15666.83	16004.55
Stock Change	12.5	1519.0	784.3	260.7	-152.9	-512.7	-843.3	-14461.6	-13870.7	-13716.3	-13848.8

Belize - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	55.40	56.41	57.30	58.09	58.79	59.43	60.02	60.57	61.09	61.58	62.06

Table 4.22 Guyana Forecast at World Prices without Policy- Base Period 1961-2000

Period 2000 actual values

Guyana - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	761	784	787	790	793	796	799	802	805	808	811
Real Per Capita Income	941.09	816.07	818.71	821.35	823.97	826.59	829.20	831.80	834.39	836.98	839.56
Exchange Rate	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43

Guyana - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Guyana - Real Domestic Sugar Prices (Guyanese cents/pound)

Guyana Price	851.00	859.21	901.87	919.06	925.99	928.78	929.91	930.36	930.55	930.62	930.65

Guyana - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	49000	47138.89	46443.64	45760.39	45504.63	45334.17	45316.61	46400.21	47247.35	47911.33	48444.15
Yield	5.58	5.23	5.01	4.88	4.78	4.70	4.63	4.54	4.44	4.34	4.25
Production	273420.0	246444.5	232775.9	223104.4	217342.8	212939.5	209648.9	210469.8	209746.8	208081.5	205881.1

Guyana - Sugar Supply and Utilization (tonnes, raw value)

Production	273420.0	246444.5	232775.9	223104.4	217342.8	212939.5	209648.9	210469.8	209746.8	208081.5	205881.1
Net Exports	265469	210703.46	198789.14	190288.39	185114.03	181127.71	178113.53	191084.47	190502.69	189176.12	187437.23
Exports	277446	219567.39	209464.04	202263.21	197836.10	194415.94	191809.22	207001.03	206359.42	205117.18	203547.04
Imports	11977	8863.93	10674.91	11974.82	12722.06	13288.23	13695.69	15916.56	15856.73	15941.05	16109.81
Consumption	30441	32513.95	33531.43	34354.23	35030.81	35596.42	36077.33	36493.40	36859.77	37188.04	37487.09
Stock Change	-22490.0	3227.1	455.3	-1538.2	-2802.1	-3784.7	-4542.0	-17108.1	-17615.6	-18282.6	-19043.2

Guyana - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	40.00	41.48	42.61	43.49	44.17	44.71	45.14	45.49	45.77	46.00	46.20

Table 4.23 St. Kitts-Nevis Forecast at World Prices without Policy- Base Period 1961-2000

Period 2000 - actual values

St. Kitts-Nevis - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	41	40.97	40.95	40.92	40.90	40.88	40.86	40.84	40.82	40.81	40.79
Real GDP (mil 1995$)	314.08	249.61	257.11	264.62	272.12	279.62	287.13	294.63	302.13	309.64	317.14
Exchange Rate	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70

St. Kitts-Nevis - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

St. Kitts-Nevis - Real Domestic Sugar Prices (EC cents/pound)

Caribbean Price	19.15	30.99	34.13	35.51	36.12	36.38	36.50	36.55	36.57	36.58	36.59

St. Kitts-Nevis - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	3440	3633.23	3776.26	3876.34	3946.62	3995.37	4028.57	4052.88	4068.61	4078.19	4083.39
Yield	5.33	5.46	5.41	5.28	5.12	4.96	4.81	4.66	4.53	4.40	4.28
Production	18335.2	19824.5	20420.6	20469.0	20224.6	19832.9	19375.7	18901.8	18422.3	17949.3	17487.4

St. Kitts-Nevis - Sugar Supply and Utilization (tonnes, raw value)

Production	18335.2	19824.5	20420.6	20469.0	20224.6	19832.9	19375.7	18901.8	18422.3	17949.3	17487.4
Net Exports	10252	14370.76	15333.23	15423.19	15140.85	14677.09	14130.09	11340.38	10758.60	10178.46	9605.95
Exports	12758	15917.34	16867.69	16978.45	16730.70	16308.27	15805.33	13172.79	12634.93	12097.93	11567.67
Imports	2506	1546.58	1534.46	1555.26	1589.86	1631.18	1675.24	1832.42	1876.33	1919.47	1961.72
Consumption	8088	5778.13	4715.43	4228.08	4008.24	3911.49	3871.41	3857.49	3855.61	3860.19	3866.30
Stock Change	-4.8	-324.4	371.9	817.7	1075.5	1244.4	1374.2	3703.9	3808.1	3910.7	4015.2

St. Kitts-Nevis - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	197.27	141.03	115.16	103.32	98.00	95.68	94.75	94.45	94.44	94.59	94.77

Table 4.24 Trinidad & Tobago's Forecast at World Prices without Policy-Base Period 1961-2000

Period 2000 actual values

Trinidad & Tobago - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	1301	1341	1353	1365	1377	1389	1401	1413	1426	1438	1450
Real Per Capita Income	5122.70	5157.75	5226.78	5295.82	5364.86	5433.89	5502.93	5571.96	5641.00	5710.04	5779.07
Exchange Rate	6.3	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30

Trinidad & Tobago - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Trinidad & Tobago - Real Domestic Sugar Prices (Trinidad & Tobago cents/pound)

Caribbean Price	44.23	86.42	97.46	103.09	105.96	107.42	108.17	108.55	108.74	108.84	108.89

Trinidad & Tobago - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23000	23311.05	23633.57	23821.78	23926.87	23961.84	23938.44	25180.77	26254.19	27179.34	27973.21
Yield	4.83	3.95	3.57	3.37	3.23	3.12	3.01	2.86	2.71	2.56	2.42
Production	111090.0	92120.4	84473.8	80339.7	77341.4	74658.9	72036.9	72127.3	71228.2	69710.4	67766.4

Trinidad & Tobago - Sugar Supply and Utilization (tonnes, raw value)

Production	111090.0	92120.4	84473.8	80339.7	77341.4	74658.9	72036.9	72127.3	71228.2	69710.4	67766.4
Net Exports	24354	45587.06	32596.42	25381.75	20438.54	16445.71	12882.99	-3907.03	-4323.93	-5632.38	-7566.31
Exports	90493	90191.29	80303.85	74561.59	70756.45	67949.77	65700.84	65784.21	64964.19	63579.90	61806.85
Imports	66139	44604.23	47707.43	49179.84	50317.91	51504.06	52817.85	69691.24	69288.12	69212.28	69373.16
Consumption	59549	64813.68	67402.45	69212.54	70594.80	71743.71	72766.73	73722.83	74644.34	75548.99	76446.39
Stock Change	27187.0	-18280.3	-15525.1	-14254.6	-13691.9	-13530.5	-13612.8	2311.5	907.8	-206.2	-1113.6

Trinidad & Tobago - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	45.77	48.34	49.82	50.70	51.26	51.64	51.93	52.16	52.36	52.55	52.73

4.1.4 Scenario 4. Forecast at EU Prices Decreased by 15% after Policy Expiration

This price level was arbitrarily chosen since it falls somewhere between EU and US sugar producer's prices. This scenario was evaluated at EU prices decreased by 15% using OLS (as was the case with the previous scenarios), with dummy variables (zeros) representing the periods before the EU sugar protocol was implemented, and after it expires, and ones representing the periods the protocol was in effect.

The results in tables 4.25 to 4.30 show that as is the case with US producer's prices, and world sugar prices, there is statistically no difference in these three results. This re-enforces the point that these producers aren't driven by prices. Again, this result is not surprising, as the evaluation of the elasticities indicates that sugar production response to its own price is inelastic. Countries tend to increase their hectares until it reaches some point were the price no longer shows any effect. In the case of Jamaica hectares maximizes at around 49,500 hectares.

Finally, it must be noted that for all these scenarios it is assumed that all countries, including the US, will honor its export commitments by allowing these countries to fulfill their quota allotments.

Table 4.25 Jamaica's Forecast at EU Prices Decreased by 15% without Policy

Period 2000 actual values

Jamaica - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	2633	2676	2702	2727	2753	2778	2804	2829	2855	2881	2906
Real Per Capita Income	1785.50	1832.10	1836.90	1841.71	1846.52	1851.33	1856.13	1860.94	1865.75	1870.56	1875.37
Exchange Rate	42.7	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70	42.70

Jamaica - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Jamaica - Real Domestic Sugar Prices (Jamaican cents/pound)

Caribbean Price	210.56	407.84	440.35	450.90	454.32	455.43	455.79	455.91	455.95	455.96	455.96

Jamaica - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	39390	39284.15	39149.61	39263.30	39443.41	39650.99	39864.74	42476.52	4 4817.20	47815.33	49528.24
Yield	5.15	5.25	5.28	5.29	5.29	5.29	5.29	5.65	5.14	5.35	5.57
Production	202858.5	206097.6	206559.4	207565.1	208651.8	209812.4	210997.7	240107.6	230291.4	255761.1	275948.1

Jamaica - Sugar Supply and Utilization (tonnes, raw value)

Production	202858.5	206097.6	206559.4	207565.1	208651.8	209812.4	210997.7	240107.6	230291.4	255761.1	275948.1
Net Exports	66185	84316.99	80912.24	79173.80	78105.61	77552.88	77276.16	96967.11	104499.43	132978.88	153771.23
Exports	169996	157995.27	153393.35	151242.93	150349.10	150172.35	150381.78	180080.73	172718.56	191820.85	206961.05
Imports	103811	73678.28	72481.11	72069.13	72243.49	72619.47	73105.63	83113.62	68219.14	58841.97	53189.82
Consumption	129365	132500.91	135180.35	137373.36	139476.76	141381.21	143180.41	144877.53	146504.10	148072.96	149598.84
Stock Change	7450.0	-10720.3	-9533.2	-8982.0	-8930.6	-9121.6	-9458.9	-1737.0	-20712.1	-25290.7	-27422.0

Jamaica - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	49.13	49.51	50.03	50.37	50.67	50.89	51.06	51.20	51.31	51.40	51.48

Table 4.26 Barbados Forecast at EU Prices Decreased by 15% without Policy

Period 2000 actual values

Barbados - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	267	269	270	271	271	272	273	274	275	276	277
Real Per Capita Income	8282.00	7974.97	8054.68	8133.94	8212.77	8291.19	8369.21	8446.87	8524.16	8601.11	8677.73
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Barbados - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Barbados - Real Domestic Sugar Prices (Barbadian cents/pound)

Caribbean Price	15.03	17.04	17.89	18.24	18. 39	18.45	18.48	18.49	18.49	18.49	18.49

Barbados - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	9000.00	8882.45	8768.94	8674.20	8592.94	8523.70	8465.11	9089.74	9674.58	10222.04	10734.55
Yield	6.49	5.51	5.28	4.94	4.72	4.49	4.28	3.93	3.52	3.09	2.66
Production	58410.0	48979.6	46323.6	42866.5	40559.0	38274.7	36218.7	35697.4	34055.1	31614.0	28593.5

Barbados - Sugar Supply and Utilization (tonnes, raw value)

Production	58410.0	48979.6	46323.6	42866.5	40559.0	38274.7	36218.7	35697.4	34055.1	31614.0	28593.5
Net Exports	44907	27351.58	25437.42	22444.74	20428.34	18408.80	16580.39	10869.43	10158.14	8710.84	6726.62
Exports	55384	40501.25	38304.98	35446.27	33538.27	31649.37	29949.24	29518.21	28160.19	26141.58	23643.95
Imports	10477	13149.67	12867.56	13001.53	13109.93	13240.57	13368.84	18648.77	18002.05	17430.74	16917.33
Consumption	16246	17882.61	19065.24	19957.88	20637.72	21162.40	21574.59	21905.29	22177.01	22406.20	22604.74
Stock Change	-2743.0	3745.4	1820.9	463.8	-507.0	-1296.5	-1936.3	2922.7	1720.0	496.9	-737.9

Barbados - Per Capita Sugar Consumption (kilograms)

Per Capita Consump tion	60.85	66.55	70.71	73.77	76.02	77.69	78.93	79.87	80.58	81.14	81.59

Table 4.27 Belize Forecast at EU Prices Decreased by 15% without Policy

Period 2000 actual values

Belize - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	240	227	230	234	237	240	244	247	251	254	258
Real Per Capita Income	3140.60	3161.25	3227.06	3292.97	3359.00	3425.12	3491.33	3557.64	3624.03	3690.51	3757.07
Exchange Rate	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Belize - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Belize - Real Domestic Sugar Prices (EC cents/pound)

Caribbean Price	16.07	16.40	17.29	17.65	17.79	17.85	17.88	17.89	17.89	17.90	17.90

Belize - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23198	23280.64	23335.98	23416.83	23506.39	23601.65	23700.06	22503.59	21514.36	20697.85	20025.59
Yield	5.27	5.10	5.07	5.07	5.09	5.12	5.15	5.37	5.56	5.73	5.87
Production	122253.5	118785.5	118273.2	118747.5	119663.5	120770.1	121961.7	120853.7	119636.0	118515.5	117550.8

Belize - Sugar Supply and Utilization (tonnes, raw value)

Production	122253.5	118785.5	118273.2	118747.5	119663.5	120770.1	121961.7	120853.7	119636.0	118515.5	117550.8
Net Exports	108944	104490.63	104310.80	104924.85	105884.45	106992.30	108163.55	120330.73	118181.88	116568.36	115398.28
Exports	109324.0	105131.50	104817.61	105352.92	106260.04	107327.94	108465.53	122292.28	119983.49	118231.71	116941.00
Imports	380.00	640.88	506.81	428.07	375.59	335.64	301.98	1961.55	1801.61	1663.35	1542.73
Consumption	13297	12777.96	13179.36	13563.37	13933.01	14291.63	14642.18	14987.01	15328.01	15666.83	16004.55
Stock Change	12.5	1516.9	783.0	259.2	-154.0	-513.8	-844.0	-14464.0	-13873.9	-13719.7	-13852.0

Belize - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	55.40	56.41	57.30	58.09	58.79	59.43	60.02	60.57	61.09	61.58	62.06

Table 4.28 Guyana Forecast at EU Prices Decreased by 15% without Policy

Period 2000 actual values

Guyana - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	761	784	787	790	793	796	799	802	805	808	811
Real Per Capita Income	941.09	816.07	818.71	821.35	823.97	826.59	829.20	831.80	834.39	836.98	839.56
Exchange Rate	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43	182.43

Guyana - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Guyana - Real Domestic Sugar Prices (Guyanese cents/pound)

Caribbean Price	851.00	859.21	901.87	919.06	925.99	928.78	929.91	930.36	930.55	930.62	930.65

Guyana - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	49000	47139.01	46443.11	45760.02	45503.53	45332.68	45314.46	46399.08	47247.42	47911.18	48443.41
Yield	5.58	5.23	5.01	4.88	4.78	4.70	4.63	4.54	4.44	4.34	4.25
Production	273420.0	246444.6	232773.2	223102.6	217338.2	212933.8	209641.5	210467.1	209748.0	208080.8	205878.2

Guyana - Sugar Supply and Utilization (tonnes, raw value)

Production	273420.0	246444.6	232773.2	223102.6	217338.2	212933.8	209641.5	210467.1	209748.0	208080.8	205878.2
Net Exports	265469	210703.95	198787.79	190287.78	185111.24	181124.03	178108.47	191086.64	190508.51	189180.48	187439.69
Exports	277446	219567.77	209462.95	202262.73	197833.85	194413.01	191805.20	207002.96	206364.29	205120.83	203549.17
Imports	11977	8863.82	10675.16	11974.95	12722.62	13288.98	13696.73	15916.32	15855.78	15940.36	16109.48
Consumption	30441	32513.95	33531.43	34354.23	35030.81	35596.42	36077.33	36493.40	36859.77	37188.04	37487.09
Stock Change	-22490.0	3226.7	454.0	-1539.4	-2803.9	-3786.7	-4544.3	-17112.9	-17620.3	-18287.7	-19048.6

Guyana - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	40.00	41.48	42.61	43.49	44.17	44.71	45.14	45.49	45.77	46.00	46.20

Table 4.29 St. Kitts-Nevis Forecast at EU Prices Decreased by 15% without Policy

Period 2000 - actual values

St. Kitts-Nevis - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	41	40.97	40.95	40.92	40.90	40.88	40.86	40.84	40.82	40.81	40.79
Real GDP (mil 1995$)	314.08	249.61	257.11	264.62	272.12	279.62	287.13	294.63	302.13	309.64	317.14
Exchange Rate	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70

St. Kitts-Nevis - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

St. Kitts-Nevis - Real Domestic Sugar Prices (EC cents/pound)

Caribbean Price	19.15	30.99	34.13	35.51	36.12	36.38	36.50	36.55	36.57	36.58	36.59

St. Kitts-Nevis - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	3440	3633.14	3776.16	3876.21	3946.50	3995.26	4028.49	4052.84	4068.58	4078.20	4083.47
Yield	5.33	5.46	5.41	5.28	5.12	4.96	4.81	4.66	4.53	4.40	4.28
Production	18335.2	19823.9	20420.1	20468.5	20224.3	19832.8	19375.8	18902.0	18422.5	17949.7	17487.8

St. Kitts-Nevis - Sugar Supply and Utilization (tonnes, raw value)

Production	18335.2	19823.9	20420.1	20468.5	20224.3	19832.8	19375.8	18902.0	18422.5	17949.7	17487.8
Net Exports	10252	14370.22	15332.72	15422.64	15140.58	14677.00	14130.28	11341.07	10759.36	10179.43	9607.15
Exports	12758	15916.85	16867.22	16977.94	16730.45	16308.19	15805.51	13173.44	12635.64	12098.84	11568.79
Imports	2506	1546.62	1534.50	1555.30	1589.88	1631.19	1675.23	1832.37	1876.28	1919.41	1961.64
Consumption	8088	5778.13	4715.43	4228.08	4008.24	3911.49	3871.41	3857.49	3855.61	3860.19	3866.30
Stock Change	-4.8	-324.4	371.9	817.8	1075.5	1244.3	1374.1	3703.4	3807.6	3910.1	4014.4

St. Kitts-Nevis - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	197.27	141.03	115.16	103.32	98.00	95.68	94.75	94.45	94.44	94.59	94.77

Table 4.30 Trinidad & Tobago's Forecast at EU Prices decreased by 15% without Policy-Base Period 1961-2000

Period 2000 actual values

Trinidad & Tobago - Macroeconomic Variables

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population ('000)	1301	1341	1353	1365	1377	1389	1401	1413	1426	1438	1450
Real Per Capita Income	5122.70	5157.75	5226.78	5295.82	5364.86	5433.89	5502.93	5571.96	5641.00	5710.04	5779.07
Exchange Rate	6.3	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30

Trinidad & Tobago - Real Sugar Prices (U.S. cents/pound)

Caribbean Price	8.51	6.72	7.42	7.87	8.28	8.66	9.01	9.33	9.63	9.91	10.16

Trinidad & Tobago - Real Domestic Sugar Prices (Trinidad & Tobago cents/pound)

Caribbean Price	44.23	86.42	97.46	103.09	105.96	107.42	108.17	108.55	108.74	108.84	108.89

Trinidad & Tobago - Sugarcane Area Harvested (hectares), Yield (tonnes sugar/hectare), and Production (tonnes)

Area Harvested	23000	23311.05	23633.57	23821.78	23926.87	23961.84	23938.44	25180.77	26254.19	27179.34	27973.21
Yield	4.83	3.95	3.57	3.37	3.23	3.12	3.01	2.86	2.71	2.56	2.42
Production	111090.0	92120.4	84473.8	80339.7	77341.4	74658.9	72036.9	72127.3	71228.2	69710.4	67766.4

Trinidad & Tobago - Sugar Supply and Utilization (tonnes, raw value)

Production	111090.0	92120.4	84473.8	80339.7	77341.4	74658.9	72036.9	72127.3	71228.2	69710.4	67766.4
Net Exports	24354	45587.06	32596.42	25381.75	20438.54	16445.71	12882.99	-3907.03	-4323.93	-5632.38	-7566.31
Exports	90493	90191.29	80303.85	74561.59	70756.45	67949.77	65700.84	65784.21	64964.19	63579.90	61806.85
Imports	66139	44604.23	47707.43	49179.84	50317.91	51504.06	52817.85	69691.24	69288.12	69212.28	69373.16
Consumption	59549	64813.68	67402.45	69212.54	70594.80	71743.71	72766.73	73722.83	74644.33	75548.99	76446.39
Stock Change	27187.0	-18280.3	-15525.1	-14254.6	-13691.9	-13530.5	-13612.8	2311.5	907.8	-206.2	-1113.6

Trinidad & Tobago - Per Capita Sugar Consumption (kilograms)

Per Capita Consumption	45.77	48.34	49.82	50.70	51.26	51.64	51.93	52.16	52.36	52.55	52.73

CHAPTER 5

SUMMARY AND CONCLUSION

The Caribbean sugar industry is faced with the daunting task of preparing itself for survival after the preferential treatment it now enjoys from the EU begins to disappear at the start of the crop year 2007. Currently, trade is governed via a Sugar Protocol laid down in the Convention of Lomé, which has been an established instrument of commodity policy for close to 30 years. The basic rule is; the EU imports, at guaranteed prices, agreed quantities of sugar from ACP countries for an indefinite duration.

However, because of complaints from other WTO member states (such as Brazil and Thailand), that they don't have access to the EU market, the World Trade Organization (WTO) dispute resolution panel ruled that preferential treatment arrangement between some member states goes against its general principles. The GATT/WTO principle is non-discriminatory, while the EU's preferential accords are, by definition, discriminatory. There is provision in the WTO for developing countries to be treated differently from developed states in various regards. These include, the provision by developed countries trade preference in favor of developing states. In other words, developed states may discriminate against other developed countries in their trade policy, provided that it benefits developing countries. The main problem for an EU attempt to justify any of its preferential accords other than the standard Generalized System of Preference (GSP) in this way, is that they don't cover all developing countries (Stevens C., 2002). In this respect, therefore, the arrangements derived through Cotonou between the EU and ACP states, is thus anti-WTO.

The resolution of this problem between the EU and complainants to the WTO was resolved by the implementation of a waiver. Based on this waiver, ACP countries have until the

year 2006 to enjoy this preferential treatment, and in the meantime prepare themselves to trade in a liberalized world market environment. Based on this arrangement, after the waiver is exhausted ACP countries will be exposed to competitive forces such as lower prices, within the sugar market that they weren't previously or on a limited basis exposed to.

Because of these factors it is imperative that Caribbean territories being members of the ACP group improve in areas such as production, consumption of locally produced sugar, and other variables that lower production cost in order to improve trading competitiveness. An econometric analysis of these variables would provide players within the Caribbean sugar industry valuable information on the possible situation that the industry may face in the near future.

With this in mind the main objective of this study is to evaluate the impact that preferential treatment arrangement changes will have on Caribbean territories being a part of the ACP group of countries after 2006, by projecting variables such as production, consumption, stocks and trade. This was done by evaluating specific objectives such as: (i) review existing trade policies concerning Caribbean and world sugar trade, (ii) evaluate and adapt the World Sugar Simulation Model developed by Benirschka, M., Koo, W., and Lou J. of the North Dakota State University, for use in analyzing individual Caribbean territories, (iii) evaluate the effects of farm and trade policies on the Caribbean sugar economy by simulating estimates for production, consumption, stocks, and trade of sugar over a 10 years period econometrically, (iv) based on results from objective (i) and (iii), an evaluation of how Caribbean territories will fair under various price related simulated scenarios.

These objectives were achieved by evaluating sugar supply and demand and other exogenous variables econometrically using the Statistical Analysis Software (SAS) package.

Models were based on economic theory and adjustments were made to compensate for data problems and the correction of poorly performing estimated equations in the simulation.

Different countries sub-models included behavioral equations for area harvested, yield, production, domestic consumption, and stock changes. In these models sugar was assumed to be a homogenous commodity i.e., no distinction is made between raw and refined sugar, thus all quantities will be expressed in raw sugar equivalents. Supply and demand elasticities were computed for explanatory purposes in the evaluation of the impact of policy changes, as well as to make relative comparison across the regions among different variables. These elasticities represents the measure of responsiveness of the dependent variable whether in the demand or supply section to a 1% change in the independent (determinant) variable.

Scenarios relating to possible price movements was assumed and evaluated to theorize what impact policy changes will have on the variables within the models. These scenarios were made at: (1) at EU prices with the current policy in place. This is seen as the status quo situation and serves as a reference point for alternative options, (2) at current US prices (after the policy has expired it is considered that EU prices could fall to US producer prices), (3) at world prices, (this price is considered to be the lowest price or a worst case scenario), (4) prices 15% below the current EU prices, (this a price is arbitrarily chosen, and falls somewhere between EU and US producer prices).

5.1 Summary of Econometric Models Results and Elasticities

The supply and demand equations estimated by OLS were evaluated on the following criteria: (1) the sign and magnitudes of the coefficients, (2) the t-statistic to determine statistical significance of the coefficients, (3) the coefficient of multiple determination (R^2), to measure the degree of association between the observed and expected values of the dependent variable, (4)

the Godfrey LM statistic to test for higher-order autocorrelation in residuals, and (5) the Goldfeld-Quandt test for heteroskedasticity. The residuals of each equation were analyzed by visual inspection to examine how well the equation fits the data, whether the residuals have systematic patterns of behavior, and whether any exceptionally large residuals (outliners) exist.

Tables 4.1 through 4.6 shows that the results vary from one country to another. The hectares harvested equation includes, hectares harvested lagged one year, real world sugar price lagged one year, and government policy, as independent variables had acceptable statistical properties. However, expected signs weren't consistent across all territories. The results for yield were somewhat similar. The signs were all positive and significant with small coefficient for the lagged yield variable. This implies that current yield is somewhat dependent on last years yield. Increases in hectares harvested were found to have a negative impact on yield. The signs were as expected (negative) for all countries. However, the level of statistical significance varied across the region. This could be explained by such factors as limited capital and human resources in the short-run, and/or bringing marginal land into production. The price variable showed low levels of significance with varying signs across countries. It was decided that this variable would not be dropped since in cases where prices are completely eroded, farmers will choose not to harvest their crops. Also, the unexpected signs and/or t-ratios could be due to inconsistency data. The results indicate that producers planting decisions in response to economic incentives may follow a partial adjustment and that, consequently, it may take more than one year for full adjustment to occur.

On the demand side, Per Capita Sugar Consumption was used to reduce multicollinearity between population and personal income. The estimated coefficients had the expected sign for all coefficients, except for real domestic prices in some countries. The level of significance for each

coefficient varied across countries. For exports all estimated coefficients had the expected signs and in most cases were significant at the 5% level except for government policies. The R^2 was very high in all cases, thus the variation in exports was adequately explained by the independent variables. The results showed that yield and hectares harvested had a direct relationship with export. Thus, when production is high, export is significantly influenced, while surprisingly, government policies had a negative relationship this was expected to be positive. This could be explained since these countries export under a quota system thus this negatively impacts exports. Because of preferred prices in the EU, producers aren't pressured to maximize revenues and exports aren't optimized. For imports, variables included in this equation were exports, yield, hectares harvested and consumption. The coefficients on all variables had the expected signs and were statistically significant except for consumption, which at times had inconsistent signs and was insignificant in some cases. The R^2 ranged from a high of 0.79 to a low of 0.21 across the different countries, indicating the variation in import is better explained in some countries than others. Export has a direct relationship with import, so when exports are high, imports are high. Conversely, yield and hectares harvested had an inverse relationship with import. This is expected, since when local production is high imports tend to be low, as some percentage of local consumption is taken care of by local production. It was expected that consumption would have a direct relationship with imports. However, in the case of Barbados and Guyana, the data showed an inverse relationship. The variable ending stock was omitted from this equation because of data problems, low quantities of ending stock in all cases where data was available, and finally, insignificant values for the proxy stock change which was evaluated instead of ending stock. For the proxy stock change the coefficient estimates had the expected signs and were significant at the 5% level. The R^2 ranged from a high of 0.92 to a low of 0.52 for the

different countries across the region in this analysis. The variables yield, hectares harvested, and imports has a direct relationship with stock change, as expected, while exports and domestic consumption displayed the expected inverse relationship. Because of problems encountered with the data set, there isn't much confidence with the accuracy of these estimates and consequently the levels of accuracy and predictability.

For elasticities, because of the biological nature of sugarcane, hectares harvested and yields' response to price changes in the short-run tends to be inelastic, an examination of table 3.25 reveals that yields elasticity in response to changes in real sugar price ranges from 0.005 to 0.03 and 0.02 to 0.05 for hectares harvested response to lagged real prices (absolute values) for both variables. These results imply that the effects of lower prices in the EU sugar market on Caribbean sugar production will be small in the short run. This result of an inelastic response of sugar production to prices is supported by Koo and Taylor in their *"2002 Outlook of the US and World Sugar Market, 2001- 2011"* report.

5.2 Conclusion

The results for this study were obtained based on observations under the current policy and it predecessor (CSA) policy, with particularly high level of prices, which technically acts as a subsidy to ACP and by extension Caribbean sugar producers. Therefore, a drastic policy change as a move away from preferential prices would likely change the characteristics of Caribbean sugar production in the long-run, though the relative fixity of capital resources in sugar production would still cause a lagged response to economic incentives by sugar producers in the short-run. Also, if there is significant structural change in the market structure only countries that exhibits a comparative advantage over the other may remain in sugar production.

The scenario analysis showed that the probable effects of price changes would bring about varying responses from the regions' producers though minimal in the short-run. Under the current regime the regions' production would meander along as it is currently, however, under the new policy most countries tend to at least maintain their current production levels while others such as Jamaica and Guyana actual partially increases production. For Jamaica, the increase in hectares reaches its maximum in the tenth forecast year. This could be due to the country's economies been so dependent on this industry thus in order to maintain social stability, production is risen to maintain revenues. Countries such as Barbados and Trinidad & Tobago seem to suggest that they might move away from the production of sugar. This analysis reveals that there is some other factor other than prices that drives sugar production in this region.

Finally, it may be suggested that areas such as the production of value added commodities for the Caribbean sugar industry be evaluated since currently there is local demand for approximately 170,000 tonnes of refined sugar and the region only currently produces less than 50% of this amount. Other commodities such as ethanol production, electricity production through cogeneration, and other derivatives of cane sugar such invert sugar production that is considered to be a healthier form of sugar needs to be explored.

5.3 Limitations and Future Research

This research was plagued with data problems, thus the data used can at best be described as rough. Proxies had to be used in cases where the actual data inconsistent or nonexistent. Because of this problem, areas such as ending stocks analysis were limited, since the proxy "stock change" had to be used. It is my opinion that this data set and the econometric analysis was the most challenging aspect of this study.

Further studies may need to examine additional parameters in order to derive factors that determine responses in production in the Caribbean sugar market. A closer examination of the respective government activities regarding the industry other than trading arrangements may provide some valuable insights. These government activities could include duty concessions on capital resources and motor vehicles, soft government loans for various industry related activities, low cost on property lease, and guaranteed market for canes produced. These factors weren't considered in this study.

REFERENCES

ACP Sugar Group; *"ACP Sugar Trade"*. 2001, (http://www.acpsugar.org/protocols.htm).

ACP Sugar Group; *"Commonality of Interests"*. 2001, (http://www.acpsugar.org/protocols.htm).

ACP Sugar Group; *"Summary description of the EU Sugar Policy"*. 2001, (http://www.acpsugar.org/eusugardescription.htm).

ACP Sugar Group; *"The 1995 Review of the EU Sugar Policy"*. 2001, (http://www.acpsugar.org/eusugar1995review.htm).

Ahmed, Belal; " *The Impact of Globalization on the Caribbean Sugar and banana Industries"*. The Society for Caribbean Studies Annual Conference Papers, vol.2 2001 issn 1471-2024.

Allen, Tim; *"EU Trade with ACP Countries"*. Statistics in Focus, External Trade, Theme 6-3/2002, Eurostat, ISSN 1024-6878, European Communities, 2002.

Benirschka, Martin; Koo, Won W; Lou, Jianqiang; *"World Sugar Simulation Model: Description and Computer Program Documentation"*. Agricultural Economic Report No. 356, Department of Agricultural Economics, Agricultural Experiment Station, North Dakota State University, Fargo, ND 58105-5636, August 1996.

Government of Jamaica (GoJ); *"Green Paper on the Sugar Industry #_/03"*, Sugar Industry Authority of Jamaica , National Plan for the Sugar Industry, 2003.

Guyana Sugar Corporation Inc. (GuySuCo); *"Sugar Agreements"*. Ogle Estates, East Coast Demerara, Guyana, 2003. (http://www.GuySuCo.com).

Herrmann, Roland; Weiss, Dietmar; *"A Welfare Analysis of the EC-ACP Sugar Protocol"*. (African, Caribbean and Pacific Group of States), Journal of Development Studies, August1995, v31 n6 p918(24).

Hylton , Anthony (Honorable); *"Caribbean Single Market in a global Economy: Some Challenges for Law and Economics in the Millennium"*. Minister of State, Ministry of Foreign Affairs and Foreign Trade, Government of Jamaica, November 17, 1999.

Koo, Won W; Taylor, Richard D.; *"2002 Outlook of the US and World Sugar Markets, 2001-2011"*. Northern Plains Trade Research Center, Department of Agribusiness and Applied Economics Report No. 487, Agricultural Experiment Station, North Dakota State University, Fargo, ND 58105-5636, August 2002.

Koo, Won W; Taylor, Richard D.; *"2000 Outlook of the US and World Sugar Markets"*. Northern Plains Trade Research Center, Department of Agribusiness and Applied Economics Report No. 444, Agricultural Experiment Station, North Dakota State University, Fargo, ND 58105-5636, July 2000.

Lal Das, Bhagirath; *"An Introduction to The WTO Agreements"*. Trade and Development Issues of the World Trade Organization, Zeb Books Ltd, Third World Network, Printed by Jutaprint, 2 Solok Sungai Pinng 3 11600 Penang, Malaysia, 1998.

MacGregor, A. *" The Lome Convention and the ACP Sugar Exports: The Political Economy of Conflicting Policies"*. University of Woolongong, Economic Research Bulletin No. 8, Woolongong, Australia, 1978.

Stevens, Christopher; *" The WTO and its Implications for the Negotiations on Agriculture in an ACP-EU Trade Agreement: current status and prospects"*. Paper presented at CTA International Seminar 'Meeting the challenge of effective ACP participation in agricultural trade negotiation: the role of Information and Communication', Bedford Hotel, Brussels, 27-9, November 2002.

Skully, David W.; *"Economics of Tariff-Rate Quota Administration"*. Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1893, 1800 M Street, NW Washington, DC 20036-5831, April 2001.

Swerling, Boris C.; *"A Sugar Policy for the United States"*. The American Economic Review, Volume 42, Issue 3, 347-357, June 1952.

Tomek, William G.; Robinson, Kenneth L.; *"Agricultural Product Prices"*. 2nd Edition, Ithaca, N.Y., Cornell University Press, 1981.

Trade in Agriculture, "The EU and Trade in Agricultural Products". Trade, 2002, (http://europa.eu. int/comm./trade /goods/agri/index_en.htm.

Watanabe, Satoko; Stanton, B.F.; Willett, Lois S.; *" Potential Effect of Decoupling on the U.S. Rice Industry"*. Department of Agricultural Economics, Cornel University Agricultural Experiment Station, New York State College of Agriculture and Life Science, A Statutory College of the State Universities, Cornell University, Ithaca, New York 14853-7801, March 1990.

Wilkinson, Bert; *"Caribbean: Sugar Makers Scramble to Become Competitive"*, (http://athena.tbwt.com/content), The Black World Today, article 353,4/1/ 2002.

World Trade Organization; *"European Communities- The ACP-EC Partnership Agreement"*. Ministerial Conference, Fourth Session, Doha, WT/MIN (01)/15, November 2001.

APPENDIX

SEEMINGLY UNRELATED REGRESSION (SUR) EQUATION MODEL RESULTS

Table 4.31 Empirical Estimation Results for SUR Model

Jamaica

Demand

Per Capita Sugar Consumption

$cqpsu = 13.28708 + 0.625577cqpsu_{t-1} + 0.00139realdomp + 0.002912rpci$

(1.94) (5.09) (0.71) (0.87) t-values

n = 40, $R^2 = 0.47$ Adj. $R^2 = 0.43$

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -239017 + 47247.07y + 4.03887hh + 0.974978qm - 0.86491qx - 1.12794sc$

(-11.56) (20.45) (18.88) (17.36) (-21.70) (-12.46) t-values

n = 40, $R^2 = 0.93$ Adj. $R^2 = 0.92$

Sugar Exports

$qx = -153822 + 3.299856hh + 42915.25y - 60908.5g$

(-2.60) (5.18) (7.15) (-3.48) t-values

n = 40, $R^2 = 0.94$ Adj. $R^2 = 0.93$

Table 4.32 Empirical Estimation Results for SUR Model

Barbados

Demand

Per Capita Sugar Consumption

$cqpsu = 18.6423 + 0.1186cqpsu_{t-1} + 0.0694realdomp + 0.00000638rpci$

(1.51) (5.45) (0.51) (0.00) t-values

n = 40, $R^2 = 0.50$ Adj. $R^2 = 0.46$

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -74424.7 + 10606.46y + 4.535266hh + 1.118685qm - 0.62543qx - 0.72131sc$

(-6.68) (6.60) (7.19) (5.90) (-7.13) (-4.86) t-values

n = 40, $R^2 = 0.66$ Adj. $R^2 = 0.61$

Sugar Exports

$qx = -69976.7 + 3.75581hh + 17262.3y - 25373.7g$

(-5.49) (6.79) (12.26) (-5.31) t-values

n = 40, $R^2 = 0.97$ Adj. $R^2 = 0.96$

Table 4.33 Empirical Estimation Results for SUR Model

Belize

Demand

Per Capita Sugar Consumption

$cqpsu = 11.3253 + 0.697228cqpsu_{t-1} + 0.031539realdomp + 0.001935rpci$

(3.53) (8.86) (1.08) (1.59) t-values

n = 40, $R^2 = 0.81$ Adj. $R^2 = 0.79$

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -64763.3 + 11768.57y + 3.026882hh + 0.463195qm - 0.54744qx - 0.71252sc$

(-5.31) (5.53) (5.71) (1.27) (-6.02) (-2.20) t-values

n = 40, $R^2 = 0.47$ Adj. $R^2 = 0.39$

Sugar Exports

$qx = -96939.5 + 5.381943hh + 16947.14y - 10844.7g$

(-9.02) (16.98) (10.36) (-2.54) t-values

n = 40, $R^2 = 0.95$ Adj. $R^2 = 0.95$

Table 4.34 Empirical Estimation Results for SUR Model

Guyana

Demand

Per Capita Sugar Consumption

$cqpsu = 6.064166 + 0.71028cqpsu_{t-1} - 0.00057realdomp + 0.009755rpci$

(0.70) (6.10) (0.45) (1.23) t-values

n = 40, $R^2 = 0.54$ Adj. $R^2 = 0.50$

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -234864 + 37686.69y + 4.438688hh + 1.395507qm - 0.7726qx - 0.33817sc$

(-8.11) (9.18) (9.24) (5.47) (-8.86) (-1.17) t-values

n = 40, $R^2 = 0.74$ Adj. $R^2 = 0.70$

Sugar Exports

$qx = -185925 + 4.430405hh + 38898.34y - 5569.71g$

(-6.10) (12.08) (12.73) (-0.76) t-values

n = 40, $R^2 = 0.91$ Adj. $R^2 = 0.91$

Table 4.35 Empirical Estimation Results for SUR Model

St. Kitts-Nevis

Demand

Per Capita Sugar Consumption

$cqpsu = 69.0247 + 0.187354cqpsu_{t-1} - 0.18849realdomp + 3.309798rpci$

(5.03) (1.33) (1.31) (1.89) t-values

n = 40, $R^2 = 0.05$ Adj. $R^2 = -0.04$

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -19771.9 + 2724.095y + 4.583657hh + 0.891639qm - 0.63096qx - 0.63048sc$

(8.06) (8.30) (7.98) (5.52) (-8.27) (-6.96) t-values

n = 40, $R^2 = 0.67$ Adj. $R^2 = 0.62$

Sugar Exports

$qx = -28150.5 + 6.410016hh + 4029.029y - 246.994g$

(-12.00) (11.68) (18.98) (-0.45) t-values

n = 40, $R^2 = 0.94$ Adj. $R^2 = 0.93$

Table 4.36 Empirical Estimation Results for SUR Model

Trinidad & Tobago

Demand

Per Capita Sugar Consumption

$cqpsu = 25.1235 + 0.341948cqpsu_{t-1} + 0.003159realdomp + 0.001597rpci$

(4.59) (2.89) (0.45) (1.86) t-values

n = 40, $R^2 = 0.38$ Adj. $R^2 = 0.33$

Sugar Consumption:

sc = cqpsu * pop

Sugar Stock Change

$qs = -107685 + 21310.52y + 3.79768hh + 0.863933qm - 0.69408qx - 0.87484sc$

(-6.26) (10.93) (11.81) (10.04) (-10.42) (-4.32) t-values

n = 40, $R^2 = 0.82$ Adj. $R^2 = 0.79$

Sugar Exports

$qx = -21576.7 + 2.5485499hh + 18454.3y - 42838.5g$

(-0.67) (4.51) (5.55) (-3.84) t-values

n = 40, $R^2 = 0.87$ Adj. $R^2 = 0.86$

VITA

Delroy Anthony Armstrong a true son of the Jamaican soil was born in the parish of Manchester in the town of Mandeville in the tropical paradise called Jamaica. He completed his bachelor's degree at the Louisiana State University (LSU) in Agricultural Economics and Agribusiness Management with a minor in Business Administration in Fall 2000 where he graduated Summa Cum Laude.

Delroy worked in the Jamaica's sugar industry for few years where he gained valuable experience, training and a clear understanding how the Caribbean sugar industry works, and the significance of this industry to the region's economy.

He later completed his master's degree in agricultural economics at LSU where his thesis work evaluated the potential impact of preferential changes, in trading arrangements, with the European Union, on the Caribbean Sugar Industry.