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Mozambique and the Reform of the EU Sugar Regime

– A CGE Analysis of the Consequences for the Mozambican Economy

Abstract
The EU regulation concerning the sugar market will expire in July 2006. How the sugar regime will change is not yet decided and different options are being discussed. In the current situation some countries have preferential trade agreements with the EU, meaning that they are allowed to export a certain volume of sugar at the high EU price. A reform of the EU sugar regime could mean a substantial decrease in the price of sugar and thus an erosion of the preference these countries enjoy. One of these countries is Mozambique, where severe concerns about the reform of the EU sugar regime have arisen. There is a fear that a lower price in the EU would harm the sugar production and threat the country's economic development. By using a Computable General Equilibrium model this thesis analyzes how Mozambique will be affected by a reform of the sugar regime. Two scenarios are evaluated: free access to the EU sugar market with a sustained and with a lowered price. The simulations show that although the average export price of sugar varies from a fall of 8 percent to a rise of 153 percent, the effects on the Mozambican economy are very small.

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List of Abbreviations

ACP	African, Caribbean and Pacific
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE model	Computable General Equilibrium model
CMO	Common Market Organisation
EBA	Everything but Arms
EC	European Commission
EU	European Union
GAMS	General Algebraic Modeling System
GDP	Gross Domestic Product
LDC	Least Developed Country
LES	Linear Expenditure System
RoW	Rest of the world
SACU	Southern African Customs Union
SAM	Social Accounting Matrix
SLI	Swedish Institute for Food and Agricultural Economics (Livsmedelsekonomiska institutet)
WTO	World Trade Organization

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1 Introduction

Rich countries are often being criticized for having and building up high walls of protection and thereby excluding developing countries from their lucrative markets. They are also being criticized for dumping products in the markets that developing countries could access. These dumped exports drive down prices, outcompete local producers and make many developing countries unable to compete in sectors in which they have a comparative advantage. Several trade rounds have been designated to this problem but in spite of promises from the industrialized world of trade liberalization and market access, not much has been done. Trade liberalization is normally regarded as a precondition for economic growth in developing countries and it is generally considered that many of these countries have comparative advantages, especially in agriculture, which they cannot fully enjoy.

Agriculture is one of the major areas that could move developing countries out of poverty and the Doha trade round initiated in 2001 focuses on this sector (Petersson 2005). Agriculture has been emphasized in earlier WTO negotiations and although the market for agricultural products has become more liberalized, some products within the sector are still subject to high protection, especially in the EU and the US. This has put much pressure on further liberalization of the agricultural sector, and in particular bananas and sugar. The EU sugar regime, with its heavy tariffs and subsidies, has only changed marginally since its introduction in 1968 and major changes will be determined in the nearest future.

The reform of the EU sugar regime is currently a heavily debated topic. European sugar producers stand against sugar producing developing countries, as arguments for and against liberalizing the highly protected EU sugar market grow numerous. The potential winners of a reform are many. European consumers would benefit from lower prices and producers in developing countries would get greater access to the European market while probably enjoying a higher price in the world market. However, many developing countries have signed preferential trade agreements with the EU, which makes the effects of trade liberalization less obvious. Lower sugar prices in the EU, resulting from a liberalization of the sugar sector, lowers the value of the preferential market for those privileged developing countries.

One of the countries that enjoy preferential agreements with the EU is the sugar producing Mozambique. Mozambique is part of the trade agreement "Everything but Arms", meaning that it has the possibility to sell sugar to the EU at the high internal EU price. This opportunity has proven to be very valuable and a lower EU price would naturally erode this preference. As a consequence, Mozambique argues for retained protection of the European sugar market and much attention has been given to the preference erosion following a potential future reform.

The fear that the Mozambican economy will be severely affected by a lower price in the EU might be exaggerated. Still, there is widespread concern that this will be the case. One person expressing these concerns is Arnaldo Ribiero - director of the sugar industry's national institute in Mozambique and coordinator at the agricultural department. He says that "This reform will erode the market for Mozambique, which in turn will mean no investments in the sugar industry here" (Koblanck 2005). José Chilengue, executive director of the Mozambique Sugar Producers Association and representative of the Least Developed Countries, supports that view and says that "With these reforms, most of our dreams will collapse. The sugar industry is the largest employer in Mozambique and is a key element for economic development due to its power to reduce poverty. With the proposed sugar reform all this will be under serious threat. We will not survive with these changes" (Oxfam 2005). Although many similar statements can be read in newspapers and heard in speeches, it is not clear how Mozambique's economy will react to a change in the EU sugar regime. The size of the economic changes is unknown and the question whether Mozambique will turn out to be a winner or a loser from a reform still needs an answer.

1.1 *Purpose*

The purpose of this thesis is to analyze how the Mozambican economy is affected by a reform of the EU sugar regime.

1.2 *Method*

In order to fulfill the purpose, a method that is sophisticated enough to incorporate many different features of the Mozambican economy is needed. A general equilibrium analysis incorporating both direct and indirect effects of changes will therefore be conducted, showing the effect on a number of different variables, which a partial equilibrium analysis could not capture. Detailed results for Mozambique require a model capturing the most important features of the economy. Such a model tends to become large, in the sense of consisting of many equations, and numerical simulation is needed. A computable general equilibrium (CGE) model, solved in the computer modeling language called GAMS, will therefore be used. An alternative to the general equilibrium analysis would be to carry out a partial equilibrium analysis when analyzing the policy reform. However, such an analysis, which exclusively focuses on the sugar market, would exclude many of the potentially important effects on the economy.

Building a CGE model is a tedious task that requires the collection of large amounts of data as well as advanced computer-programming skills. To stay within the limits of this thesis and to focus on constructing simulations that fit its purpose, an existing CGE model of Mozambique will be used.

The model was constructed for the purpose of analyzing effects of the Doha trade round and should thus be built in a way which is suitable for analyzing the question raised in this thesis.

The effects on the Mozambican economy of a change in the EU sugar regime will be analyzed by defining two different scenarios and by studying the outcome of a number of simulations. The choice of scenarios is based on the current debate on the extent of the changes in the EU sugar regime. They have also been used in a previous study on the consequences for all developing countries as a group.[1]

1.3 *Delimitations*

This thesis focuses solely on a reform of the sugar sector and the effects on Mozambique. Effects of the change in the EU sugar regime on other countries and on sugar producers, consumers and other players within the EU will not be taken into consideration. A potential liberalization of other protected sugar markets, such as the US and Japan, has also been ignored. Further, the results and the analysis are limited by the structure and features of the pre-developed CGE model on Mozambique, which is calibrated with data from 2002-2003.

The economic consequences for Mozambique will be derived by changing the average export and import price of sugar. This means that only the first paragraph, which concerns the price change, in the EU reform proposal will be taken into consideration.[2] The effects on Mozambique will be analyzed by examining the following variables: Sugar exports and imports, output level of sugar, nominal and real GDP consisting of five components, nominal and real exchange rate, labor demand and factor prices in food production.

1.4 *Contribution*

Earlier studies have covered general consequences of the reform of the EU sugar regime, and the consequences of trade liberalization for Mozambique have been dealt with in several research papers. However, to the best of our knowledge, no other paper has combined these two in a way that this thesis does. The contribution of this thesis is thus the focus on the changes taking place in the sugar market and their quantitative impact on the Mozambican economy.

1.5 *Structure*

Chapter 2 gives an overview of the world sugar market. It also explains the EU sugar regime and presents the latest reform proposal. Chapter 3 gives a description of the Mozambican economy with emphasis put on the sugar industry. Chapter 4 describes previous research relevant for this thesis and

[1] This study is presented in Chapter 4.1.
[2] For the full reform proposal, see *Appendix A*.

chapter 5 explains the CGE model used for the analysis. The analyzed scenarios are outlined in chapter 6 and in chapter 7 the results and analysis of the simulations are reported. Chapter 8 discusses the validity of the model and chapter 9 summarizes, concludes and provides suggestions for future research.

2 The Sugar Market

The sugar production in the world is increasing steadily and 144 million tonnes were produced in 2004 (Lutherhjälpen 2005). The production is divided between sugar beets and sugar canes, where the former is produced in a temperate climate mainly in Europe, North America and China. Sugar canes, on the other hand, are primarily produced in tropical areas in the West Indies, Brazil and in parts of Africa and Asia (Axelsson Nycander and Jonasson 2005). The main difference between the two is that beets produce only white sugar whereas canes produce both white and raw sugar.[3] The main sugar producers in the world are Brazil and India followed by the EU-15, China and the US (European Commission[4] 2005b).

The sugar market is characterized by intensive trade. Around one third of total production is traded in the international market, which in comparison to other agricultural goods is a high figure. Brazil and the EU-15 are the largest sugar exporters followed by Thailand, Australia and Cuba. Exports from these countries amount to as much as 70 percent of total world exports (EC 2005b). Russia and Indonesia are the two largest importers in the world and the EU, with its sugar imports of two million tonnes per year, is in third place (EC 2004a). Only 40 percent (Mitchell 2004) of total trade is free and thus traded without preferential or any other kind of trade agreements (EC 2005b). In this paper, this residual part constitutes trade in the "residual market", often referred to as the world market. The remaining 60 percent is traded under special agreements, one of which is the EU sugar regime.

2.1 *The EU Sugar Regime*

The Common Market Organisation (CMO) in the EU sugar sector is known as the "sugar regime". It was introduced in 1968 and only minor changes have taken place since then (Axelsson Nycander and Jonasson 2005). The regime's main characteristics are constituted by support prices, production quotas, import protection and export subsidies. These were introduced to satisfy domestic demand

[3] In this thesis no difference is made between white and raw sugar and the term "sugar" is thus used for both kinds.
[4] Henceforth denoted EC.

with domestically produced sugar (Oxfam 2004b) and to protect the income and self-support of sugar producers[5] (EC 2005b).

2.1.1 Support Prices and Production Quotas

The European producers are guaranteed a high price for a limited volume of their production sold in the European market. These limits are called A and B quotas. A sugar, now amounting to about 14.3 million tonnes, was initially defined as the sugar consumption within the EU and B sugar, about 3.1 million tonnes, is a supplementary volume produced to be exported. The quotas were introduced in order to limit overall production, and thus keep the price high, and to allocate production between the member countries (EC 2005b).

The intervention price (minimum price) paid to sugar manufacturers within the EU is EUR 632 per ton for white sugar, which is equivalent to more than three times the residual market price, and EUR 520 per ton for raw sugar. Moreover, the market price within the EU tends to be even higher than the guaranteed minimum price due to import duties and restricted volumes (National Board of Trade 2004; EC 2004a).

2.1.2 Import Restriction and Export Subsidies

In order to uphold CMO and maintain a high internal price, the EU has an import restriction system in place. This system consists of a fixed tariff in combination with a flexible tariff that is raised as the price in the residual market falls. The protection system is equivalent to a tariff of around 324 percent (Oxfam 2004a).

The so-called B sugar is exported with the help of export subsidies that amount to the price differential between the EU and the residual market (National Board of Trade 2004; EC 2004a). The subsidy is around EUR 512 per ton and is applicable to a maximum of 1.27 million tonnes or EUR 499 million. In the current situation, the latter criterion is more restrictive (EC 2004a).

2.1.3 Non-Quota Sugar/C Sugar

The non-quota sugar, called C sugar, and the trade preferential system are two additional features of the EU sugar regime. The European sugar producers are allowed to produce an unlimited volume of non-quota sugar. However, this volume must be stored or sold internationally outside the EU without any export subsidies. To do so is still attractive for the EU's high cost producers since the guaranteed minimum price for quota sugar is high enough to cover fixed costs. Although the residual market price is low, it still covers the producers' marginal costs (Axelsson Nycander and Jonasson

[5] In this thesis the word "sugar producer" denotes the group consisting of beet/cane growers and sugar manufacturers.

2005). The WTO has concluded that this is a case of cross-subsidization, i.e. a hidden subsidy on non-quota sugar (EC 2005b).

2.1.4 The Preferential Trade System

A number of countries are part of the EU's preferential trade system, which consists of two main components. The first one is the Sugar Protocol, which is an agreement with 20 African, Caribbean and Pacific (ACP) countries. The Sugar Protocol allows the ACP countries to export 1.3 million tonnes of sugar per year to the EU at the high internal price without paying any duties (EC 2005b).

The second component is the Everything but Arms (EBA) initiative, which is applied to the world's 46 least-developed countries (LDCs) (EC 2004a). The underlying idea of EBA is a non-limited duty free access to the European market, including all goods except arms, for these developing countries (EC 2005b). However, some goods are still subject to exceptions and the fulfillment of EBA will therefore be delayed. Sugar is one such exception and free access to the European market is limited to a quota of about 150,000 tonnes. This quota will increase by 15 percent per year and in 2009 all access restrictions will be abolished (EC 2004a). This means that the LDCs will be allowed to export their total production of about 3.5 million tonnes to the EU whereas the ACP countries will have to decrease their exports by the same amount. Mozambique is one of the countries included in the EBA agreement (EC 2005b).

2.1.5 Future Development of the Sugar Regime

Sugar is one of the sectors in the EU next in line to be reformed. The prevailing sugar regime has been widely criticized for hampering competition, distorting markets and through high prices passing on the cost of the regime to the consumers. Furthermore, some developing countries suffer large losses due to exclusion from the EU market (EC 2004b).

Since the EU regulation concerning sugar will expire on July 1, 2006 (EC 2004b), a substantial reform is currently being negotiated. A conflict with Brazil and other countries outside the EU has arisen concerning the interpretation of the export subsidies allowed within the WTO (Axelsson Nycander and Jonasson). The EU lost this conflict and will therefore have to decrease its exports from today's good 5 million tonnes per year to a maximum of 1.3 million tonnes (Jansson 2005). Almost all countries affected by the EU sugar regime agree that substantial change is needed. However, the views on how and how fast the regime should change are still a matter of discussion.

2.1.6 The EU Sugar Reform Proposal

A proposal of a reform of the EU sugar regime was presented by the European Commission in November 2005. The most significant change is a cut in the price by 36 percent over four years beginning in 2006/07.[6]

Reactions to the European Commission proposal have come from both ACP countries and LDCs. The trade preferences given to the ACP countries through the Sugar Protocol have over the years gained much importance. Many of the countries depend heavily on the possibility to export to the EU and there is concern that the complete EBA in combination with the proposed price cut will jeopardize their future income from exports.

The LDCs express similar reactions as the ACP countries. According to the EBA agreement, these countries have been promised free exports to the EU by 2009. In an attempt to keep the EU sugar prices high, they offer to give up the right to free exports in exchange for gradually increasing import quotas and an unchanged price until 2016 (Axelsson Nycander and Jonasson 2005).

3 The Mozambican Economy

Mozambique, with its 19 million inhabitants, is located along the South Eastern coast of Africa and borders to Tanzania, Malawi, Zambia, Zimbabwe, Swaziland and South Africa. After almost five centuries as a Portuguese colony, Mozambique gained its independence in 1975. The country was then one of the world's poorest countries, a situation that worsened due to political mismanagement and a brutal civil war lasting from 1977 to 1992. To stabilize the economy the Mozambican government introduced a macroeconomic reform program in 1987, which has resulted in significant improvements in the country's economic situation (World Fact Book 2005).

An annual GDP growth of close to 7 percent between 1987 and 1995 increased to 10 percent during the years 1996 to 1999. In 2000, GDP growth decreased to 1.5 percent due to severe floods in Mozambique and instability in Zimbabwe. The situation improved gradually and in 2004 annual GDP growth reached 7.8 percent (World Bank Group 2005a) with a GDP per capita of USD 233 in 2003 (FAO/WFP 2005). According to Arndt (2005a), international trade will likely play a crucial role if this growth rate is to persist.

[6] The complete proposal is presented in *Appendix A*.

Table 1. Key Economic Indicators for Mozambique 2000-2003

	2000	2001	2002	2003
GDP per capita in USD	207	187	195	233
Real GDP growth (%)	1.5	13.0	7.7	7.8
Agricultural GDP growth rate (%)	-6.7	13.0	8.0	7.0
Consumer price inflation (%)	11.4	21.9	9.1	13.8
Trade Deficit in million USD	682	271	536	348

Source: FAO/WFP (2005)

Nonetheless, Mozambique still remains dependent upon foreign assistance and 70 percent of the population lives below the poverty line. This makes Mozambique the world's sixth poorest country (Koblanck 2005). Half the population is undernourished (Lutherhjälpen 2005), which, in combination with a rapidly growing population, makes heavy demands on high and sustainable growth. The fulfillment of these demands is counteracted by the HIV/AIDS epidemic that results in significant demographical changes. Life expectancy (today 41 years) (World Bank Group 2005b) as well as population growth is expected to decrease and, according to the Government Offices of Sweden (2001), HIV/AIDS might become the most severe hindrance to Mozambique's development in the long run.

Another important impediment to development is the generally low level of education. 60 percent of the population is illiterate and the gulfs between men and women and between the countryside and the capital Maputo are large. Around 85 percent of the poor live in the rural areas, where 85 percent of all women are illiterate (Government Offices of Sweden 2001). These areas are also characterized by their limited integration with the rest of the economy, which results in a high level of home consumption of agricultural production. Large distances and poor transport infrastructure mean high trade and transport margins that sometimes amount to 50 percent of the marketed price. This increases the propensity to consume at home (Tarp Jensen 2004). Home consumption is more common in rural areas (36 vs. 8 percent of total consumer spending) (Arndt 2005a) and accounts for 65 percent of total agricultural production and for about 23 percent of total household consumption of commodities (Tarp Jensen 2004).

80 percent of the Mozambican population lives out of agriculture but in spite of this heavy dependence on agriculture for employment and support, agricultural GDP amounts to only 28 percent of total GDP. Services amount to 27 percent, industry to 25 percent and commerce amounts to 20 percent of GDP (Tarp Jensen 2004). Nonetheless, exploitation of natural resources constitutes a considerable share of economic activity in Mozambique. Fisheries, cotton, tobacco, forestry and mineral resources are some of the most important areas. Foreign-owned aluminum smelting accounted for close to half of total export revenues in 2001 and another 10 percent stemmed from electricity. The revenues from these exports are mainly used for importing intermediates, paying

salaries for expatriate personnel and for repatriation of profits, meaning that not much can be enjoyed by the Mozambican economy. Fishery is another important export sector. Imported products are mainly processed food, fuel and manufactures (Arndt 2005a).

3.1 *The Sugar Industry*

During the last years much attention has been given to the Mozambican sugar industry although the opinions about its economic importance differ. Locke (2003, p. 51) states that "Despite the sugar industry being relatively small by international standards, in the context of Mozambique's limited economy and such concentration of economic activity, sugar has provided a significant contribution to agricultural and agro-industrial production, and the generation of revenue, foreign exchange and employment." Mozambique has grown sugar canes for a long time and, according to Axelsson Nycander and Jonasson (2005), expertise within the field has been built up throughout the years. However, only 0.1 percent of total value added in Mozambique can be attributed to sugar. Its share of total exports is 0.5 percent and its share of imports 0.6 percent (Arndt 2005a).

Before Mozambique's independence in 1975, 325,000 tonnes of sugar were produced but during the civil war almost all sugar plantations were shut down and production amounted to no more than 13,000 tonnes in 1992 (Koblanck 2005). The rehabilitation of the sugar industry started in 1998 (Lutherhjälpen 2005), partly as a consequence of an offer to freely export to the EU's internal market (Koblanck 2005) but also as a result of the inflow of new capital and specialized management due to the initiated privatization of the industry (Locke 2003). Since 1998, much effort and resources have been devoted to strengthen the sugar industry and today's production of 250,000 tonnes is expected to increase to 360,000 tonnes in 2012 (Koblanck 2005).

The role of the government in Mozambique's sugar industry has diminished. The government is still a shareholder in some of the sugar companies but South Africa has majority ownership and is thereby a more important player. A precondition for the success of the privatization of the industry is the 7.5 percent import tariff in combination with the introduction of a flexible levy on the price of imports when the price falls below an established historical world price (Locke 2003).

The government views sugar as an important export product and believes that favorable export conditions would create thousands of new jobs in the sugar industry (Lutherhjälpen 2005). Today, 25,000 Mozambicans are employed in the four producing sugar mills (Koblanck 2005). According to Axelsson Nycander and Jonasson (2005), favorable export conditions could result in 20,000 new jobs within the sugar industry and an additional 10,000 jobs thanks to increasing economic activity connected to the factories.

Mozambique currently has access to three lucrative sugar markets through preferential export agreements with the US, the EU (through EBA) and the Southern African Customs Union (SACU).[7] This means that a limited amount of sugar is exported at prices significantly higher than prices in the residual market with the EU offering the highest price. These beneficial prices are necessary for the survival of the Mozambican sugar industry since the price in the residual market is too low to cover production costs (Axelsson Nycander and Jonasson 2005).

Table 2. Mozambique's Export Markets

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	10 580	528	5 588 356
SACU	15 520	314	4 865 520
Residual Market	90 000	126	11 371 500
Total Exports	129 350	209	26 986 251

Source: INA (Instituto Nacional do Acúcar) (Axelsson Nycander and Jonasson 2005)

4 Previous Research

To the best of our knowledge, no quantitative study has been carried out on the economic effects for Mozambique of the proposed changes in the EU sugar regime. However, previous research provides useful insight to the problem at hand. First of all, the CGE model developed by Channing Arndt[8] has been used for a similar type of analysis. Secondly, the reform of the EU sugar regime and its influence on developing countries as a group are analyzed in a quantitative report by Torbjörn Jansson and SLI.[9] Thirdly, the reform of the EU sugar regime and its consequences for Mozambique are presented in a qualitative study by Gunnel Axelsson Nycander and Anna Jonasson.[10] This chapter summarizes the two latter studies and the next chapter describes the Mozambican model developed by Arndt.

4.1 *Jansson*

Jansson has carried out a study on how developing countries are affected by a change in the EU sugar regime. The results, which are valid in the long term, are derived from a numerical simulation

[7] SACU comprises South Africa, Swaziland, Botswana, Namibia and Lesotho.
[8] Associate Professor at Purdue University, USA, and active at the Ministry of Planning and Development in Mozambique.
[9] The report is a forthcoming Doctoral Dissertation and was presented by Jansson at a seminar held by the Swedish National Board of Trade in September 2005 (Jansson 2005).
[10] Axelsson Nycander and Jonasson are active at Lutherhjälpen.

model called CAPRI.[11] By using CAPRI, Jansson quantitatively analyzes how developing countries as a group are affected by the implementation of EBA and the EU sugar reform proposal. Jansson does not study any countries in isolation and emphasizes that although developing countries as a group might gain or lose from a particular change, individual countries might face the opposite outcome. Since several of the parameters in the model are uncertain, no exact results can be presented. However, by varying the parameters within reasonable intervals, approximate numbers can be given and a loss or gain is possible to predict.

In the case of EBA, Jansson predicts an average sugar price increase for LDCs of 36 percent compared to today. This results in higher export volumes from the LDCs to the EU. The reform scenario, on the other hand, implies a decrease in the price of sugar in the EU, which results in a significantly smaller increase in the export volume from LDCs to the EU. In both scenarios, the price of sugar in the residual market will increase slightly as a consequence of a lowered export volume from the EU. Jansson concludes that the LDCs will gain more from EBA than from the reform. He also finds that LDCs are better off at present than in the case of a reform due to the fact the LDCs are net importers of sugar. The higher price of sugar in the residual market is not compensated for by the unlimited, free access to the EU market when the EU price has been lowered.

4.2 *Axelsson Nycander and Jonasson*

A qualitative study that focuses on the effects on Mozambique of a change in the EU sugar regime was conducted by Axelsson Nycander and Jonasson in 2005. Their report is based on interviews from a field study of Mozambique and on previous research, often with a focus on information from the poverty-fighting international confederation Oxfam.

Axelsson Nycander and Jonasson state that EBA has stimulated investments in the sugar industry in Mozambique but that a lower export price of sugar due to the EU reform proposal is a threat to the industry. Mozambique would probably manage to increase its exports in spite of a lower price but to make necessary investments would be difficult. Furthermore, social and environmental aspects would likely be ignored. Beneficial export conditions like EBA could, on the other hand, lead to the creation of 30,000 new jobs connected to the sugar industry. This is due to the fact that Mozambique has an export capacity much larger than what is exported to the EU today. Also, all four factories have the potential to increase their production substantially.

In their field study, the authors also find that increased sugar production is likely to reduce poverty and contribute to sustainable development. However, the links are not clear since most

[11] CAPRI stands for Common Agricultural Policy Regionalized Impact analysis and is a quantitative partial equilibrium model developed for the agricultural sector.

positions within the sugar production are subject to a low wage. Moreover, the larger parts of the profits fall into the hands of the owners, which often are foreigners. To benefit the people, the authors suggest increased taxes paid by the sugar companies and improved working conditions on the plantations and in the factories. The authors also mention that increased production of one agricultural good could mean that other food production is out-competed. In the case of sugar, however, this risk seems to be negligible. As a conclusion, the authors suggest that the high price level in the EU should be kept for a period long enough to let the LDCs create competitive sugar industries.

5 The CGE Model

5.1 *Introduction to CGE Modeling*[12]

Computable General Equilibrium models (CGE models) have been developed in order to analyze complex economic problems. The theoretical basis of this type of models is the concept of general equilibrium in the economy. A model economy is constructed by defining a large number of simultaneous equations representing various features of the economy and equilibrium conditions. The system of equations is calibrated against real world data and with the help of a computer program the model can be solved. Quantities and relative prices are endogenously determined within the model. Changes in exogenous conditions are inserted into the model with the help of a simulation file and the effects on the economy are then computed.

The major strength of the CGE model approach is that it makes it possible to study large and complex economic issues for which analytical solutions are difficult to obtain and for which there is no empirical evidence to draw on. It is often used for assessing the effects of policy changes, but can naturally be used for a wide variety of other purposes. Whereas standard analytical models only yield qualitative results, a CGE model makes it possible to obtain quantitative information. This is particularly useful when it is of importance to know exactly how large the economic effect of a certain change will be.

CGE modeling has become particularly popular within the field of development economics. Considering the wide range of views on suitable development strategies for a country, a CGE model provides a helpful opportunity to analyze such propositions and evaluate policy proposals. CGE modeling has thus become an established methodological approach in development economics as well as in other fields.

[12] This section is based on information from Bergman (1990).

5.2 *Description of the Mozambique Model*

For the purpose of this thesis a CGE model will be used, constructed for Mozambique by Channing Arndt. The model was developed for the purpose of analyzing potential implications for Mozambique of the Doha Development Agenda and other trade liberalization scenarios. It has been calibrated against data for Mozambique and gives an elaborate picture of the country's economy (Arndt 2005a). A high-level modeling system called GAMS, General Algebraic Modeling System, is used in order to implement the CGE model.

5.2.1 The Structure of the Model

The Mozambique model builds on a standard CGE model developed by Löfgren, Harris and Robinson.[13] The characteristics of the model can be divided into four main building blocks: (a) activities, production and factor markets; (b) institutions; (c) commodity markets; and (d) macro closures. This part of the model is static and the dynamic feature of the model is then obtained by constructing simulation files, which are used for modeling changes in the economy. In this thesis, one simulation file is constructed where the scenarios are included. The simulation file is run against the main file, computing a new general equilibrium.

(a) Activities, Production and Factor Markets

This section presents a rough picture of the activities carried out in the economy and describes how production and factor markets function. Due to the complexity of CGE modeling, the number of equations representing these characteristics is vast. In this section, the main features are discussed, in particular those which make the Mozambique model unique.

Producers are assumed to choose a certain production technology, which they are subject to when maximizing profits. In production they make use of intermediate inputs and add value to the product before selling it. They are assumed to follow a sectoral constant elasticity of substitution (CES) when deciding the mix of intermediate inputs and value added. By using CES, the model is allowing for the aggregate mix of intermediate inputs and value added to vary when the relative prices change. Producers take all prices as given, implying that they operate in a perfectly competitive setting.

$$QA_a = \alpha_a^a \cdot \left(\delta_a^a \cdot QVA_a^{-\rho_a^a} + \left(1-\delta_a^a\right) \cdot QINTA_a^{-\rho_a^a}\right)^{-\frac{1}{\rho_a^a}} \qquad a \in ACES$$

[13] A more detailed description of this model is to be found in Löfgren, H., Lee Harris R., and Robinson, S. (2002). *A Standard Computable Equilibrium (CGE) Model in GAMS*. IFPRI.

$$\begin{bmatrix} activity \\ level \end{bmatrix} = CES \begin{bmatrix} quantity\ of\ \ aggregate\ value\ added, \\ quantity\ of\ \ aggregate\ intermediate\ input \end{bmatrix}$$

where

QA_a = quantity (level) of activity

α_a^a = efficiency parameter in the CES activity function

δ_a^a = CES activity function share parameter

QVA_a = quantity of (aggregate) value-added

ρ_a^a = CES production function exponent

$QINTA_a$ = quantity of aggregate intermediate input

$a \in ACES$ = a set of activities with a CES function at the top of the technology nest

One activity can produce one or any number of commodities. Also, each commodity can be produced by more than one activity. For example, in the Mozambique model the activity "food production" produces the commodity "sugar". In addition, "food production" produces a number of other commodities. Each activity makes use of factors at the rate which equates marginal product of a factor with the price of that factor.

The model uses closures to determine how the factor market functions. It is possible to choose from three different factor market closures. For the purpose of the simulations at hand, labor is assumed to be fully employed and mobile between sectors. This is a reasonable assumption since a large part of the labor in Mozambique is low skilled and thus movable in the medium or long run. Even though unemployment is high in Mozambique (21 percent) (World Fact Book 2005), the model assumes full employment of labor. This assumption allows the wage to stay flexible and clear the market.

The labor market is disaggregated into several different categories based on area (rural/urban), gender and skill level (unskilled/skilled/highly skilled). It is possible to detect changes in each of the categories for each activity.

Capital is assumed to be fully employed and activity-specific, since it is often difficult to transform capital used in one activity to another activity. Quantities of activity-specific capital demand are fixed and the activity-specific rent is flexible in order for supply to match demand.

(b) Institutions

The actors in the CGE model are divided into four institutions: households, enterprises, the government and the rest of the world (RoW). Interaction between the different institutions provides

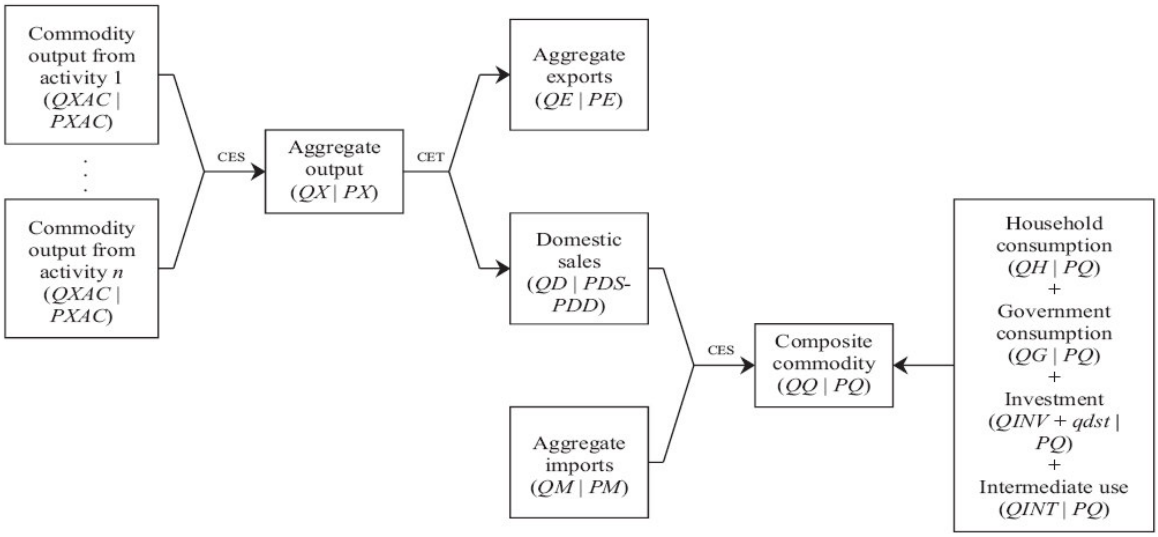
a description of how the economy is assumed to function, how economic decisions are made and what flows of money and commodities that exist.

Households receive income from factors of production, mainly from wage earnings. The obtained income is spent on taxes, savings, transfers to other institutions and on consumption. Households consume a range of different commodities, which they are assumed to demand according to a linear expenditure system (LES) utility function. This means that what households spend on a single commodity is a linear function of total consumption spending. It is worth noting that the model incorporates two different types of commodities: marketed commodities and home commodities. Marketed commodities are purchased at market prices whereas home commodities never enter the market and thus lack a market price.

Enterprises receive income in the form of factor incomes and transfers from the government and the RoW. Their income is spent on taxes, savings and transfers to the RoW. However, nothing is spent on consumption. The role of the government is to receive taxes, which they spend on transfers to the other institutions, savings and consumption. The RoW gives and receives transfers from the other three institutions. The second major role of the RoW is to import and export.

(c) Commodity Markets

The structure of the commodity market is presented in the figure below. Aggregate output is the sum of the output of all activities producing commodities. Home-consumed output is excluded from the figure since these commodities do not enter the market. The different commodities are imperfect substitutes, due to quality differences and distance between locations of activities, and follow a CES function when aggregated.



Source: Löfgren et al. (2002)

The aggregate output is in turn divided between exports and domestic sales, following a constant elasticity of transformation (CET) function. This function deals with the fact that domestically produced output can not be perfectly transformed into exportable output. In other words, exports differ from domestically sold output and the two are thus treated as separate commodities. With the CET function, the model is able to handle these differences and it allows the prices for the two to differ. The elasticity can be increased or decreased and consequently make exports and domestically sold output more or less similar.

$$QX_c = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + \left(1-\delta_c^t\right) \cdot QD_c^{\rho_c^t}\right)^{\frac{1}{\rho_c^t}} \qquad c \in (CE \cap CD)$$

$$\begin{bmatrix} aggregate\,marketed \\ domestic\,output \end{bmatrix} = CET \begin{bmatrix} export\,quantity, domestic \\ sales\,of\ \ domestic\,output \end{bmatrix}$$

where

QX_c = aggregate marketed quantity of domestic output of commodity
α_c^t = a CET function shift parameter
δ_c^t = a CET function share parameter
ρ_c^t = a CET function exponent
QE_c = quantity of exports
QD_c = quantity sold domestically of domestic output

In the next step, aggregate demand is defined as the sum of demand for household and government consumption and demand for investment, intermediate inputs and transactions inputs. Domestic demand is met by domestic output and imports, which are assumed to be imperfectly substitutable. Aggregation is again handled by a CES function, in this case often called an Armington function. The CES parameters are chosen in order to determine the degree of substitutability between domestic output and imports.

$$QQ_c = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_c^{-\rho_c^q} + \left(1-\delta_c^q\right) \cdot QD_c^{-\rho_c^q}\right)^{-\frac{1}{\rho_c^q}} \qquad c = (CM \cap CD)$$

$$\begin{bmatrix} composite \\ supply \end{bmatrix} = f\begin{bmatrix} import\ quantity, domestic \\ use\ of\ domestic\ output \end{bmatrix}$$

where

QQ_c = quantity of goods supplied to domestic market (composite supply)
α_c^q = Armington function shift parameter
δ_c^q = Armington function share parameter
QM_c = quantity of imports of commodity
ρ_c^q = Armington function exponent

Using CES and CET functions instead of perfect substitutability and transformability makes the model more in line with reality in the sense that it corresponds better to empirical observations of the Mozambican economy. Constructed in this way, the model gives a more realistic response to changes in export and import prices. However, the suitable degree of substitutability can be discussed.

Commodity prices include so-called marketing margins, which reflect costs of storage and transportation, but also the risk involved in trading. Each commodity in the model requires a fixed amount of marketing services, especially high for agricultural products, in order to reach the market.

(d) Macro Closures

All CGE models include macroeconomic balances, which have to be closed in order to obtain general equilibrium. The Mozambique model includes three macro closures: the government balance, the external balance and the savings-investment balance. The choice of macro closure can have a large impact on the characteristics of the model and the results which it yields. It is therefore important to consider how a change in the choice of macro closures would affect the results from

the model. In this section the different macro closures are explained and the alternatives most appropriate for the simulations in this thesis are chosen. Other alternatives are tested in the sensitivity analysis.

The government balance can be defined as in the equation below, where government revenue equals the sum of government expenditures and government savings. Government savings are often negative, then better defined as the government deficit. In the simulations in this thesis, the direct tax rate is fixed whereas government savings are flexible and clear the government balance. With this government closure it is possible to analyze how the imposed changes affect the government deficit.

$$YG = EG + GSAV$$

$$\begin{bmatrix} government \\ revenue \end{bmatrix} = \begin{bmatrix} government \\ expenditures \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix}$$

where

YG = government revenue
EG = government expenditures
$GSAV$ = government savings

The external balance is the current account of the balance of payments, including the trade balance.

$$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\ f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\ row} + \overline{FSAV}$$

$$\begin{bmatrix} import \\ spending \end{bmatrix} + \begin{bmatrix} factor \\ transfers \\ to\ RoW \end{bmatrix} = \begin{bmatrix} export \\ revenue \end{bmatrix} + \begin{bmatrix} institutional \\ transfers \\ from\ RoW \end{bmatrix} + \begin{bmatrix} foreign \\ saving \end{bmatrix}$$

where

pwm_c = import price (foreign currency)
QM_c = quantity of imports of commodity
$trnsfr_{row\ f}$ = transfer from factor *f* to the RoW
pwe_c = export price (foreign currency)

$trnsfr_{i\,row}$ = transfer from the RoW to institution *i*

$\overline{FSAV}$ = foreign savings (foreign currency)

The external balance is expressed in foreign currency. Foreign savings and transfers from the RoW are fixed exogenously. The real exchange rate is a flexible variable, which adjusts through changes in aggregate exports and imports in order to equilibrate the external balance equation. The advantage of this choice of closure is that by holding foreign savings constant, misleading welfare effects are avoided. An increase in foreign savings would for example increase current welfare since it would enable a higher level of consumption. However, in the future the country would suffer from a higher foreign debt (Löfgren et al. 2002).

The last of the macro closures is the savings-investment balance. This balance can either be investment-driven or savings-driven.

$$\sum_{i \in INSDNG} MPS_i \cdot (1 - TINS_i) \cdot YI_i + GSAV + EXR \cdot \overline{FSAV} = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$$

$$\begin{bmatrix} non\text{-}government \\ savings \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix} + \begin{bmatrix} foreign \\ savings \end{bmatrix} = \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$$

where

MPS_i = marginal propensity to save for domestic non-government institution (exogenous variable)

$TINS_i$ = direct tax rate for institution *i*

YI_i = income of domestic non-government institution

$GSAV$ = government savings

EXR = exchange rate (local currency units per unit of foreign currency)

PQ_c = composite commodity price

$QINV_c$ = quantity of investment demand for commodity

$qdst_c$ = quantity of stock change

In the simulation, a balanced savings-investment closure is chosen. The closure is investment-driven in the sense that the investment is fixed. However, investment is only fixed as a share of absorption[14], meaning that the quantity of investment can vary. Savings rates for the three institutions adjust by an equal number of percentage points in order to clear the closure. Changes in

[14] Absorption = Consumption + Investment + Government purchases

absorption are thus spread across all three components: household consumption, government consumption and investment. A balanced closure is generally seen as a more realistic way of depicting the real world than a strictly savings-driven or investment-driven closure. The two latter closures assume fixed savings rates and a fixed investment quantity respectively.

5.2.2 Data

The data for the Mozambique model is structured in a social accounting matrix (SAM). A SAM is a representation of the economy in the form of a matrix with accounts designated to activities and commodities. Institutions are also assigned individual accounts. Each account is represented by a row and a column, with the row showing the incomes to that account and the column showing the expenditures. Thus, each cell in the matrix shows the flow from one account to the other. By definition, the total of each row must equal the corresponding total in the column of the same account.

The Mozambique model is highly elaborate in its collection of data and incorporates detailed information about the economy of the country. It includes a SAM, compiled of data from the 2002-2003 Mozambican Household survey. The survey was conducted for 8,700 households and can be considered representative for the country. It shows consumption patterns and education level for household members as well as in which sector of economic activity household members are engaged (Arndt 2005a).

From these input data, values of the different parameters included in the model are calculated, such as the CET parameters and Armington elasticities for the different commodities. These parameter values can thus be assumed to be in line with reality, although it is important to keep in mind that changing parameters will affect the results. A critical evaluation of the relevant parameter values is conducted in the sensitivity analysis.

6 Simulation of Scenarios

In order to analyze the economic consequences for Mozambique of a change in the EU sugar regime, two different policy changes will be analyzed in two different rounds of simulations. On the one hand there is the scenario advocated by the LDCs, i.e. free access to the EU market at maintained prices. On the other hand there is the proposal of a reform of the EU sugar regime, which many LDCs have argued against. Previous research has covered the impact of these two scenarios on LDCs as a group but not on a single country such as Mozambique, which makes it interesting to analyze this case. Further, these two scenarios can be considered most likely to be implemented, although, at this point in time, it seems as if the latter proposal will win the battle (Johansson 2005). This chapter describes the two scenarios and how the Mozambique model is used

to simulate them. At the end of the thesis a sensitivity analysis is carried out in order to analyze the robustness of the results. The scenarios are defined as follows:

1. Everything but Arms ("EBA")
2. EBA in combination with the EU Reform proposal ("Reform")

Valid for both scenarios is that LDCs are allowed to freely export an unlimited volume of sugar to the EU from 2009. Further, the WTO decision stating that the EU will have to decrease its yearly exports of sugar from 5 million tonnes to 1.3 million tonnes is implemented in both scenarios.

The scenarios are implemented in the model through changes in the exogenous world export price[15] (*pwe*) (first round of simulations) and in the world export *and* import price (*pwm*) (second round of simulations). Changing the average export and import price is a realistic representation of the scenarios since the export price is an average of different prices in different markets. By gaining free access to the EU market, Mozambique has the possibility to redirect exports from another export market to the EU and thus increase its average world export price. The size of the EU market is assumed to stay constant since increased exports from LDCs will be compensated for by decreased imports from ACP countries. Increased imports from LDCs are thus assumed not to have an effect on the price in the EU market.

The chosen simulation approach portrays the incentive effect of the new opportunity to export more to the EU. The model will handle the changes in production and trade patterns which come about when the world export price of sugar increases. The first and the second scenario are similar in the sense that Mozambique has unlimited access to the EU. However, the second scenario offers unlimited access at a lower price than the first scenario. Most of the concerns about the economic effects on Mozambique of a change in the EU sugar regime stem from a change in the future price level of sugar. By lowering the price in the second scenario the difference between the two options for the Mozambican economy can be discerned.

When calculating the possible price changes, the total export volume is held constant and a new average export price is reached by moving export volumes between the various markets with different prices. These assumed changes in the direction of exports and the consequent changes in the average export price are presented in *Appendix B*. The changes in the average export price are then inserted into the model, a new equilibrium is reached and effects on the export volume are

[15] The world export price is the average of the export prices prevailing in the different markets to which Mozambique exports. The world export price should thus not be confused with the residual market price, which refers only to the price prevailing in the so-called residual market.

found. This approach assumes that when the export volume increases it does so with maintained shares in the various export markets.

Within each scenario, a number of simulations will be presented where Mozambique's average export and import price of sugar will be altered by different percentage shares. The results of the price changes will be compared to the current situation called *Status quo*. *Status quo* stands for an unchanged sugar regime and for the EU ignoring the EBA and the outcome of the WTO dispute. This is not a realistic option for the future and is only used for comparison (Jansson 2005; Johansson 2005). The year for comparison of the scenarios is 2012, at which time the changes can be assumed to have had an effect. The model is otherwise unchanged, meaning that the characteristics of the Mozambican economy are assumed to be identical to the year 2003, when the data of the model was collected.

Another possible approach to model the reform of the EU sugar regime could have been to initially change the export volume of sugar. However, since exports are endogenously determined in the model, this would have been problematic. By letting the model determine changes in the export volume, assumptions about elasticities and production capacities incorporated in the model are allowed to be at work. If the export volume had been changed, the response in prices would most likely be unrealistic. Since the special features of the sugar market are not fully represented in the Mozambique model we considered it a better option to make calculations of price changes outside the model and then let the model react to those changes.

The two scenarios are compared to *Status quo* and all percentage changes refer to the difference between the current scenario and *Status quo*. *Table 3* below presents a summary of the two scenarios and their simulations.

Table 3. Summary of Simulations (Percentage Change in Sugar Prices)

		Round One		Round Two	
Scenario	Simulation	Export Price	Import Price	Export Price	Import Price
EBA	EBA 1	+153%	0%	+153%	+10%
	EBA 2	+134%	0%	+134%	+10%
	EBA 3	+32%	0%	+35%	+10%
Reform	Reform 1	+64%	0%	+64%	+10%
	Reform 2	+63%	0%	+63%	+10%
	Reform 3	+9%	0%	+13%	+10%
	Reform 4	-8%	0%	-3%	+10%

6.1 *EBA*

The prevailing EU sugar regime will remain in its current form in the case of EBA. The scenario differs from *Status quo* in the sense that the world's least developed countries will get unlimited, duty free access to the EU's internal sugar market from 2009.

Since the EBA scenario assumes that no reform will take place in the EU, the price of sugar in the EU market will remain high. In 2003, 10,580 of the total 129,350 tonnes of sugar exported from Mozambique were exported to the EU's internal market (Axelsson Nycander and Jonasson 2005). With an unlimited access to this market, Mozambique is assumed to have an incentive to increase its export volume to the EU. Total exports are held constant and Mozambique is assumed to redirect sugar exports from other export markets to the EU. Export to the EU will consequently constitute a larger share of the total export volume than before. Given the high price in the EU market, such a redirection will result in a higher world export price (*pwe*) for Mozambique. How much the world export price will rise depends on Mozambique's ability to shift away its exports from less preferential markets to the EU.

It is also possible that the price in the residual market will change as a consequence of the redirection of exports in the case of EBA. The decrease in the EU exports of sugar, as a consequence of the WTO dispute, is also likely to have an effect on the price in the residual market (Jansson 2005). In the first round of simulations only the world export price change resulting from access to the high EU market price will be taken into consideration. The effects, which concern both the export and the import price, will be considered in the second round of simulations.

Three different options regarding the extent of the redirection of exports are assumed. In the first simulation Mozambique is expected to be able to transfer all of its current exports to the EU, which will result in a price increase of around 153 percent (EBA 1). The second price increase of 134 percent (EBA 2) is a result of Mozambique shifting all current exports from the non-preferential residual market to the EU while continuing exporting to the US and SACU market. Finally, a price increase of 32 percent (EBA 3) will be realized when 15 percent of exports to the residual market is shifted to the EU annually between 2006 and 2009. Thereafter, the export volume shifted away from the residual market to the EU is assumed to double. This alternative reflects the current agreement that Mozambique is allowed to increase its exports to the EU by 15 percent per year until 2009. In this simulation Mozambique is then assumed to double its exports to the EU, once it is allowed to export freely. The new world export price in the model is defined in the following way:

$$pwe_{EBA\,1} = 2.53 * pwe_{STATUS\,QUO}$$

$$pwe_{EBA\,2} = 2.34 * pwe_{STATUS\,QUO}$$

$$pwe_{EBA\,3} = 1.32 * pwe_{STATUS\,QUO}$$

6.2 *Reform*

The Reform scenario comprises the implementation of the EU proposal from November 2005 in combination with EBA described above. EBA is included since the promise from the EU of free exports from LDCs to the European market cannot be withdrawn. The major change in this scenario is a cut in the EU sugar price by 36 percent, i.e. a new price of EUR 338 instead of EUR 528.[16]

In the first simulation in this scenario (Reform 1) Mozambique is assumed to be able to export as much as it wants to the EU market, as in EBA 1. In this case, however, the price in the EU is lower than in the US but still higher than the price in SACU and the residual market. In Reform 1 it is therefore assumed that Mozambique keeps its exports to the US but transfers its exports from SACU and the residual market to the EU. These changes imply an increase in the world export price by 64 percent and in the model it is defined as follows:

$$pwe_{REFORM\ 1} = 1.64 * pwe_{STATUS\ QUO}$$

Another possible outcome is that only exports to the residual market will be shifted to the EU since the price differential between SACU and the EU (EUR 314 vs. EUR 338) is too small to consider a shift of exports. The percentage change in the world export price for Mozambique in this case becomes 63 percent (Reform 2) and thus almost identical to Reform 1:

$$pwe_{REFORM\ 2} = 1.63 * pwe_{STATUS\ QUO}$$

The third simulation will be the counterpart to EBA 3. This means that Mozambique gradually shifts parts of its exports from the residual market to the EU market, although some exports to the residual market will be kept in 2012. When combining the decrease in the EU price with these changes, the world export price is predicted to rise by 9 percent (Reform 3):

$$pwe_{REFORM\ 3} = 1.09 * pwe_{STATUS\ QUO}$$

An additional assumption in the Reform scenario is that Mozambique keeps its export volume to each market. This results in a simulation where the world export price declines by 8 percent (Reform 4) and is defined in the model as follows:

$$pwe_{REFORM\ 4} = 0.92 * pwe_{STATUS\ QUO}$$

[16] The most likely scenario according to EC (2005c) and Johansson (2005).

6.3 *EBA and Reform in Combination with a Change of the Residual Market Price*

Since exports to the residual market are maintained in some of the simulations described above, it could be important to consider how a change in the EU sugar regime affects the residual market price. This would have an effect on Mozambique's world export price of sugar. Changes in the price in the residual market would also affect the world import price of sugar, a highly relevant variable since Mozambique is a net importer of sugar. The following second round of simulations will therefore combine the seven simulations with an additional change in the world export price (*pwe*) and a higher world import price (*pwm*) of sugar.

The world's total trade volume of sugar amounts to about 40 million tonnes (EC 2005b), whereof only 40 percent is traded freely (Mitchell 2004). What in this thesis is referred to as the residual market thus amounts to about 16 million tonnes. The EU mainly exports to the residual market and adjustments in the EU export volume can therefore be assumed to have an impact on this market. In both EBA and Reform a decrease in the EU's exports by 3.7 million tonnes is assumed to affect the residual market price of sugar positively since the total trade volume will decrease. Other LDCs will also have the same possibility as Mozambique to shift part of their exports from the residual market to the EU. This could put further upward pressure on the residual market price. However, this pressure will only be realized as long as shifted exports are not replaced by exports from other countries.

When LDCs increase their exports to the EU, ACP countries might have to decrease their exports to that market. The ACP countries might then increase their exports to the residual market instead, unless it is unprofitable to export at the residual market price. A possible compensation from the EU in such a situation may however serve to support exports from ACP countries to the residual market.

Due to uncertainties about how the residual market price will react to a decrease in exports from the EU and about other exporting countries' redirection of exports to/from the residual market, the price increase of sugar is difficult to predict. Opinions differ but a common view seems to be a negligible effect on the residual market price. In the case of total deregulation in the EU market, several studies point towards a 10 to 20 percent increase in the residual market price of sugar (Axelsson Nycander and Jonasson 2005). In order to see the direction of the consequences from a higher residual market price, the simulations incorporate an increase by 10 percent. This is probably closer to the upper limit but serves the purpose to discern an effect. In the following simulations the initial changes in the world export price will be combined with an increase in the import price of sugar for Mozambique. Mozambique is assumed to import all of its sugar at the residual market price. In the simulations where Mozambique exports to the residual market, the higher price will be

included in the change in the world export price as well. The world import price will be fixed at a level 10 percent above the prevailing price and is defined as follows:

$$pwm_{EBA + REFORM} = 1.10 * pwm_{STATUS\ QUO} \quad (8)$$

The increase in the residual market price affects the world export price of sugar in EBA 3, Reform 3 and Reform 4, i.e. the simulations where Mozambique still exports to the residual market. With a 10 percent increase in the residual market price the new price changes will be:

$$pwe_{EBA\ 3} = 1.35 * pwe_{STATUS\ QUO} \quad (9)$$

$$pwe_{REFORM\ 3} = 1.13 * pwe_{STATUS\ QUO} \quad (10)$$

$$pwe_{REFORM\ 4} = 0.97 * pwe_{STATUS\ QUO} \quad (11)$$

In the rest of the simulations, the world export price remains the same.

7 Results and Analysis

In this section the results from the simulations will be reported and possible explanations for the results will be discussed. When looking at the results in the model it is possible to see the effects on all of the included variables. In principle every variable in the model is affected by the simulation since the equations are solved simultaneously and a new equilibrium is reached. However, when analyzing the results from the simulations, the focus will be on the selected variables presented below.

7.1 *General Results*

Table 4. General Results (percentage change)

			EBA 1	EBA 2	EBA 3
Sugar exports			170.61	159.85	59.27
Sugar imports			9.19	8.09	1.71
Output level of sugar			0.86	0.72	0.11
Nominal	**GDP**		0.28	0.24	0.04
		Private consumption	0.06	0.05	0.00
		Government consumption	0.06	0.05	0.00
		Investment	0.08	0.06	0.01
		Exports	1.45	1.26	0.27
		Imports	-0.18	-0.16	-0.04
	Exchange rate		-0.62	-0.54	-0.12
Real	**GDP**		-0.02	-0.02	0.00
		Private consumption	0.14	0.12	0.02
		Government consumption	0.00	0.00	0.01
		Investment	0.10	0.08	0.02
		Exports	0.14	0.17	0.15
		Imports	0.45	0.39	0.08
	Exchange rate		-0.46	-0.40	-0.08

Table 4 above displays the effects of the three different simulations included in the EBA scenario. Naturally, the most dramatic changes take place within the sugar sector. In the case of a 153 percent increase in the export price of sugar, the quantity of sugar exports increases by an astounding 171 percent. Sugar imports also show a significant increase, due to the fact that imported sugar becomes cheaper in relation to domestically produced sugar when the higher export price drives up the domestic price. Worth noting is that production of sugar only increases by 0.86 percent at the most (EBA 1). This means that the main part of the increase in sugar exports used to be sold domestically. Further, imports of sugar do not increase as much as exports of sugar in any of the above simulations, which indicates that domestic consumption of sugar falls. Interesting to mention is that when expanding, the sugar production does not force the output of any other commodity in food production to decrease. In fact, output of all commodities within food production grows as the export price of sugar rises.

Turning to the aggregate variables, in the first simulation nominal GDP increases slightly by 0.28 percent. Although marginally, all of the components in nominal GDP contribute positively to this finding.[17] The variable which changes the most relative to *Status quo* is nominal exports, with a

[17] GDP = Consumption + Investment + Government purchases + Exports - Imports

1.45 percent increase. However, the effect can still be considered marginal, which is a consequence of the sugar sector's small share of total exports in Mozambique. The positive change can be attributed to the higher world export price as well as a larger total export volume resulting from the incentive to increase exports as the price increases. Nominal imports decrease by 0.18 percent, which also adds to the positive change in nominal GDP. The relative price of imports declines as the export price increases, leading to an incentive to meet more of the demand for commodities by imports rather than domestic production. As can be seen from the negative effect on the value of imports, the relative decrease in the price of imports outweighs the increase in the import volume.

When the overall value of production increases, the income of households also increases, mainly in the form of higher wage earnings. This enables households to consume more and the same is true for the government. In nominal terms, both private and government consumption increase by the same percentage, following the assumption in the model that these variables change at the same rate.

However, it should be kept in mind that changes in the nominal variables are influenced by changes in the price level. The world export price increases while the world import price is held constant. This implies a terms of trade improvement for Mozambique. When the export price increases it leads to an upward pressure on the domestic price level since Mozambican producers would choose not to sell locally otherwise. The relative price of imports thus decreases, which would put upward pressure on the quantity of imports. As mentioned above, when the relative price of imports decreases, the value of imports decreases in spite of the increased volume of imports. The value of exports, on the other hand, is exaggerated by the higher export price level.

In contrast to nominal GDP, real GDP decreases. The main driving force behind this result is the increase in real imports. This is explained by the lower relative price of imports compared to the domestic price level, which encourages imports. Further, the increase in exports is smaller when measured in real terms than in nominal. Again, this is explained by the higher price of exports affecting the value of exports in nominal terms.

Looking at the exchange rate[18], in nominal terms there is an appreciation of 0.63 percent. The real exchange rate appreciates by 0.46 percent. The difference is explained by the increase in the world price level relative to the domestic price level. Both price levels increase but the world price level increases more than the domestic price level.

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[18]

$$\text{Nominal exchange rate} = \text{real exchange rate} \cdot \frac{\text{domestic price level}}{\text{world price level}}$$

$$\text{Real exchange rate} = \text{nominal exchange rate} \cdot \frac{\text{world price level}}{\text{domestic price level}}$$

When Mozambique redirects exports only from the residual market to the EU and continues exporting to the US and SACU (EBA 2), the result variables do not differ much from EBA 1. This is worth noting since the difference between the price increases is as high as 20 percentage points. The effects on the result variables are all in the same direction following the same logic as in the analysis above. In the last EBA case the effects are minimal, with real GDP even being unaffected. Differences between EBA 1 and EBA 3 are, however, discernible, indicating that the export volume which Mozambique is able to redirect to the EU does have an impact on the economic outcome for the country.

Table 5. General Results (percentage change)

			Reform 1	Reform 2	Reform 3	Reform 4
Sugar exports			101.68	100.55	18.80	-18.43
Sugar imports			3.72	3.65	0.43	-0.33
Output level of sugar			0.28	0.27	0.03	-0.02
Nominal	**GDP**		0.10	0.10	0.01	-0.01
		Private consumption	0.01	0.01	0.00	0.00
		Government consumption	0.01	0.01	0.00	0.00
		Investment	0.02	0.02	0.00	0.00
		Exports	0.57	0.56	0.07	-0.06
		Imports	-0.08	-0.08	-0.01	0.01
	Exchange rate		-0.25	-0.25	-0.03	0.03
Real	**GDP**		-0.01	-0.01	0.00	0.00
		Private consumption	0.04	0.04	0.00	0.00
		Government consumption	0.01	0.01	0.00	0.00
		Investment	0.04	0.04	0.00	0.00
		Exports	0.21	0.21	0.05	-0.06
		Imports	0.18	0.17	0.02	-0.02
	Exchange rate		-0.18	-0.17	-0.02	0.02

The simulation in which Mozambique transfers all of its exports of sugar to the EU in EBA 1 can best be compared to Reform 1, where Mozambique also redirects as much as it wants of the exports to the EU market. Even though the price in the EU market has decreased by 36 percent, the net change facing Mozambique is still an increase in the world export price. The effects on the result variables are thus in the same direction as in EBA 1, only smaller. Sugar exports still show a dramatic increase, but the increase in sugar imports is in this case rather small. Nominal GDP shows a small increase whereas real GDP decreases marginally. All of the aggregated variables now show changes of less than one percent.

As could be expected, the results for Reform 1 and Reform 2 are practically identical. Thus, according to this outcome, Mozambique's ability to transfer exports to the EU plays a smaller role in the case with a lower EU price. This is intuitive since the reform makes the sugar prices more similar across the different markets.

Reform 3 can be compared to EBA 3, as these simulations build on the same assumption that Mozambique gradually transfers exports from the residual market to the EU. Sugar exports now show an increase of only around 19 percent, compared to 59 percent in EBA 3 when the price was still at its high level. The output level of sugar is, as expected, even less affected than in the EBA scenario with its highest growth in Reform 1 of 0.28 percent. Since the effects on the aggregated variables are minimal in both cases there are no differences worth mentioning, other than that the changes are smaller in Reform 3. Many of the variables show zero effects.

Looking at the case where Mozambique maintains its original exporting pattern (Reform 4), the price decrease in the EU has a negative impact on nominal GDP and nominal exports. In this case Mozambique faces a deterioration of its terms of trade since the average export price declines. Both the nominal and the real exchange rate depreciate. Again, many of the changes are too small to be discernable. Real GDP, for example, is unaffected by the export price decrease.

7.2 *General Results Including a Change in the Residual Market Price*

The results from the second round of simulations are presented below. As can be seen in *Table 6* the results differ from the first round since the price in the residual market is assumed to change as well.

Table 6. General Results (percentage change)

			EBA 1*	EBA 2*	EBA 3*
Sugar exports			167.32	156.42	60.32
Sugar imports			-0.22	-1.25	-6.99
Output level of sugar			0.91	0.78	0.19
Nominal	**GDP**		0.21	0.17	-0.01
		Private consumption	0.00	-0.02	-0.06
		Government consumption	0.00	-0.02	-0.06
		Investment	0.03	0.02	-0.04
		Exports	1.38	1.19	0.23
		Imports	-0.24	-0.21	-0.10
	Exchange rate		-0.68	-0.60	-0.19
Real	**GDP**		-0.03	-0.02	-0.01
		Private consumption	0.10	0.08	-0.02
		Government consumption	-0.01	-0.01	-0.01
		Investment	0.11	0.10	0.03
		Exports	0.14	0.18	0.16
		Imports	0.38	0.32	0.03
	Exchange rate		-0.40	-0.34	-0.04

*Including change in residual market price

In EBA 1 and EBA 2 the residual market price only has an effect through the change in the import price. When comparing these two cases with the corresponding cases without the residual market price change it is worth noting that the effect on sugar imports turns negative in the second round. The fact that sugar imports become more expensive has a large enough impact to counteract the decrease in the relative price of sugar imports due to the change in the export price. The decrease in sugar imports contributes to a higher, although still small, increase in the production of sugar for all EBA simulations in the second round compared to the first round. Also worth noting is that in EBA 1 and EBA 2 nominal GDP increases less in the second round. Nominal exports increase less due to the less favorable export/import price ratio and nominal imports decrease more due to the lower volume of imports at the higher import price. However, in real terms the relative price of imports still decreases, inducing an increase in real imports, although smaller than in the first round. The nominal exchange rate appreciates more than in the first round of simulations since less demand for imports means less demand for foreign currency and thus a contribution to the nominal appreciation.

In EBA 3 in the second round there is a slightly negative effect on nominal GDP, which can be compared to the positive effect in EBA 3 in the first round. As in EBA 1 and EBA 2, the effect of the higher import price counteracts the effects of the higher export price and now sugar imports

decrease by approximately seven percent compared to the increase by almost two percent in EBA 3 in the first round.

Table 7. General Results (percentage change)

			Reform 1*	Reform 2*	Reform 3*	Reform 4*
Sugar exports			97.92	96.79	23.55	-9.07
Sugar imports			-5.31	-5.37	-8.13	-8.82
Output level of sugar			0.33	0.33	0.10	0.05
Nominal	**GDP**		0.03	0.03	-0.04	-0.06
		Private consumption	-0.05	-0.05	-0.06	-0.06
		Government consumption	-0.05	-0.05	-0.06	-0.06
		Investment	-0.03	-0.03	-0.04	-0.05
		Exports	0.50	0.49	0.05	-0.08
		Imports	-0.13	-0.13	-0.07	-0.05
	Exchange rate		-0.30	-0.30	-0.10	-0.04
Real	**GDP**		-0.01	-0.01	-0.01	-0.01
		Private consumption	0.00	0.00	-0.03	-0.04
		Government consumption	0.00	0.00	-0.01	-0.01
		Investment	0.05	0.05	0.02	0.01
		Exports	0.21	0.21	0.07	-0.02
		Imports	0.11	0.11	-0.02	-0.06
	Exchange rate		-0.12	-0.12	0.02	0.06

*Including change in residual market price

Turning to the reform scenario, in the first two simulations the only difference is that the import price changes, since again there is no export to the residual market. The differences are similar to the ones described in the EBA scenario. Sugar exports increase somewhat less with the higher residual market price compared to the Reform simulations in the first round as long as Mozambique has no exports to the residual market. However, as in EBA 3, in Reform 3 and Reform 4 Mozambique's sugar exports are also affected by the higher residual market price since this is now included in the average sugar export price. This means that sugar exports increase compared to the first round.

In Reform 3, where the higher residual market price affects both the export and import price for Mozambique, nominal as well as real GDP turn negative. Nominal consumption and investment again turn negative and even real consumption experiences a decrease. For the first time the real exchange sees a slight depreciation due to the higher world price level.

Assuming that Mozambique continues exporting the same volumes to the original export markets, the effects on the economy are worse when there is an increase in the residual market price

compared to when there is not. Even though the export price only decreases by 3 percent compared to the 8 percent decrease in the first round, the increase in the import price leads to a larger decrease in nominal GDP as well as a slight decrease in real GDP. All of the nominal result variables experience a decrease, compared to the first round where exports is the only nominal GDP component which decreases. Negative effects can be seen for real consumption, both private and government.

Regarding the exchange rates, in Reform 4 different effects dominate in the two rounds of simulations. In the first round both the nominal and the real exchange rate depreciate. The real exchange rate depreciates even though foreign goods become relatively cheaper. In the second round the nominal exchange rate appreciates due to the lower import demand. The real exchange rate depreciates even though the nominal exchange rate appreciates. An explanation for this is that the increase in the import price is larger than the decrease in the export price. The world price level thus increases, making it more expensive for Mozambique to buy foreign goods.

7.3 *The Labor Market*

Table 8. Labor Demand in Food Production (percentage change)

			EBA 1	EBA 2	EBA 3
Female labor	**Rural**	Unskilled	1.50	1.29	0.21
		Skilled			
	Urban	Unskilled	1.29	1.08	0.17
		Skilled	1.06	0.88	0.13
		Highly skilled	1.05	0.89	0.14
Male labor	**Rural**	Unskilled	1.36	1.15	0.19
		Skilled	1.10	0.93	0.14
	Urban	Unskilled	1.12	0.94	0.14
		Skilled	1.02	0.86	0.13
		Highly skilled	1.03	0.87	0.13

Table 9. Labor Demand in Food Production (percentage change)

			Reform 1	Reform 2	Reform 3	Reform 4
Female labor	**Rural**	Unskilled	0.52	0.50	0.06	-0.04
		Skilled				
	Urban	Unskilled	0.40	0.39	0.04	-0.02
		Skilled	0.33	0.33	0.03	-0.03
		Highly skilled	0.34	0.33	0.04	-0.01
Male labor	**Rural**	Unskilled	0.45	0.44	0.04	-0.03
		Skilled	0.35	0.34	0.03	-0.02
	Urban	Unskilled	0.36	0.35	0.03	-0.02
		Skilled	0.33	0.32	0.03	-0.02
		Highly skilled	0.32	0.32	0.03	-0.02

Taking the effects on labor into account, it appears that demand of female and male workers in the activity food production increases in all simulations but the last (Reform 4). An increase in the export price of an agricultural commodity thus has a positive effect on the demand of labor used in its production. This is intuitive since a high price implies a larger supply of sugar reached through the use of more resources. Worth noting is that the largest positive change in demand is enjoyed by unskilled female and male workers in rural areas. It also appears that female labor is demanded more than male labor in all corresponding groups. Further, the increase in demand seems to be closer connected to skill level than type of area. When the skill level is the same, labor in rural areas will be demanded relatively more. Hence, the smallest positive effect will be enjoyed by highly skilled male labor in urban areas. All in all, the percentage changes in labor demand point in the direction that an expansion of sugar production will have its largest positive impact on the demand for unskilled labor, especially women, in rural areas. Consequently, this group will also be demanded the least when the price development of exported sugar goes in the opposite direction.

Table 10. Wage and Rent in Food Production (percentage change)

			EBA 1	EBA 2	EBA 3
Female labor	**Rural**	Unskilled	0.21	0.17	0.03
		Skilled	0.23	0.19	0.03
	Urban	Unskilled	0.37	0.32	0.07
		Skilled	0.36	0.31	0.07
		Highly skilled	0.36	0.31	0.07
Male labor	**Rural**	Unskilled	0.29	0.25	0.04
		Skilled	0.34	0.29	0.06
	Urban	Unskilled	0.44	0.38	0.07
		Skilled	0.40	0.35	0.07
		Highly skilled	0.39	0.34	0.07
Capital			0.84	0.72	0.12

Table 11. Wage and Rent in Food Production (percentage change)

			Reform 1	Reform 2	Reform 3	Reform 4
Female labor	**Rural**	Unskilled	0.06	0.06	0.01	0.00
		Skilled	0.08	0.08	0.01	-0.01
	Urban	Unskilled	0.14	0.14	0.02	-0.02
		Skilled	0.14	0.14	0.02	-0.02
		Highly skilled	0.14	0.14	0.02	-0.02
Male labor	**Rural**	Unskilled	0.10	0.10	0.01	-0.01
		Skilled	0.12	0.12	0.01	-0.01
	Urban	Unskilled	0.16	0.16	0.02	-0.02
		Skilled	0.15	0.15	0.02	-0.02
		Highly skilled	0.15	0.14	0.02	-0.02
Capital			0.29	0.28	0.03	-0.02

When looking at the percentage change in wages, it is important to emphasize the assumption in the model that the wage change is the same for all subgroups in all sectors in the economy. The results from the simulations show very small and similar wage changes compared to *Status quo*. More interesting than the sizes is the direction of the changes and to see what kind of labor that gains the most. *Table 10* and *Table 11* show that labor in urban areas enjoys the highest increase. Unskilled female workers in rural areas enjoy the smallest positive wage change in all simulations. This might seem somewhat contradictory to the results concerning labor demand since this group is subject to the largest increase in demand when the price of exported sugar rises. The

explanation for this could be that the total number of workers is constant, which is the case for all labor subgroups. This means that if food production needs and demands more unskilled female workers in rural areas, these workers will move from other sectors, where the demand is lowered, to food production. The same is true for all other subgroups. The change in wage for a certain subgroup is thus determined by the change in total demand in all sectors in the economy for that kind of labor.

Consequently, the reason why unskilled female workers in rural areas enjoy the lowest wage increase despite the high rise in demand for that group, could be that other sectors face a corresponding decrease in demand for that group. This means that total demand for these female workers only slightly exceeds total supply, giving little room for a wage increase. Unskilled urban male workers, on the other hand, enjoy the highest wage increase in spite of the fact that the rise in demand for this labor group is relatively small. The reasoning here is the same as for unskilled rural female workers. Total supply of unskilled male workers in urban areas is constant. However, increase in total demand for that subgroup rises more relative to supply than does demand relative to supply for unskilled female workers in rural areas. The larger gap between demand and supply is compensated for by a higher wage increase. This increase follows the development of the export price of sugar with the highest increase of 0.44 percent in EBA 1. The second round of simulations, when the import price of sugar is affected, is not mentioned in this analysis since the results more or less correspond to the first round.

Comparing rent to capital with the wage development, it appears that capital gains more than labor in all simulations but the last. Rent to capital is, on the contrary to wages, activity-specific, meaning that the rent changes differ between sectors. The more positive development for rent in food production can be explained by the fact that each entity of capital gets more labor. Demand for labor in food production has increased and workers have moved from other sectors, resulting in more labor per capital.

To summarize the results generated by the model, it seems that the consequences of a change in the export and import price of sugar are complex, with unexpected effects on aggregate variables. However, the effects appear to be extremely small.

8 Validity of the Model

8.1 *External Validity*

The chosen CGE model is developed under the assumption of perfect competition. Since most markets are characterized by market power and economies of scale, a common view is that many CGE models lack in the ability to portray the real world. To get a more realistic picture of markets

and to see the effects of policy changes more clearly, many researchers strive to incorporate imperfect competition when developing models. In many cases this makes sense but due to its specific characteristics, the sugar market is modeled fairly well with perfect competition. Another option would have been to use a partial equilibrium model and analyze the sugar sector in isolation. As mentioned before, this would not generate as realistic results of the sugar reform and the choice to use a CGE model must therefore be considered justified.

8.2 *Internal Validity*

The results and analysis of the various scenarios in this thesis are dependent on the pre-developed CGE model for Mozambique. The model was developed to analyze the policy changes of the liberalizations in the Doha trade round. Thus, the sugar sector with all its specific characteristics is not modeled in detail. However, the general level of aggregation is low and the data is detailed enough to provide an accurate and reliable picture of the effects stemming from a change in the EU sugar regime.

It is also worth noting that the data in the model stems from 2002-2003 whereas the presented results are estimated for 2012. Thus, the analysis is conducted under the assumption that the features and parameter values are the same in 2012 as in 2002-2003. Should it be the case that the characteristics of the Mozambican economy change significantly, the model would need to be respecified with new parameter values in order to mirror the real world. However, it is a reasonable assumption that the economy continues to function in the same way during the intended time period since many parameters in the model change slowly. For example, preferences in households and firms tend to be stable and substitution possibilities do not usually change in the short run.

Nonetheless, the values of some parameters might be over- or underestimated in the first place. Performing a sensitivity analysis of the results is therefore necessary in order to test the robustness of the model. In the sensitivity analysis, we choose to vary the parameter *rho* (ρ_c^q), representing the Armington elasticity, since this is a parameter which could have an important effect on the results. We will also allow for additional changes in the import price of sugar and change the macro closures.

8.2.1 Sensitivity Analysis

One reason for the overall small effects of the sugar price changes could be the value of the Armington elasticity, which controls the degree of substitutability between imported and domestically produced sugar. With less than perfect substitutability, consumers in Mozambique do not consume imported sugar to the same extent as they consume domestically produced sugar. Increasing the Armington elasticity would result in these two types of sugar being more perfect substitutes. The

elasticity present in the model is estimated from actual data for Mozambique and should thus be a good representation of how consumers behave. Imported and domestically produced sugar are then close to perfect substitutes. However, it is interesting to see how sensitive the model is to changes in the Armington elasticity. A sensitivity test is therefore performed which increases the elasticity towards perfect substitutability. A change in this direction is chosen since there is a reason to believe that sugar can be viewed as a perfectly homogenous good, regardless if being imported or domestically produced.[19]

The sensitivity test is performed by increasing the Armington elasticity, σ_q, defined as:

$$\sigma_q = \frac{1}{1+\rho_c^q}, \quad \text{where } \rho_c^q > -1$$

The value of ρ_c^q is initially estimated to -0.63. By multiplying this parameter with 1.5 the denominator approaches zero, increasing the Armington elasticity towards perfect substitutability. All simulations were rerun with the higher elasticity and the results attained are compared to the initial results in *Table 12* and *Table 13* below.

Table 12. Initial Results from Round One Compared to Results with Higher Armington Elasticity

		EBA 1	EBA 2	EBA 3	Reform 1	Reform 2	Reform 3	Reform 4
Sugar exports	**Initial**	170.61	159.85	59.27	101.68	100.55	18.80	-18.43
	Larger σ	193.52	182.28	72.22	119.08	117.83	27.84	-12.53
Sugar imports	**Initial**	9.19	8.09	1.71	3.72	3.65	0.43	-0.33
	Larger σ	26.04	23.78	10.04	14.43	14.29	7.26	5.66
Nominal GDP	**Initial**	0.28	0.24	0.04	0.10	0.10	0.01	-0.01
	Larger σ	0.33	0.28	0.06	0.12	0.12	0.03	0.00
Real GDP	**Initial**	-0.02	-0.02	0.00	-0.01	-0.01	0.00	0.00
	Larger σ	-0.02	-0.02	0.00	-0.01	-0.01	0.00	0.00

[19] It is debated whether it is suitable to assume imperfect substitutability for sugar and some researchers argue that it is in fact best modeled with the assumption of perfect substitutability (National Board of Trade 2005).

Table 13. Initial Results from Round Two Compared to Results with Higher Armington Elasticity

		EBA 1	EBA 2	EBA 3	Reform 1	Reform 2	Reform 3	Reform 4
Sugar exports	**Initial**	167.32	156.42	60.32	97.92	96.79	23.55	-9.07
	Larger σ	186.48	174.79	69.35	110.60	109.36	29.61	-5.07
Sugar imports	**Initial**	-0.22	-1.25	-6.99	-5.31	-5.37	-8.13	-8.82
	Larger σ	13.39	11.22	-1.20	2.43	2.31	-3.65	-5.09
Nominal GDP	**Initial**	0.21	0.17	-0.01	0.03	0.03	-0.04	-0.06
	Larger σ	0.25	0.21	0.00	0.05	0.05	-0.03	-0.06
Real GDP	**Initial**	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
	Larger σ	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01

The most significant effect on the results is naturally found in the sugar sector. Due to the higher propensity to import, in EBA 1 sugar imports now increase by 26 percent, compared to the 9 percent increase in the initial run. Sugar exports also increase more, by over 190 percent compared to the initial 170 percent. Within the sugar sector, the Armington elasticity thus appears to have a significant impact on the trade pattern.

When looking at the aggregated variables, the differences are much smaller. Nominal GDP takes on somewhat higher values in all simulations. Since the effects are so small to begin with, changing the elasticity has a relatively large impact. However, the results are still in the same range and in the same direction. Further, real GDP shows no change in any of the rounds when introducing a higher Armington elasticity.

Another assumption affecting the results is the extent of the residual market price increase. In the initial simulations it was assumed to be 10 percent but some researchers have suggested a larger increase. Axelsson Nycander and Jonasson (2005) predicted an increase of 10-20 percent. In order to test the significance of the size of this price increase, 20 percent is tested instead of the initial 10 percent. Since the case of a smaller increase is portrayed by the case of no increase, only this larger increase is included in the sensitivity analysis.

Table 14. Results Including 0, 10 and 20 Percent Increase in Residual Market Price

		EBA 1	EBA 2	EBA 3	Reform 1	Reform 2	Reform 3	Reform 4
Sugar exports	**0%**	170.61	159.85	59.27	101.68	100.55	18.80	-18.43
	10%	167.32	156.42	60.32	97.92	96.79	23.55	-9.07
	20%	164.23	153.20	61.45	94.46	93.33	26.24	-2.69
Sugar imports	**0%**	9.19	8.09	1.71	3.72	3.65	0.43	-0.33
	10%	-0.22	-1.25	-6.99	-5.31	-5.37	-8.13	-8.82
	20%	-8.47	-9.43	-14.59	-13.20	-13.26	-15.65	-16.27
Nominal GDP	**0%**	0.28	0.24	0.04	0.10	0.10	0.01	-0.01
	10%	0.21	0.17	-0.01	0.03	0.03	-0.04	-0.06
	20%	0.14	0.10	-0.07	-0.03	-0.03	-0.10	-0.12
Real GDP	**0%**	-0.02	-0.02	0.00	-0.01	-0.01	0.00	0.00
	10%	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
	20%	-0.03	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01

When introducing a 20 percent increase in the residual market price, the changes observed between the first two rounds are enhanced. Regarding sugar exports, the largest discernible impact occurs in Reform 4 where Mozambique maintains its original export volume to the residual market. Sugar imports decrease rather drastically with the even higher import price of sugar. This is the variable most sensitive to the assumption made regarding the residual market price increase. Real GDP is still practically unaffected whereas nominal GDP deteriorates further. It thus seems that changes in the price at which Mozambique imports its sugar carries through to nominal GDP, even though the effects are still very small.

Since the original effects on the aggregated variables are so small, they become rather sensitive to changes in parameters and assumptions. However, the main finding, i.e. that the effects are small, is robust.

A sensitivity test was also conducted by changing the macro closures and these results are presented in *Appendix C*. In the government closure, the direct tax rate was endogenized, i.e. made flexible, and government savings exogenized. None of the analyzed variables changed when this government closure was implemented, wherefore the results from this test are not shown.

Secondly, the external balance was changed by fixing the real exchange rate and endogenizing foreign savings. In this case the result variables changed somewhat. Since the results for the aggregated variables are close to zero they changed signs in some cases. However, the effects remain small, meaning that implementing a different external balance closure leaves the main conclusion unchanged.

Thirdly, the savings-investment balance was changed to become savings-driven, with fixed savings and investment adjusting to clear the balance. Similar to when the external balance closure

was changed there are some differences in the results with a savings-driven closure. However, again the effects remain small. Due to the reasons described in section 5.2.1 the initial macro closures are therefore still considered to be the most appropriate for the analysis at hand.

9 Summary and Concluding Remarks

In order to fulfill the purpose of this thesis, i.e. to estimate the economic consequences for Mozambique of a reform of the EU sugar regime, a CGE analysis was carried out and a number of variables were analyzed. The most striking finding is that, independent of change, the effects on the economy as a whole are very small. Even if Mozambique is able to transfer all of its sugar exports to the profitable EU market, the effects on nominal and real GDP are less than one percent. As could be expected, the sugar sector is overall much more sensitive to the price changes than is the economy as a whole. However, the output of sugar grows marginally although the export price of sugar increases dramatically. Just as Axelsson Nycander and Jonasson (2005) predicted, this increase does not affect the production of other commodities within food production negatively.

The concerns that lowering the EU price of sugar would affect the economic development in Mozambique severely can, according to this study, thus be considered exaggerated. Further, the difference in outcome between the two scenarios is marginal. Therefore, it seems that Mozambique would not suffer great losses from a lower EU price. Following the same reasoning, a beneficial export situation does not seem to contribute to reduced poverty as was predicted by Axelsson Nycander and Jonasson (2005).

The simulations in this thesis differ quite dramatically with respect to the price change, ranging from an increase by 153 percent to a decrease by 8 percent. Which simulation is most realistic depends on the decision by the EU, and Mozambique's ability to redirect its exports. Much indicates that the reform scenario will be realized. The question then remains how much of the sugar exports Mozambique will transfer to the EU market. Factors contributing to a maintained trade pattern are, for example, established contracts with trading partners, existing transport routines and uncertainties concerning the future development in the EU market. It should be kept in mind that the year for the analysis is 2012, which gives Mozambique some time for reorganization. However, a price change in the range of 153 percent would seem quite unrealistic in any case. Another important aspect is the possibility that the EU decides to open up its market to low cost producers, such as Thailand and Brazil. The value of the EU market could then diminish and Mozambique could even find itself outcompeted. According to Arndt (2005b), there is also a risk that European importing companies could capture a large part of Mozambique's export profits. Speculating about the amount of redirected exports is hence difficult.

Jansson (2005) predicts a 36 percent increase in the export price for the LDCs as a group in the case of EBA, which corresponds to EBA 3. With that price increase he finds a significant increase in sugar exports from LDCs to the EU, which is in accordance with our results. However, as already emphasized, judging from the results in this thesis, it does not seem to be of great importance for the Mozambican economy as a whole how much of its sugar exports it redirects to the EU market.

After having established that the sizes of the effects are small, it is still possible to draw conclusions from the direction of the effects. Worth noting is that the results indicate that real GDP could even fall as a consequence of a higher export price of sugar. Further, the negative effect on real GDP is the largest when the export price of sugar rises the most. Thus, when the price in the EU sugar market falls, Mozambique is better off in terms of real GDP compared to the case when the EU price remains high. This is contradictory to what could be expected from such a change. It is important to keep in mind that according to the data, Mozambique is a net importer of sugar. Should Mozambique be able to become a net exporter of sugar, it would not be as sensitive to relative changes in the import price of sugar and an increase in the export price of sugar would most likely have a larger positive effect on GDP. However, the sugar sector alone gains more in all EBA simulations compared to the corresponding Reform simulations. The concerns about the future for the Mozambican sugar industry in the case of a lower EU price can thus be considered somewhat justified. The stakeholders in the sugar industry most likely compare all alternatives with EBA, rather than *Status quo*, as they have been promised free access to the EU market.

Much of the concern regarding the change in the sugar regime is linked to the effects on the labor market. Sugar production is often viewed as a means of decreasing unemployment as well as reducing income gaps between the city and the countryside. To some extent the results point in this direction. Demand for labor in food production increases in all subgroups and in all simulations with a price increase. Although small, the largest positive change in demand is enjoyed by unskilled female and male workers in rural areas. Axelsson Nycander and Jonasson (2005) predicted a possible increase of 30,000 new jobs in the sugar sector under beneficial export conditions. This seems very optimistic in comparison with the results in this thesis, where the demand increase in food production ranges from 1.02 to 1.50 percent in the most beneficial simulation. The comparison is, however, unfair since the model gives no information on the sugar sector alone. Such a dramatic job creation should therefore not be considered impossible since the value of sugar production in relation to the value of total food production is less than two percent. A marginal increase in the demand for labor in food production could thus mean a large increase in labor demand in the sugar sector.

Whereas the change in demand for labor points in the direction of decreased inequality between urban/rural areas, male/female labor and skilled/unskilled, the change in wages gives a different picture. Unskilled female workers in rural areas enjoy the smallest positive wage change in all simulations. However, this result is dependent on the assumption in the model that the supply of labor for each subgroup is fixed and that the wage for each subgroup is determined economy wide and not for each sector. Comparing the new wages results with the rent earned by capital, it appears that capital gains more than labor in all simulations. According to these results, an increase in the export price of sugar does not appear to increase equality. In addition, since the sugar companies to a large extent are foreign-owned, a large part of the increase in factor income goes abroad.

The above conclusions drawn from the results rely on the chosen CGE model and its specifications. As discussed in the chapter about the validity of the model, we believe that the used CGE model fits the sugar industry and the reform at hand well. However, although the model can be considered detailed, it is important to remember that some features of the sugar industry are left out. Nevertheless, we argue that the results of the simulations do capture the most important aspects of the outcome of the EU sugar reform.

When evaluating the most beneficial outcome for Mozambique, it is important to keep in mind that preferential trade agreements can promote the production of commodities where no comparative advantage exists. If sugar is produced at costs that are too high for Mozambique being able to compete on a completely liberalized sugar market, in the long run there is a risk in upholding the production of sugar. This could be true for Mozambique since production costs exceed the price for sugar received in the residual market (Axelsson Nycander and Jonasson 2005). By realizing this early, unnecessary restructuring costs and investments can be avoided and more resources can be used in sectors with a long-term comparative advantage. Evaluating where Mozambique could use its resources more efficiently and how costly it would be to rearrange its production is, however, beyond the scope of this thesis. Mozambique's comparative advantages and the country's ability to redirect its resources would thus be an interesting area to study further.

When evaluating the outcome of EBA and Reform on a more general level, it is important to remember how preferential trade agreements disfavor other sugar producers, such as Brazil. Brazil is a low-cost sugar producing country that suffers great losses from the exclusion from the EU market. To carry out a similar study of the economic consequences for Brazil, and compare these with the consequences for Mozambique would also be an interesting topic for further research.

Finally, the answer to the question whether Mozambique will turn out to be a winner or a loser of a reform of the EU sugar regime is not clear cut. However, according to the results obtained in this study, the economic consequences are so small that for Mozambique it does not matter whether or not the reform is implemented.

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11 Appendix A: Details of the EU Sugar Reform Proposal

- A 36 percent price cut over four years beginning in 2006/07 to ensure sustainable market balance.
- Compensation to farmers at an average of 64.2 percent of the final price cut. Inclusion of this aid in the Single Farm Payment and linking of payments to respect of environmental and land management standards.
- In those countries giving up at least 50 percent if their quota, the possibility of an additional coupled payment of 30 percent of the income loss for a maximum of five years, plus possible limited national aid.
- Validity of the new regime, including extension of the sugar quota system, until 2014/15. No review clause.
- Merging of 'A' and 'B' quota into a single production quota.
- Abolition of the intervention system after four years and the replacement of the intervention price by a reference price.
- Introduction of a private storage system as a safety net in case the market price falls below the reference price.
- Voluntary restructuring scheme lasting 4 years for EU sugar factories, and isoglucose and inulin syrup producers, consisting of a high degressive payment to encourage factory closure and the renunciation of quota as well as to cope with the social and environmental impact of the restructuring process.
- This payment will be 730 euros per tonne in year one and two, falling to 625 in year three, and 520 in the final year.
- The possibility to use some of this fund to compensate beet producers affected by the closure of factories.
- An additional diversification fund for Member States where quota is reduced by a minimum amount, which increases the more quota is renounced.
- Both these payments will be financed by a levy on holders of quota, lasting three years.
- Sugar beet should qualify for set-aside payments when grown as a non-food crop and also be eligible for the energy crop aid of 45 euros/hectare.
- To maintain a certain production in the current "C" sugar producing countries, an additional amount of 1.1 million tonnes will be made available against a one-off payment corresponding to the amount of restructuring aid per tonne in the first year.
- Sugar for the chemical and pharmaceutical industries and for the production of bio-ethanol will be excluded from production quotas.
- Increase of Isoglucose quota of 300,000 tonnes for the existing producer companies phased in over three years with an increase of 100,000 tonnes each year.
- Possibility to purchase extra isoglocose quota in (Italy 60,000 tonnes, Sweden 35,000t and Lithuania 8,000t) at the restructuring aid price.

Source: EC (2005a)

12 Appendix B: Export Patterns and Price Calculations

Table 15. ***Status quo***

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	10 580	528	5 588 356
SACU	15 520	314	4 865 520
Residual Market	90 000	126	11 371 500
Total Exports	129 350	209	26 986 251

Table 16. EBA 1 (+153%)

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	0	390	0
EU	129 350	528	68 322 670
SACU	0	314	0
Residual Market	0	126	0
Total Exports	129 350	528	68 322 670

Table 17. EBA 2 (+134%)

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	100 580	528	53 126 356
SACU	15 520	314	4 865 520
Residual Market	0	126	0
Total Exports	129 350	488	63 152 751

Table 18. EBA 3 (+32%)

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	32 200	528	17 008 040
SACU	15 520	314	4 865 520
Residual Market	68 380	126	8 639 813
Total Exports	129 350	276	35 674 248

Table 19. Reform 1 (+64%)

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	116 100	338	39 265 020
SACU	0	314	0
Residual Market	0	126	0
Total Exports	129 350	343	44 425 895

Table 20. Reform 2 (+63%)

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	100 580	338	34 016 156
SACU	15 520	314	4 865 520
Residual Market	0	126	0
Total Exports	129 350	340	44 042 551

Table 21. Reform 3 (+9%)

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	32 200	338	10 890 040
SACU	15 520	314	4 865 520
Residual Market	68 380	126	8 639 813
Total Exports	129 350	228	29 556 248

Table 22. Reform 4 (-8%)

	Volume (tonnes)	**Price** (EUR/ton)	**Export Revenues** (EUR)
US	13 250	390	5 160 875
EU	10 580	338	3 578 156
SACU	15 520	314	4 865 520
Residual Market	90 000	126	11 371 500
Total Exports	129 350	193	24 976 051

The calculations for the price changes are:

EBA 1: 153 percent: (((129,350*528)/129,350)/209-1)*100≈153

EBA 2: 134 percent: (((13,250*390+100,580*528+15,520*314)/129,350)/209-1)*100≈134

The other calculations follow the same logic.

13 Appendix C: Alternative Macro Closures

Table 23. General Results (Percentage Change)

			EBA 1*	EBA 2*	EBA 3*
Sugar exports			171.46	160.65	59.53
Sugar imports			8.31	7.33	1.54
Food production output level			0.89	0.75	0.12
Nominal	**GDP**		0.01	0.00	-0.01
		Private consumption	-0.19	-0.17	-0.05
		Government consumption	-0.19	-0.17	-0.05
		Investment	-0.18	-0.16	-0.04
		Depreciation	-0.63	-0.55	-0.12
		Exports	2.68	2.33	0.51
		Imports	-0.07	-0.07	-0.02
	Exchange rate		-0.62	-0.54	-0.12
Real	**GDP**		-0.02	-0.02	0.00
		Private consumption	-0.09	-0.09	-0.03
		Government consumption	-0.05	-0.04	0.00
		Investment	-0.18	-0.16	-0.04
		Depreciation	0.00	0.00	0.00
		Exports	0.72	0.68	0.27
		Imports	-0.07	-0.07	-0.02
	Exchange rate		-0.46	-0.40	-0.08

* With alternative external balance closure.

Table 24. General Results (Percentage Change)

			EBA 1*	EBA 2*	EBA 3*
Sugar exports			171.11	160.26	59.30
Sugar imports			9.59	8.43	1.77
Food production output level			1.08	0.92	0.15
Nominal	**GDP**		0.26	0.22	0.04
		Private consumption	0.31	0.26	0.05
		Government consumption	0.05	0.03	-0.01
		Investment	-0.62	-0.54	-0.11
		Depreciation	-0.59	-0.52	-0.11
		Exports	1.31	1.14	0.24
		Imports	-0.28	-0.25	-0.06
	Exchange rate		-0.62	-0.62	-0.54
Real	**GDP**		-0.02	-0.02	0.00
		Private consumption	0.37	0.32	0.06
		Government consumption	0.00	0.00	0.00
		Investment	-0.41	-0.35	-0.07
		Depreciation	0.00	0.00	0.00
		Exports	0.09	0.14	0.14
		Imports	0.44	0.38	0.08
	Exchange rate		-0.46	-0.46	-0.40

* With alternative savings-investment closure.