Projected Economic Impacts of the New Partnership Agreement Between the EU and ACP States on the Senegalese Groundnut Sector

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(Abstract)

With the signing of the New Partnership Agreement (Cotonou Convention) between the European Union and the African, Caribbean, and Pacific States in June 2000, the trading relationship between Senegal and the European Union (EU) has taken a new direction. Under the new agreement, Senegal must decide by 2004 if it will enter into a Regional Economic Partnership Agreement (REPA) with the EU, similar to a free trade arrangement, or move to an enhanced form of the Generalized System of Preferences (GSP). Given the high percentage of Senegalese groundnut products that are exported to the European Union and the significance of the groundnut sector to the Senegalese economy, this study examines the economic impacts of both options on the Senegalese groundnut sector in conjunction with changes in development funding, infrastructural investments, and structural adjustment policies.

Overall, the study finds that the REPA option is the more beneficial for the Senegalese groundnut sector. This result stems partially from the ability of increases in development funding to offset any adverse economic impacts caused by the REPA. Though overall more harmful than a REPA, moving to an enhanced GSP does have the benefit of increasing groundnut (in-shell and shelled) exports by a significant amount. Thus, the Senegalese government must weigh the benefit of a boost in the confectionery sector against the adverse impact on producers caused by the GSP.

This study provides needed information for policy decisions by the Senegalese government, and a framework for future modeling efforts pertaining to the Senegalese groundnut sector.

Dedication

I dedicate this work to my wife, Susan Bergtold, for her consistent support, patience, and motivation during the writing and research of this thesis.

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Acronyms

ACP	African, Caribbean, and Pacific States
CERDI	Centre d'Etudes et de Recherches sur le Développement International
CNIA	Comite National Interproffesionnel de L'Arachide
EU	European Union
FTA	Free Trade Area/Arrangement
GAMS	General Algebraic Modeling System
GOS	Government of Senegal
GSP	Generalized System of Preferences
IF	Investment Facility
IMF	International Monetary Fund
LDC	Lesser Developed Country
MERCOSUR	Mercado Común del Sur
NIP	National Indicative Program
NOVASEN	Nouvelles Arachides de Sénégal
NPA	New Partnership Agreement
OPS	Organismes Privés Stockeurs
REPA	Regional Economic Partnership Agreement
ROW	Rest of World
SESRTCIC	Statistical, Economic, and Social Research and Training Centre for Islamic Countries
SONACOS	Société Nationale Commericalisation des Oléagineaux du Sénégal
SONAGRAINES	Société Nationale d'Approvisionnement on Graines
STABEX	Stabilisation des Recettes d'Exportation
SWOPSIM	Static World Policy Simulation Modeling Framework
SYSMIN	System for Safegaurding and Developing Mineral Production
US	United States
WAEMU/UEMOA	West African Economic and Monetary Union
WTO	World Trade Organization

Chapter 1: Introduction

1.1 Introduction

Increased trade liberalization around the world has led the European Union (EU) and African, Caribbean, and Pacific (ACP) states to the negotiating table to correct the inefficiencies of past agreements. The new partnership agreement (NPA), or Cotonou Convention, between the ACP states and the European Union is the first step toward replacing the fourth Lomé convention, which expired in February 2000. The central objective of the NPA is to reduce and eventually eradicate poverty in the ACP states, while maintaining sustainable development as the ACP states are integrated into the global economy (Eurostep, 2000). In the agreement, regional integration is stressed as the primary tool for the integration of the ACP states into the global economy. By building on present regional integration initiatives in the ACP countries, the NPA will establish regional economic partnership agreements (REPA) or some other form of economic arrangement that will meet with the central objectives of the NPA, such as an 'enhanced' form of the Generalized System of Preferences (GSP) (Eurostep, 2000). The term 'enhanced GSP' refers to lower import duties on products covered by the GSP and/or the introduction of some form of differentiation by country of origin, e.g. through a vulnerability index (Kuster and Becker, 1999).\

In 2004, the EU will conduct a preliminary assessment of those ACP countries not classified as least developed countries (LDC) to see whether they are willing and able to establish a REPA with the European Union. The REPA would consist of a free-trade area (FTA) between one of six proposed ACP regional blocs (e.g. the West African Economic and Monetary Union (WAEMU/UEMOA)) and the EU. The FTAs would substantially liberalize trade in all sectors, and would cover eighty to ninety percent of all products currently traded between the EU and the ACP states. Developmental and investment initiatives similar to those under the previous conventions would remain, but would be administered at the regional level (McQueen, 1999b). If any of the ACP countries are unable or unwilling to establish a REPA by 2008, then alternative economic arrangements with the EU will be made. The most likely arrangement is a move to some enhanced form of the GSP, a system of non-negotiable non-reciprocal trade preferences that are unilateral for all developing countries.

For Senegal, a member of the ACP and of the WAEMU, the decision to enter into a REPA or an enhanced form of the GSP in 2004 is of vital importance for its groundnut sector. This sector accounts for a considerable amount of Senegal’s export earnings and economic welfare. Currently, Senegal has preferential access under the provisions of the fourth Lomé Convention. These provisions are made up of non-reciprocal trade preferences and five

commodity protocols that grant the ACP states a preferential position in comparison to other developing nations who are currently under the GSP (McQueen, 1999b).

Any changes in trade policies with the EU that change the relative position of the Senegalese economy in the international marketplace could have a significant effect on its groundnut sector, by altering their margin of preference or decreasing their international competitiveness. Currently, twenty-one percent of Senegalese exports to the European Union are in some form of groundnut product, i.e. groundnut oil, groundnut meal, and confectionery groundnuts (McQueen, et al., 1997a). Furthermore, groundnut and fishery products account for 35% of the country's export earnings (Zanin and Ba, 1999a), and 74% of its exports of groundnuts for human consumption in 1995 went to the EU (World Trade Organization, 1999).

Senegal's primary groundnut export to the European Union is groundnut oil. In the face of decreasing prices and decreasing margins of preference, the preferential position they have in the EU groundnut oil market is being threatened. This margin of preference is defined as the percentage difference between the import tariff Senegal is subject to under the Lome Convention and the import tariff rate faced by its competitors. Senegal currently enjoys a margin of preference on groundnut oil of 4.5% compared to Argentina, its largest competitor, which is subject to the GSP (European Commission, 1999a). In addition, Senegal's margin of preference has allowed the country to provide 48% of groundnut oil imports to the EU compared to Argentina, which provides 21% (European Commission, 1999a). An enhanced GSP could decrease Senegal’s margin of preference, making Argentina more competitive in the international marketplace. Their competitive advantage is further threatened by the likely formation of a free trade area between MERCOSUR (of which Argentina is a member) and the EU in the near future (Page, 2000).

The implementation of a regional economic partnership agreement could be the most beneficial option for Senegal, if their trading position, with respect to groundnuts, does not change in the international marketplace. The move to a REPA would not change Senegal’s current position in the international groundnut market, because there are no duties on Senegalese groundnut products under the current Lomé Convention (European Union, 1999). On the other hand, if another net-exporter of groundnut-oil, for which Senegal has a competitive advantage, becomes more competitive due to changes in the GSP, the margin of preference Senegal currently enjoys would decrease. This decrease could leave Senegal worse off than under the status quo. It is important therefore to examine possible future trade arrangements between the EU and Senegal's competitors (e.g. the Argentina example mentioned above), as well as, other parts of the

NPA and domestic policies that could have an economic impact on Senegal, during the implementation of a REPA.

The enhanced GSP option could make Senegal worse off by eliminating any margin of preference they currently enjoy under the Lomé Convention (i.e. on groundnut oil) thus jeopardizing their current competitive advantage in the world groundnut market. Senegal might benefit from lower import tariff rates and differentiation under an enhanced GSP, but the loss of their competitive advantage in the status quo would be significant obstacle to overcome. The term differentiation implies that tariff levels would become dependent on the economic level of development of the country and its preferential position with the EU (Kuster and Becker, 1999).

There are a number of issues, with respect to the Senegalese groundnut sector, that could affect Senegal's decision to move to a REPA or some enhanced form of the GSP. These issues relate to development funding and investment programs from the past Lomé Conventions that will continue under the NPA and structural adjustment policies initiated in the early 1980s in the Senegalese groundnut sector.

The first issue deals with the *Stabilisation des Recettes d'Exportation* (STABEX) program, a component of the previous Lomé Conventions. STABEX was used as a tool to compensate for losses in export earnings, primarily on agricultural commodities from the ACP states, due to external shocks outside of the ACP economies, e.g. a fall in world commodity prices (Aiello, 2000). STABEX funds were to be used to stabilize farmer's/producer's incomes and for export diversification efforts in the sectors that were affected by these external shocks, e.g. the groundnut sector in Senegal (European Commission, 1997b). Senegal is the third largest recipient of STABEX funds, receiving 7.37% of $4.35 billion issued under the past four Lomé Conventions (Aiello, 2000). Senegal has used STABEX funds for investments in confectionery groundnuts, income stabilization, structural adjustment policies, seed programs, credit programs, and capital investment projects in its groundnut sector (Gueymard, 2000).

Under the NPA, STABEX will be replaced by a grant envelope, which will cover a broader range of funding needs. Developmental funds from the grant envelope can be used for export stabilization, macroeconomic support, sectoral programs, etc. (European Commission, 2000b). Given the historical pattern of the application of STABEX funds by the Senegal government, the future application of development funds under the grant envelope needs to be analyzed. Further investments into the confectionery groundnut sector are of primary importance for the future vitality of Senegalese exports, due to the decline in the world demand for groundnut oil (World Trade Organization, 1998).

The second issue deals with the importance of direct investments made by the European Union. Continuing these types of investments in the areas of transportation and export diversification are critical for the future development of the groundnut sector in Senegal. Investments in the transportation sector in Senegal are important to analyze, given the success of policy-based investment approaches by the EU under past agreements (European Commission, 1997a). Investments in export diversification have been primarily in the area of confectionery groundnuts, more precisely in the stabilization of prices during the development of new confectionery groundnut varieties that will meet higher EU food safety standards (Gueymard, 2000; European Commission, 1997a; World Trade Organization, 1999). The economic impact of these investments needs to be analyzed due to their important role in the Senegalese groundnut sector.

The final issue deals with the structural adjustment policies required by the International Monetary Fund (IMF) and World Bank that have been instituted in Senegal since the early 1980s. A primary goal of these policies is the privatization of publicly owned industries. One firm affected by this goal is *Société Nationale Commercialisation des Oléagineaux du Sénégal* (SONACOS), a company held jointly by public and private owners. SONACOS controls a large share of the groundnut market in Senegal, since it is the primary producer and seller of groundnut oil (Kelly, et. al., 1996). SONACOS is now for sale, and the privatization of this firm could have a significant effect on pricing policies in the groundnut sector (Zanin and Ba, 1999a). Currently, groundnut prices are set by *Comite National Interprofessionnel de L'Arachide* (CNIA), an interprofessional board of state organizations and private entities, but as control of the sector moves from the state to the private sector, the price for groundnuts could become market determined, instead of negotiated (Gaye, 2000b). The impact of this transition needs to be analyzed given the importance of these structural adjustment policies in the Senegalese groundnut sector.

1.2 Purpose Statement

With the expiration of the Lomé Convention in February 2000, a New Partnership Agreement between the EU and ACP states was signed (by Senegal) in June 2000. According to the NPA, Senegal must decide to enter (as a member of the WAEMU) into a Regional Economic Partnership Agreement with the EU or move to an enhanced form of the Generalized System of Preferences. Thus, the purpose of this study is to examine the economic impact of a change in non-reciprocal trade preferences on groundnut products under the fourth Lomé Convention to either a REPA or an enhanced form of the GSP under the NPA.

This examination will take into account alternative trading arrangements that could further impact Senegal's decisions to enter into a REPA or enhanced GSP. Future trading arrangements between the European Union and Senegal's competitors in the international groundnut market will have a direct impact on Senegal's margin of preference, affecting their competitive advantage. The FTA being negotiated between Argentina (as a member of MERCOSUR) and the EU and the lowering of import tariffs for countries currently subject to the GSP are the two arrangements examined in this study.

Finally, the effects of development funding, direct investments by the EU, and structural adjustment policies in conjunction with the two options under the NPA are examined. Given the application of STABEX funds by Senegal in the past, increases in development funding could help offset any adverse economic impacts of the REPA or enhanced GSP. In addition, direct investments by the EU in the Senegalese transportation sector could have the same offsetting effect. Due to the institution of structural adjustment policies, there is a push for privatization of publicly held firm in the Senegalese groundnut sector. These privatization efforts could lead to domestic market liberalization in the groundnut sector, i.e. the producer price would no longer be determined by CNIA, but by the market.

1.3 Research Objectives

The following research objectives will be addressed in this study:

1. To measure the economic impact of the REPA and enhanced GSP options by examining the direct effects of both options on Senegalese groundnut consumption, production, and exports and the welfare effects on consumers and producers.

2. To measure the economic impact of the REPA and enhanced GSP options in conjunction with the FTA being negotiated between MERCOSUR and the EU and the lowering of tariff rates for countries currently subject to the GSP.

3. To determine if increases in development funding or further investments into Senegal's transportation sector can offset any adverse economic impacts of the REPA or enhanced GSP options.

4. To measure the economic impact of the REPA and enhanced GSP options in conjunction with domestic market liberalization in the Senegalese groundnut sector.

1.4 Methods of Examination

Three distinct steps are taken to achieve the research objectives discussed in the previous section.

Step 1: Market Analysis and Data Collection -- In Chapter 2, a detailed market analysis of the Senegalese groundnut sector is conducted to gain a deeper understanding of the groundnut market for all three commodities being examined in the study. This analysis provides a qualitative background and delves into the structure of the market and into issues that have an affect on the outcome of the model, but could not be modeled completely. The results of the model are later examined in the context of this qualitative analysis. Chapter 2 also provides a more detailed description of the fourth Lomé Convention, the new partnership agreement (e.g. The Cotonou Convention), and the international groundnut market to further supplement this analysis.

Data were collected primarily from secondary sources. These secondary sources include Oil World, Eurostat, various Senegalese government institutions, the EU Commission, and government institutions of the other regions examined in the model discussed below. All data are summarized in Appendix A of the paper.

Step 2: Construction of the Empirical Model -- The base model is a nine-region, three-commodity, partial-equilibrium model. The nine regions are Argentina, China, EU, India, Nigeria, Senegal, Sudan, the United States and the Rest of World. The three commodities are groundnuts (in-shell and shelled), groundnut meal, and groundnut oil. These commodities are actually large product categories that subsume a number of groundnut products under each category (e.g. peanut butter and peanut paste are included in the groundnuts product category). The regions were chosen due to the level of trade with the European Union in each commodity category and the effect they would have on Senegal's margin of preference. To relax some of the implicit assumptions of the model, special pricing and other constraints are used in Senegal's supply, demand, and pricing relationships to model the inefficiencies present in the market that were prevalent prior to the structural adjustment programs in the 1980s.

The empirical model has some integrability problems as a result of non-symmetric cross-price elasticities in the demand and supply equations, the use of ad-valorem tariffs in the pricing equations, and the functional form chosen for the supply and demand equations. These problems are alleviated by using a mixed complementarity programming approach, which does not explicitly require the use of an objective function in the model. This approach allows the pricing and quantity variables to both be endogenously and simultaneously determined by the model. This approach is discussed further in Chapter 4.

Step 3: Examination of the REPA and enhanced GSP Options -- A preliminary examination of the REPA and enhanced form of the GSP options is conducted in Chapter 3 to motivate the construction of the empirical model and the cases to be examined by the simulation of the model in GAMS, under each option. The results of these simulation runs are examined in Chapter 5, with the help of the qualitative analysis mentioned above. The examination of these cases includes investment issues and structural adjustment in the Senegalese groundnut sector. Chapter 5 summarizes the results of the model, and Chapter 6 provides conclusions about which option is the most economically feasible and beneficial to the Senegalese groundnut sector.

Chapter 2: Historical Background and Overview

This chapter provides historical background on the Senegalese groundnut sector and past Lomé Conventions, and a detailed overview of the Senegalese groundnut market(s) and New Partnership Agreement. Section one takes a brief look at the world groundnut market and pertinent developments in the international arena that could affect Senegal's decision, in 2004. Section two then focuses on the Senegalese groundnut sector specifically, providing a historical and structural overview of the sector. In addition, this section identifies pertinent issues that could affect Senegal's decision to move to either a REPA or an enhanced form of the GSP. These issues include structural adjustment policies, aflatoxins, the informal sector, and STABEX funding. The third section provides a historical analysis of the past Lomé Conventions and unresolved issues arising from them, such as STABEX and preferential access for the ACP states. Finally, section four of the paper gives an in-depth analysis and description of the NPA, including a detailed analysis of the REPA and enhanced GSP options.

2.1 Overview of the World Groundnut Market

Groundnuts are a staple, as well as, a cash crop in primarily tropical and sub-tropical developing countries around the world. World groundnut production in the crop year, 1997-1998, was twenty-seven million tons, China and India being the two largest producers in the world (Provance, 1998). The next largest producers in 1997-1998 were the United States, Nigeria, Indonesia, Senegal, and Argentina, (Provance, 1999) in order of importance. African countries accounted for less than eight percent of world production, never exceeding this amount in the last decade due to unreliable rains, lack of irrigation, small scale farming, lack of capital, outbreaks of pests, diseases, low yielding seed varieties, and high-density seeding on marginal lands. For these reasons, African production has been sporadic, fluctuating greatly from year to year (Business News, 1999).

To help combat these problems, improved groundnut varieties developed for specific purposes and growing conditions are being adopted in a number of countries. This research is ongoing for confectionery varieties in the Senegalese groundnut sector. Different groundnut varieties are being produced that are more resistant to aflatoxins and are of higher quality for consumption purposes. In other areas of the world, edible groundnut varieties are being produced specifically for the production of a particular product, such as peanut butter, groundnut oil, candies, salted nuts, roasted nuts in-shell, and cocktail. Furthermore, other types of groundnut varieties are being produced that have characteristics to help combat problems encountered while

growing the groundnut crop. These characteristics include: higher yields, early maturation, resistance to drought, disease and pest resistances, suitability for mechanized harvesting, adaptation to specific soil types, and others (Business Star, 1999).

The EU is the largest importer of groundnut products in the world, and Table 2.1.1 provides import data on groundnuts (in-shell and shelled) and groundnut oil for the EU from 1995 to1998. EU imports account for 42% of the world groundnut trade, followed by Indonesia (13%),

Table 2.1.1 Exports of Groundnuts (In-shell/Shelled) and Groundnut Oil by Region to the EU, 1995 – 1998. (MT)

	Groundnuts (In-Shell/Shelled)				**Groundnut Oil**			
Region	1995	1996	1997	1998	1995	1996	1997	1998
Argentina	95,593	179,300	103,000	223,400	41,200	49,100	54,000	36,400
China	139,251	135,173	96,041	102,694	800	76	17	12
India	17,303	27,405	46,889	45,832	0	0	0	0
Nigeria	0	186	308	127	4124	3695	18,561	7384
Senegal	4609	4345	3238	4576	77,113	63,312	44,085	46,237
Sudan	4200	1400	3500	5000	11,300	13,400	45,500	44,6
U.S.	229,907	146,120	150,477	119,621	17,140	21,908	1899	1000
ROW[1]	58,482	58,582	58,753	86,429	23,832	16,559	40,344	54,596

Source: Eurostat, 2000; ISTA Mielke GmbH, 2000
[1] ROW = Rest of World

Canada (8%), Singapore (5%), Malaysia (3%) and the Philippines (3%). The seven largest exporters of groundnut products are Argentina, then India, the United States, China, Vietnam, South Africa, and the Gambia. Eighty percent of the world groundnut trade is in edible groundnuts, with the remaining 20% in other products, such as meal or oil (Business Star, 1999). Exports of groundnuts only account for about six percent of total groundnut production, with export sales less then one billion dollars per year. This suggests there is room for export growth. To increase exports of groundnuts, two major challenges need to be addressed. The first is the issue of aflatoxins, which has become a growing concern, especially in the EU. The second is the adaptation of groundnut supplies to the demand for groundnut varieties suited to specific end - uses (Business Star, 1999).

Consumption and production patterns for groundnut products vary from country to country. Forty-eight percent of groundnut products are for food uses, and the remaining 52% is

crushed for use in oil and meal production. The United States primarily produces groundnuts for food uses (60 %) and exports one fifth of their groundnut crop. Argentina and South Africa chiefly export their crop in the form of edible products, oil or cake. In contrast, Vietnam produces groundnuts to replenish soil fertility and as a cash crop, providing income for farmers. Asian countries consume their groundnuts largely in the form of gravies and sauces and in Europe groundnuts are mainly consumed as edible products, such as dry-roasted or specialty nuts, peanut butter, etc (Business Star, 1999). In Africa, domestic demand for groundnut products has increased, but by less than expected, due to the import and increased production of substitutes, such as soybean and palm oil. In the past, groundnuts were primarily produced for export revenue and provided rural employment in African countries. Today, the production of groundnuts in African countries, such as Nigeria, is also a significant contributor to the domestic food supply (Badiane and Kinteh, 1994). To increase exports of groundnut products in the future these consumption patterns need to be recognized. New varieties need to address quality issues that have arisen in the international market, such as concerns over aflatoxins levels.

Appendix A provides statistics and data on the major exporters of groundnut products to the EU: Argentina, China, India, Nigeria, Senegal, Sudan, and the United States. The data in Appendix A is for three primary groundnut product groups: groundnuts (in-shell and shelled), groundnut oil, and groundnut meal. Data provided consists of elasticities, production and consumption statistics, prices, transportation costs, and inter-country trade data.

2.2 Senegal

The groundnut sector in Senegal is vital to the well-being of the Senegalese economy. The bulk of the groundnut crop is farmed in the Senegalese groundnut basin, which accounts for thirty-five percent of Senegal's land mass. The basin provides 80% of groundnut export production, as well as sustenance for sixty-five percent of the population (Kelly, et al., 1996). Furthermore, about seventy percent of the population is involved in some facet of groundnut production (Kelly, et al., 1996). Up to one million, out of a population of 8.2 million, are involved just in the farming of groundnuts (Akobundu 1998; U.S. Department of State, 1999). This high percentage of people involved in the groundnut sector is due to the fact that groundnuts are Senegal's main agricultural cash crop. Groundnut production and export provide household income, government revenue, and foreign exchange (Kelly, et al., 1996). Rural households and the government have "cashed in" on groundnuts by shifting agricultural production away from sustenance crops to cash crops, primarily groundnuts (Kelly, et al., 1996). This shift has occurred

over the past few decades, since Senegal's independence in 1960. (Groundnut production and consumption statistics for Senegal are provided in Appendix A, Section A.2.6.)

2.2.1 Historical Background

Since Senegal's independence in 1960, the government of Senegal (GOS) has had significant control over many aspects of the groundnut market. During French colonial rule prior to the 1960s, Senegal was transformed into a groundnut-producing machine. Upon Senegal's independence, the groundnut industry was nationalized and came under public control. This sudden spark of nationalization arose from the view that the groundnut sector was going to "save the country" (Akobundu, 1998). From 1960 to 1965 much of the groundnut industry was nationalized, i.e. research and development, extension services, peanut marketing and input distribution practices, credit programs, and price-setting were all activities now controlled by the GOS. Peanut marketing by anyone except the state was made illegal. During this period, groundnut prospects seemed good as output increased due to increased planting, and productivity rose due to increased access to credit and price subsidies instituted by the government. Government involvement introduced a relative certainty to groundnut production, while at the same time causing a relative uncertainty in the production of cereals and other crops (Kelly, et al., 1996).

From 1965 to 1974 the situation changed in the groundnut sector. Lower peanut prices and recurring droughts cut into gains made in the early 1960s. The price decline was primarily due to France's decision to remove its preferential pricing agreement for Senegalese groundnut products. The decline in the price of groundnuts from 1960/61 to 1970/71 is illustrated in Table 2.2.1. These difficulties in the peanut sector led to debt defaults by farmers that worsened as 1980 approached, providing evidence that government involvement in the groundnut sector was not efficient. It was believed, however, lower prices and the droughts were to blame for the worsening situation. Thus, up until the late 1970s, the marketing parastatals controlled by the government escaped blame (Kelly, et al., 1996). By the late 1970s, the inefficiencies in the groundnut sector were evident, and the focus turned to the effects of government involvement in the sector.

After a brief improvement in the groundnut sector from 1975-6, credit defaults began anew and grew worse as the decade progressed (Kelly, et al., 1996). During the period from 1977 to 1980 debt defaults increased. During the latter period, it was thought that the rural sector did not have the ability to make profitable economic decisions, providing justification for continued

Table 2.2.1 Producer Price for Groundnuts in Senegal 1960 – 2000 (CFA Francs/KG)

Year	Producer Price	Year	Producer Price	Year	Producer Price
1960/61	22	1974/75	41.5	1987/88	90
1961/62	22	1975/76	41.5	1988/89	70
1962/63	21.5	1976/77	41.5	1989/90	70
1963/64	21.5	1977/78	41.5	1990/91	80
1964/65	21.5	1978/79	41.5	1991/92	80
1965/66	21.5	1979/80	45.5	1992/93	70
1966/67	20.5	1980/81	44	1993/94	100
1967/68	18	1981/82	60	1994/95	120
1968/69	18	1982/83	50	1995/96	125
1969/70	18.5	1983/84	50	1996/97	150
1970/71	19.5	1984/85	60	1997/98	150
1971/72	23.1	1985/86	90	1998/99	160
1972/73	23	1986/87	90	1999/2000	145
1973/74	29.5				

Sources: Lopez and Hathie, 1998; Kelly, et al., 1996; Senegal, 2000a.

government involvement. Prior to 1978, the Senegalese government had been taxing the agricultural sector, but by 1978 the government was subsidizing the sector due to the high rates of debt default. These high rates of default, coupled with the difficulties mentioned above, led to severe public finance and balance of payment problems and an institutional crisis (Kelly, et al., 1996; Martin and Crawford, 1991).

The era of structural adjustment began in 1980, and adjustment efforts are still in progress. During 1980, the GOS was pressured internationally to institute agricultural reforms with the help of the World Bank and International Monetary Fund (IMF). The goals of these reforms were to:

> "(1) curtail direct government intervention in the agricultural sector, while encouraging private sector actors(both commercial and cooperative) to fill the gap; and
> (2) eliminate government subsidies and taxes to the greatest extent possible." (Kelly, et al., 1996: 18)

These new policies impacted all actors in the groundnut sector: government institutions, farmers, the private sector, and input manufacturers. The government retained control over the setting of producer prices and commercial margins.

The New Agricultural Policy was enacted in 1984, attempting to liberalize and privatize output and input markets, but was only partially successful. *Société Nationale Commercialisation des Oléagineaux du Sénégal* (SONACOS), the largest government entity in the groundnut sector and the primary producer of groundnut oil is yet to be privatized (Kelly, et al., 1996; Zanin and Ba, 1999a). However, most of the credit and subsidy programs provided by the government prior to 1980 were either eliminated or drastically altered. The elimination/alteration of these programs changed the face of the groundnut market, reducing the amount of inputs used by farmers (Akobundu, 1998). The reduction in input use was especially evident in the decreased use of seed, fertilizer and sustainable agricultural techniques during the 1980s (Kelly, et al., 1996). Thus, changes in input use made reforms under the New Agricultural Policy detrimental to the Senegalese groundnut sector. The only part of the sector that saw an expansion during this time was in the area of confectionery groundnuts due to increased research and extension efforts. As will be discussed below, the continuation of research and development in the confectionery groundnut market is vital to the competitiveness of Senegalese groundnut in the international market.

Overall, during the 1980s and the early 1990s, the production of groundnuts was lower than during the height in the 1960s. The decrease in groundnut production in the 1980's and 1990's is illustrated in Table 2.2.2. Due to decreasing prices for groundnut products internationally and a decreasing demand on the world market, the Senegalese government has not been able to restore the former glory of the groundnut sector that existed during the 1960s. Massive government involvement in the past led to a lack of private enterprise and experience, making many of the structural adjustment programs less than effective. In addition, these programs were put into effect too rapidly due to pressure by the international community, leaving no time for adjustment to the new policies being instituted in the sector (Kelly, et al., 1996). Thus, results up to the present day have been less than desirable, and the Senegalese groundnut sector continues to struggle to get back on its feet.

During the 1990s, Senegal began to recover from these structural adjustment policies, and a devaluation of the CFA Franc in 1994 helped the sector. Privatization efforts are still under way, especially with respect to SONACOS, and an interprofessional committee made up of government, private, and cooperative officials is now setting the producer price of peanuts (Gueymard, 2000).

Table 2.2.2 Groundnut Production (MT) by Farmers in Senegal, 1960 – 1999.

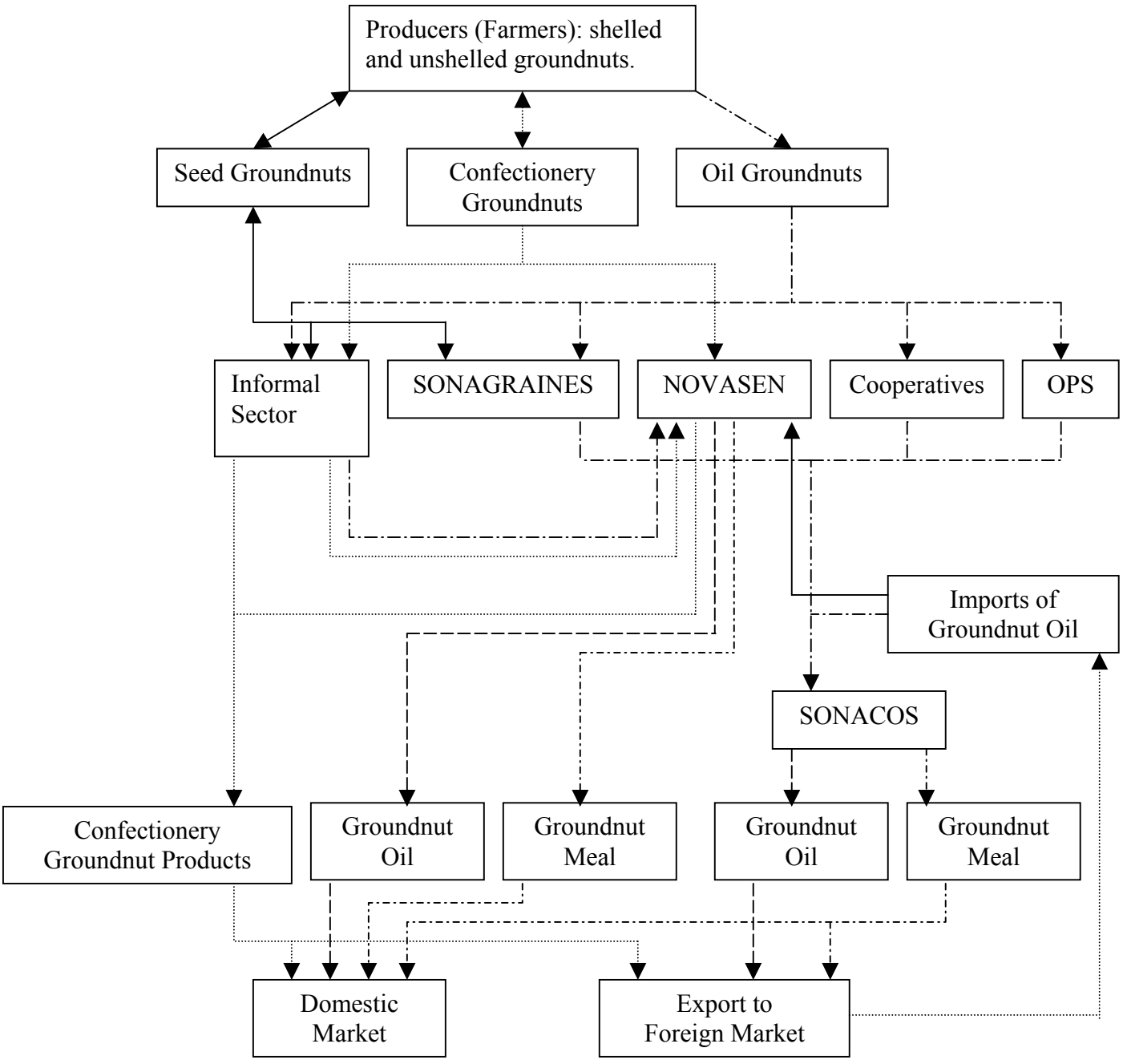
Year	Production (MT)	Year	Production (MT)	Year	Production (MT)
1960/61	892,494	1974/75	980,723	1987/88	946,445
1961/62	994,750	1975/76	1,434,147	1988/89	703,362
1962/63	893,862	1976/77	1,186,322	1989/90	819,641
1963/64	952,201	1977/78	509,285	1990/91	678,699
1964/65	1,019,088	1978/79	1,050,641	1991/92	697,329
1965/66	1,122,025	1979/80	672,887	1992/93	551,690
1966/67	857,056	1980/81	521,386	1993/94	605,766
1967/68	1,005,151	1981/82	866,624	1994/95	678,040
1968/69	819,592	1982/83	1,145,401	1995/96	790,617
1969/70	788,800	1983/84	570,488	1996/97	588,182
1970/71	582,000	1984/85	669,231	1997/98	505,894
1971/72	985,396	1985/86	590,499	1998/99	540,774
1972/73	570,010	1986/87	821,731	[redacted]	[redacted]
1973/74	657,026	[redacted]	[redacted]	[redacted]	[redacted]

Sources: Diop, 1995; Senegal, 2000.

2.2.2 The Groundnut Market.

Figure 2.2.1 is a flowchart that maps out the distribution channels through which groundnut products flow in Senegal. The figure shows the primary distribution channels beginning at the farm-level, where the groundnut crop is produced. There are three primary types of groundnut crop produced: confectionery groundnuts, oil groundnuts, and seed groundnuts. In Senegal, these types are known respectively as *arachide de bouche*, *arachide huilerie*, and *arachide semences*. Using these three varieties of groundnut crop, one can trace the production and distribution of groundnuts from the farm level to the domestic and foreign markets, where they are consumed in the form of various groundnut products.

Figure 2.2.1 Market and Distribution Channels for Groundnut Products in Senegal



Sources: Akobundu, 1998; Gaye, 1996 and 2000; Kelly, et al., 1996.

The first major type of groundnuts is oil groundnuts, the primary crop produced by Senegalese farmers. Oil groundnuts are destined to be processed into oil, meal, soaps, vinegar and various other cleaning products (Gaye, 2000). Oil groundnuts are purchased by the government at the fixed producer price, through the farmer cooperatives, *Organismes Privés Stockeurs* (OPS), private sector agents, and *Société Nationale d'Approvisionnement en Graines* (SONAGRAINES), the national grain supply company. SONAGRAINES has been privatized under reforms instituted by the structural adjustment programs in the 1980s (Akobundu, 1998; Sarr, 2000). Oil groundnuts purchased by SONAGRAINES, OPS, and the farm cooperatives are then passed on or sold to SONACOS, the primary oil groundnut purchaser and groundnut oil producer in Senegal. Oil groundnuts are also imported by SONACOS from the Gambia for groundnut oil production (Gaye, 2000). In addition, oil groundnuts are purchased by the informal sector, directly from the farmers. The informal (or unofficial) sector is a grey market, where the actors operating in the market are not certified or legally recognized by the GOS (Gaye, 2000; Fidler and Webster, 1996). *Nouvelles Arachides de Sénégal* (NOVASEN), a recently privatized subsidiary of SONACOS that deals primarily with the confectionery groundnut sector, has been known to purchase oil groundnuts from the informal sector to produce groundnut oil for domestic consumption (Gaye, 2000), and to import crude groundnut oil for further processing to sell on the domestic market for edible consumption (Ndiaye, 2000).

The second major type of groundnut crop is confectionery groundnuts. A considerable portion of the confectionery groundnut crop is kept for auto-consumption by the farmers. The rest is made primarily into paste, edible groundnut products, and peanut butter. The primary processor of these confectionery groundnut products is NOVASEN. They have cornered the confectionery market by providing credit and the inputs needed to grow confectionery groundnuts by farmers. These farmers are under contract to sell to NOVASEN, ensuring a supply for further processing (Akobundu, 1998; Gaye, 2000). In addition, confectionery groundnuts are purchased by the informal sector. Some of these are then sold to NOVASEN for further processing and the rest are distributed to urban areas of the country for resale (Gaye, 2000). The confectionery groundnut market is a vital component of the future of the Senegalese groundnut sector, given the investments made in the sector by the Senegalese government via development funds, such as STABEX.

The final type of groundnut crop produced is seed groundnuts, which are the most valuable, highest grade, and the least produced of all the different types of groundnuts. Low production has caused problems with the access of groundnut seed for farmers in Senegal (Akobundu, 1998; Kelly et al., 1996). Seed groundnuts are purchased by SONAGRAINES and

the informal sector for storage and resale the following year. Some seed groundnuts are also stored and inventoried by the farmers, when not under obligation to sell their crop by contract to SONAGRAINES or to private agents in the informal sector (Gaye, 2000; Kelly, et al., 1996). Seed groundnuts are completely produced and consumed in the country.

Oil groundnuts are processed by SONACOS and NOVASEN into two primary groundnut products, groundnut oil and groundnut meal. Statistics for the production, consumption, and export of groundnut oil and meal can be found in Appendix A, Sections A.2 and A.3. Figure 2.2.1 shows that groundnut oil and meal are both sold on the domestic market and exported to foreign markets. SONACOS exports the majority of their groundnut oil and a significant portion of meal to the European Union. Under Lomé, groundnut meal and oil enter the EU duty free, thus making the EU market more desirable then other foreign markets, which include other countries in West Africa, Russia, and the United States (ISTA Mielke GmbH, 2000). NOVASEN produces and sells all of their groundnut oil on the domestic market, which is of a higher grade for edible consumption, while SONACOS primarily produces crude groundnut oil for industrial uses (Gaye, 2000; Eurostat, 2000). Exports of groundnut oil and groundnut meal to the EU from 1995 – 1999 are indicated in Table 2.2.3. This table shows not only that Senegal provides a significant percentage of the groundnut meal and oil to the European Union, but provides evidence of the distinct competitive advantage Senegal has under the current Lomé Convention. Table 2.2.3 also illustrates that a significant amount of the production of groundnut oil and meal is exported, which may be due to the fact that SONACOS is publicly held and the export of groundnut oil and meal provides government revenue, as well as, foreign exchange.

Table 2.2.3 Senegalese Groundnut Oil and Meal Exports to the EU, 1995-1999 (1000 MT)

	Groundnut Oil			**Groundnut Meal**		
Year	Quantity Exported	% of Total EU Imports	% of Senegal's Production	Quantity Exported	% of Total EU Imports	% of Senegal's Production
1995	77.113	44.04 %	87.63 %	83.7	44.38 %	79.71 %
1996	63.312	37.67 %	71.95 %	75.4	32.81 %	71.81 %
1997	44.085	21.58 %	83.18 %	35.4	16.09 %	56.19 %
1998	46.237	24.31 %	87.24 %	37.5	18.37 %	59.52 %
1999	69	45.34 %	95.83 %	71.5	45.45 %	83.14 %

Source: Eurostat, 2000; ISTA Mielke GmbH, 2000.

Confectionery groundnuts, after being processed by NOVASEN into edible products, are sold both on the domestic market and exported to the European Union. Due to the decrease in the world demand for groundnut oil, the confectionery groundnut market is of even greater importance to the vitality of the Senegalese groundnut sector. Significant portions of STABEX funds are being utilized for the development of higher-grade confectionery groundnut varieties in Senegal that will be able to meet higher aflatoxin standards set by the EU (Gueymard, 2000). Currently Senegal provides a very low percentage of the exports of confectionery groundnuts to the EU (see Appendix A), but with further research and new investments going into the sector, via funds provided by the government and STABEX, Senegal hopes to become more competitive internationally in the confectionery market.

2.2.3 The Producer Price for Groundnuts

The producer price for groundnuts was set exclusively by the Senegalese government until 1996. The price setting changed when an agreement made between the governments of Senegal and the EU, stipulated that the producer price was to be set by an interprofessional committee, representing a number of interests in the groundnut sector (Berg, et al., 1997). Now an institution, known as *Comite National Interprofessionnel de L'Arachide* (CNIA), which is an interprofessional committee made up of governmental, SONACOS, private sector, and farmer cooperative representatives, has the task of determining the producer price for groundnuts in March of each year (Gaye, 2000; Senegal 2000b).

In the past, the government set the producer price lower than the prevailing international market price, thus providing a significant portion of government revenue by retaining the difference between the producer price and prevailing international market price (Claassena and Salin, 1991). In some instances, the international price fell below the set producer price, and in those cases, the Senegalese government ended up subsidizing the groundnut sector. Farmers have reacted to the former by selling on the informal market and defaulting on debts (Claassena and Salin, 1991). Furthermore, it is argued that this price setting has made farmers less responsive to the producer price for groundnuts, since they are guaranteed the price set by the government each year. Thus, the production of groundnuts provides a certain guaranteed income. This price guarantee has strengthened the position of groundnuts as the primary cash crop in Senegal (Berg, et al., 1997; Gaye, 2000).

The likelihood of the producer price being set by the market in the near future is very low due to the importance of the crop for Senegal and the political nature surrounding the issue. The current situation could change, given the push for the privatization of publicly held industries and

services in the sector. Currently, SONACOS is yet to be sold since being placed on the auction block in 1999 (OT Africa Line, 1999). The privatization of SONACOS will mark an end to primary government ownership of firms in the groundnut sector, and could eventually lead to complete market liberalization, as government influence declines in the sector. In addition, the informal sector is beginning to merge with the formal sector of the economy as more private traders (such as NOVASEN) purchase groundnuts in informal markets (Gaye, 2000). The informal sector is currently limited to domestic consumption not provided by the government and due to the setting of the producer price for groundnuts this market is more volatile, since farmers can get a guaranteed income by selling to the formal sector (Berg, et al., 1997). Intervention by private firms could begin to stabilize this volatility by formalizing the informal markets. This intervention coupled with the move to privatize the groundnut market could eventually push the GOS to allow the producer price for groundnuts to be determined by the market and not by CNIA. Before such a move could occur, there are some significant political hurdles that need to be overcome, e.g. the effect a market determined price would have on government revenues.

The change to a market determined price in the groundnut sector could have an impact on a move either to a REPA or to an enhanced form of the GSP by absorbing some of the impact of the move. Any impact would likely be in the long run given the relatively new presence of private enterprise in the groundnut sector and these new private firms tend to be risk averse (Martin and Crawford, 1991).

2.2.4 The Informal Sector

The government of Senegal established the nationalized part of the groundnut sector to primarily purchase and process shelled groundnuts. The unshelled groundnuts are left to be sold in the informal sector, or consumed by local farmers. (Groundnuts are not only a cash crop, but consumed at home, which means that farmers absorb part of the groundnut crop at the farm-level.) The local demand for unshelled groundnuts has yet to really catch the attention of the Senegalese government, so it has fallen to the informal sector to satisfy local demand. Most of this local demand comes from the cities and northern parts of the country (Gaye, 2000). The informal sector comprises mostly the sales of unshelled peanuts that can be transformed into paste and other products and sent to other parts of the country (primarily urban), across the border, or used as seed for the following year (Claassen and Salin, 1991). In addition, as mentioned above, the informal sector also sells some of its surplus to private industry, such as to NOVASEN. This surplus arises due to the higher price paid in the informal sector (Berg, et al., 1997). Some of the surplus is lost though, when firms in the formal sector coupled with a guaranteed price offer other

incentives such as credit and seed (Gaye, 2000). This lack of surplus makes this kind of trade in the informal market highly volatile given the changing nature of the Senegalese groundnut sector under structural adjustment.

The informal sector should be considered in any study conducted on the Senegalese groundnut sector, but it is difficult to quantify the impact of this sector on the Senegalese economy. This difficulty arises, since the exact size of the informal sector for any given year is difficult to determine, given the lack of data availability. An estimate of the amount of groundnut crop that is absorbed by the informal sector for any given year has ranged from 9% to 25% (Gaye, 2000).

2.2.5 The Confectionery Groundnut Market and STABEX

With the decline in international demand for groundnut oil, Senegal has begun to look for ways to increase the competitiveness of the groundnut sector in the confectionery market. The government in 1997 announced the objective of increasing the cultivated land used for confectionery groundnuts from 59,000 hectares to 100,000 hectares. This increase was to be accomplished by further developing irrigated farming, instituting a 3 billion CFA Franc triennial investment program, instating a 5.2 billion CFA Franc price stabilization fund with the EU, and conducting research into higher grade confectionery groundnut varieties (World Bank, 1998). The research into new varieties of groundnuts is due to the heightened aflatoxins standards of the EU, which Senegal does not currently meet (World Bank, 1998). The investments and research being made in the confectionery groundnut sector are funded primarily from STABEX funds (Gueymard, 2000), provided under the Lomé Conventions.

STABEX-type or developmental funds are very important to the Senegalese groundnut sector (see also Chapter 1, Section 1.1), since all funds received from STABEX are invested in the sector. Table 2.2.4 provides a look at the distribution of the funds for the fiscal year 1996, which was totally disbursed by mid-year 2000. Currently, Senegal is receiving funds that were slated for use in 1997 (Gueymard, 2000). Table 2.2.4 provides some insight into the importance of use of the funds by the Senegalese government, especially in the confectionery part of the sector. After STABEX funds are discontinued in 2008, additional funds will be provided, but distributed regionally as a grant envelope to each designated ACP region, under the NPA (Gueymard, 2000). The infusion of development funds in the future via the grant envelope cannot be ignored when analyzing the impact of a REPA or an enhanced form of the GSP on the Senegalese groundnut sector. Future development funding could help offset any adverse impacts experienced by either option.

Table 2.2.4 Allocation of STABEX Funds in Senegal for 1996 (millions of CFA Francs)

Nature of Program	Amount of Funds Provided
Seed Program (includes for confectionery groundnut sector)	1769.5
Diversification of confectionery groundnut varieties	490
Usual channels	100
Restructuring efforts for SONACOS/SONAGRAINES	300
Price stabilization	1750
Future studies	217

Source: Gueymard, 2000.

2.3 The Lomé Conventions

The Lomé Convention has had an overriding influence on relations between the ACP states and the European Union. This close relationship started in the mid seventies, after the oil price shocks of 1973 made Europe aware of the need to safeguard its source of natural resources, while at the same time the Third World was expressing the need for a new world economic order. These circumstances led to the signing of the first Lomé Convention in 1975, which was a unique multilateral agreement that dealt with issues such as trade, development, compensation/ stabilization funds, and political stability. The agreement was organized around the central theme of economic and political partnership between the EU and ACP states, the first agreement of its kind to do so (Kappel, 1996). The EU has argued that the Lomé agreements need to be recast to account for the changing political and economic atmosphere in the world, as well as changed attitudes in the European Union (European Commission, 1996).

The three primary components of the past Lomé Conventions were: aid, political stability, and trade. The aid component of the Lomé Convention consisted of STABEX and SYSMIN (System for Safeguarding and Developing Mineral Production), in addition to regional and national financial support for various programs (e.g. building institutional capacities for future negotiations), debt relief, technical assistance and investments into infrastructure and production activities (Greenidge, 1997).

The political stability component was built around the aid and trade components of the Lomé Convention to ensure that the principles of democracy and human rights stated in the convention were adhered to by the ACP states in the interests of stability and security. To ensure this adherence, an “essential elements clause” was added to the fourth Lomé Convention, allowing the EU to suspend the Convention to any ACP state that did not act in accordance with

the principles of democracy, human rights, or the law stipulated in the convention (Raffer, 1997). In Senegal, STABEX funds are conditional on certain democratic and human rights stipulations made by the European Union, and when applying for funds Senegal must show these principles have been met (Gueymard, 2000).

The trade component of the Lomé Conventions consisted primarily of non-reciprocal trade preferences. These preferences were the trade advantages provided by the EU, to the ACP states. They provided exemptions to tariffs and other barriers meant to protect EU markets from harmful trading practices. Manufactured and industrial goods that met certain rules of origin could enter the EU duty free. Agricultural commodities that did not compete against domestic commodities could enter the EU duty free. These commodities include confectionery groundnuts and groundnut meal. All other agricultural commodities were subject to an import tariff level below that of the GSP, except for sugar, beef, veal, rum, and bananas, which were covered by certain commodity protocols (Koning, 1997; McQueen, 1999b). These protocols used duty free quotas with ceilings above which exports began to face restrictions.

Non-reciprocal trade preferences were used to promote export diversification and to increase the total share of ACP exports going to the European Union. These preferences have had relatively little impact, since ACP countries have shown no significant increase in exports or export diversification in the industries that are given preference under the Lomé Convention. The share of ACP exports has fallen over the last 20 years and is now the lowest among all countries exporting to the EU (Koning, 1997b). Non-oil exporting ACP countries lost 40% of their market share in the EU from 1970 to 1984, and the share of imports from 1975 - 1992 in the EU decreased from 6.1% to 2.9%, even with an increase in ACP membership from 46 to 69 members (McQueen, et al., 1997a). As a mechanism for trade creation the Lomé Conventions overall have not lived up to the EU's or ACP's expectations.

Most of the reasons attributed to such low ACP performance are supply-side factors, such as inadequate infrastructure, low levels of capital, lack of market know how, etc (European Commission, 1996). The ACP states are exporters of primary commodities with low-income elasticities of demand, making export growth difficult. These primary exports have been subject to lower prices and lower margins of preferences since the first Lomé Convention in 1975 (McQueen, 1999b). Overall, the EU points out that ACP states have not maintained their market share in the EU since the signing of the first convention, while other less preferred importers have increased their market share. Despite these issues, the European Union is still a very important export market for the ACP. Africa still exports 46% of its exports to the EU (European

Commission, 1996). The poor track record of the Lomé Conventions is not only due to the trade component of the agreement, but to the aid component as well.

The EU concluded in its green paper on the future of the Lomé Convention that development aid has had relatively little effect on growth, investment, and social economic indicators. Countries, such as Senegal, already in the process of structural adjustment seemed to benefit the least. Though there have been successful investments in infrastructure projects and social schemes, these have failed to be effective in the long-run due to a lack of incentive policies, funding, and dynamic sectoral institutions in the ACP states (European Commission, 1996). This failure is in addition to the movement from the ideal of ownership to one of conditionality. With each successive Lomé Convention, the independence and voice given to each ACP member state has decreased. New stipulations have added more bureaucracy via tougher administrative procedures, which have made the aid components of the conventions even less effective (Box, Braun, and Gabas, 1999). The Lomé Conventions have not been as successful as expected for numerous reasons, but some of the foundations laid in the past conventions need to be carried over to the NPA.

Reports show that the EU was most effective in "transport and infrastructure- building sector projects" (Box, Braun, and Gabas, 1999). Furthermore, there is evidence that when using policy-based approaches the EU was successful not only in the transport sectors, but in the health sectors as well (Box, Braun, and Gabas, 1999). This dual success is very important for Senegal. The EU has invested seventy million ECU into Senegal to rehabilitate the road networks, cover costs of maintenance, and provide training in the transport sector. The EU is planning to continue aid in the future for further development of the transport sector. This aid is to be used to revitalize the road network, build railway capacity, and further modernize the port in Dakar (European Commission, 1997a). This aid is vital to help curb the supply-side constraints that plague the ACP states.

Although some aspects of the Lomé Conventions were successful, the EU and the ACP negotiated a new partnership agreement. The main argument for the new agreement (pursued by the EU) is that the Lomé Convention is not WTO compatible. Agreements under the WTO require that the EU provide preferential treatment on a non-discriminatory basis to all LDCs under Part IV of the GATT. The Lomé Convention violates these conditions by providing improved preferential access over the GSP only to the ACP states and not to other developing countries. This incompatibility is the reason a World Trade Organization (WTO) waiver needs to be obtained to extend Lomé to the year 2008 until the economic arrangements under the NPA take effect (McQueen, et al., 1997b).

2.4 The New Partnership Agreement (Cotonou Convention)

> **"**Today, the decline in terms of trade for non-fuel ACP primary commodities appears to be irreversible, preferential access on the basis of former colonial attachments – rather than the level of development – is regarded as arbitrary and discriminatory, and the Uruguay Round has institutionalized the impetus towards freer and more competitive international trading conditions, steadily eroding the value of ACP preferential access to the European Union. (Watts, 1998: 48)."

The New Partnership Agreement (NPA) not only replaces the past Lomé Conventions, but redefines the relationship between the EU and ACP states. The European Union decided that the fourth Lomé Convention was inconsistent with its future goals and present international agreements. Furthermore, it appears that the EU no longer feels the ACP group, particularly sub-Saharan member states, are of strategic importance in the present global economy, and wants to focus on more dynamic economies, such as those in Southeast Asia and Latin America (Watts, 1998). The signing of the Cotonou Convention in June 2000 has shifted the partnership between the EU and ACP states in a new direction that encompasses certain aspects of the past Lomé Conventions, but at the same time instills new innovations into the agreement that could prove to make this the most comprehensive trade/aid agreement signed to date.

The innovations and changes made in the NPA can be categorized into four main areas: political, participation by non-state actors, trade, and aid and development assistance. The first innovation is stronger political dialogue. Political dialogue is at the core of the NPA, and stresses new issues such as conflict prevention, peace and security, capacity building, and migration (ECDPM, 2000). The second innovation is the participation of new non-governmental actors in the political dialogue as well as the planning and administration of national and regional initiatives. These non-state actors include civil society, non-governmental organizations (NGOs), private businesses and consultants, and trade unions. The non-state actors will have access to financial resources for efforts to accomplish the goals of the NPA (ECDPM, 2000). The third innovation is in the area of trade cooperation. As extensively discussed in Chapter 1, the NPA represents a shift from a global focus (the ACP states as a whole group), to a regional focus (the ACP as six distinct regions) with respect to trade, investment, and development initiatives, hence the push for the formation of regional economic partnership agreements (REPA). Under the NPA, ACP countries classified as LDCs by the EU will have the option to retain Lomé style preferences, and this option will be extended to all other LDCs by 2005. (Senegal is not classified as an LDC by the EU.) The two options for non-LDCs are to enter into a REPA with the EU or move to some enhanced form of the GSP (ECDPM, 2000; Holtz, 2000; Watts, 1998). The fourth

innovation is performance based aid management, with the simplification of aid instruments and rolling programs incorporated into it. These innovations gave rise to two new aid instruments, the Investment Facility (IF) and the grant envelope. Both are meant to simplify the aid process and bypass the complex aid structure that plagued previous conventions (ECDPM, 2000; Eurostep, 2000). These innovations provide an opportunity to circumvent the complexities and inefficiencies of the past Lomé Conventions, but their implementation still is yet to be seen.

By 2004, Senegal must decide to enter into a REPA, as a member of WAEMU (see section 2.4.2) or move to an enhanced form of the GSP. In 2004, negotiations will begin on the aspects of the trade arrangement agreed upon by the Senegalese government, ending in 2008. After 2008, the aspects of the NPA agreed upon in the previous negotiations will be implemented (European Commission, 2000b). The provisions of the fourth Lomé Convention will be extended for the transition period from 2000 to 2008, during negotiations. A waiver has been requested of the WTO for approval to extend the fourth Lomé Convention to 2008, while the NPA takes shape. The decision of the WTO is still unknown, but it is highly likely the waiver will be approved since the banana protocol under the past conventions has been replaced, the current convention is only temporary, and there is unlikely to be much international resistance given the nature of other similar agreements around the world (ACP-Secretariat, 2000; McQueen, 1999b). From 2008 to 2020 the economic arrangements under the NPA will be instituted by both the EU and ACP states (regions), effectively giving the ACP states a twenty-year transition period from the end of the last Lomé Convention (European Commission, 2000b).

2.4.1 The Grant Envelope and Investment Facility

As of 2008 STABEX will cease to exist. All of the aid and development programs under the past Lomé Conventions will be consolidated into two broad aid instruments. One instrument will be the grant envelope and the other will be the Investment Facility (IF). The grant envelope is to be used for long-term development. Each ACP country (region) will receive a lump sum disbursement each year, which can be utilized for macroeconomic support, sectoral programs, traditional projects that were done under Lomé, debt relief, income/price stabilization, decentralized co-operation, and humanitarian efforts. The capital risk and loans component will be overseen by the IF, which will be managed by the European Investment Bank. Funds from the IF will be used to finance private and public enterprises that are income earning and commercially and economically viable. The IF will also assist in privatization efforts in ACP countries, as well as, assist in the building of capital markets and financial institutions (European Commission, 2000b). The EU has allocated 13.5 billion Euro (10 billion Euro for the grant

envelopes, 2.2 billion Euro for the IF and 1.3 billion Euro for regional cooperation) to fund these aid instruments (Holtz, 2000).

The requirements needed to receive funds are more stringent than under past conventions. The need for aid will be assessed according to the following criteria: per capita income, population size, social indicators, level of indebtness, export earning losses, dependence on export earnings in the agriculture and mining sectors, level of development, and geographical location (e.g. land-locked) (Eurostep, 2000). Senegal has an advantage in the fields of export earning losses, dependence on export earnings in the agriculture sector, and level of indebtness, but the other indicators could provide a problem for the level of aid received by the Senegalese government. Furthermore, future aid is also dependent on certain performance criteria such as efficiency and allocation of aid, progress in institutional reforms, poverty alleviation/eradication, sustainable development, and macroeconomic and sectoral policy performance. Each country has to establish a National Indicative Program (NIP), which lays out the strategic use and plans for implementation of aid received. These NIPs will then be evaluated by both the EU and the ACP states. After these reviews are made, aid will be reallocated according to need (as defined previously) and past performance evaluations (Eurostep, 2000).

The timely receipt of funds was an issue under past conventions that could plague the NPA. There was a five-year delay before funds were dispersed to the ACP states after the signing of the first Lomé Convention in 1975. These funds were not completely distributed until the end of 1992. In the same year, only 64% of funds designated for use under the third Lomé Convention signed in 1984 had been released. This lack of timeliness has been attributed to the large amounts of bureaucracy required by the EU, under past conventions. The problem remains one of the largest blockades to the implementation and effectiveness of aid instruments under past conventions (Greenidge, 1997). The timely receipt of aid funds is an issue that needs to be addressed in future negotiations.

2.4.2 The West African Economic and Monetary Union (WAEMU)

The West African Economic and Monetary Union began in 1988 with the formation of the West African Economic Community (WAEC),whose members were Benin, Burkina Faso, Cote d'Ivoire, Mauritania, Niger, and Senegal. The aim of this regional group was to foster faster and more balanced economic growth. The WAEC was successful in increasing intra-country trade from 5% in1965 to 7% in 1985 (Tuho, 1996). In 1994, the WAEC merged with the West African Monetary Union, to former a larger union of eight states, which was to become known as the WAEMU. The two new states added in 1994 were Togo and Mali (Tuho, 1996). The

WAEMU became a customs union and adopted a common external tariff structure in January 2000. To help facilitate this development the WAEMU has set up institutions to oversee the macroeconomic aspects of the union, adopted common business and insurance laws, and formulated a Francophone parliament, which will monitor the democratization process and the integration programs of the customs union and the NPA (Africa News Service, 1999; European Commission, 1999b).

The WAEMU consists of six LDCs and two non-LDCs (classified by the EU), the two non-LDCs being Senegal and Cote d'Ivoire. Most of the members of the WAEMU have small open economies that are dependent on a small list of primary commodities. Agriculture is the dominant activity, providing household income to almost sixty million people living in the union. Cote d'Ivoire has a relatively more developed industrial sector, and Senegal is becoming more industrialized. Furthermore, both Senegal and Cote d'Ivoire dominate the interregional trade, controlling 15% and 79% respectively (U.S. Embassy, 1999b). Poor communication and lack of developed infrastructural linkages has hindered further trade in the union. In addition, most of the members are heavily dependent on tax revenues generated by trade, and Senegal is no exception (U.S. Embassy, 1999a and 1999b). The EU is WAEMU's main supplier and export market. The WAEMU exports primary products and commodities to Europe, while the EU exports manufactured goods and equipment to West Africa. The EU accounts for 47% of imports and 46% of exports entering and exiting the WAEMU (European Commission, 1999b).

2.4.3 Regional Economic Partnership Agreement (REPA) Option

The first option for a replacement of the nonreciprocal preferences received under the Lomé Conventions is a Regional Economic Partnership Agreement or REPA. A REPA as defined in Chapter 1, consists of a free trade area (FTA) between the EU, and one of six regional groupings of ACP countries (defined using current regional integration initiatives). A REPA would change the face of the current trade situation between the ACP and EU states. No longer, would there be non-reciprocity for ACP states, but all ACP states that enter into a REPA with the EU would have to extend reciprocity to the EU, as the EU has done for the last twenty-five years. This reciprocity would come in the form of variable geometry reciprocity, where the ACP states could only maintain protection on a number of domestic commodities that would be threatened by entering into an FTA with the EU. The EU would be extended the same privilege (European Commission, 1996). The REPAs will have to be WTO compatible, meaning that eighty to ninety percent of the bilateral trade between the EU and the WAEMU under the REPA would have to be liberalized over a reasonable time span. Under the NPA, this transition period is twenty years.

The WAEMU would be able to backload the reciprocity extended to the EU by postponing the bulk of the trade liberalization until the end of the transition period (Cadot, Melo, and Olarreaga, 1999).

The economic impact of a REPA has been analyzed by a number of studies funded by the EU. The Centre d'Etudes et de Recherches sur le Développement International (CERDI), a French institute, conducted a study utilizing a partial equilibrium model that simulated the effects of a REPA between the EU and the WAEMU plus Ghana, under the assumption of perfect and imperfect substitutability of imports between the two regions. The model did not assume the backloading of the tariff reduction schedule but did include a large variety of commodity groups, which were used to help calculate the results. The results of the CERDI study indicate that there would be substantial trade diversion, with EU imports displacing imports from the rest of the world and in some instances, imports from the WAEMU members. The study concluded that consumers would gain, especially consumers in Senegal due to the high dependence of the Senegalese economy on trade with the EU. Furthermore, CERDI stated that the WAEMU countries would incur fiscal losses of the magnitude of –0.20 to –0.84 percent of their GDP. Again, Senegal would be the most affected due to its high reliance on the EU as an export market (McQueen, 1999a). The WAEMU countries overall are not likely to gain any economies of scale, and the level of exports to the EU should not decrease (European Commission, 1999b). The authors of the study concluded that these results should be taken with great caution, because some of them are likely to be exaggerated. They mention that financial measures can be a great method to offset losses in government revenue incurred by the formation of the REPA with the EU (McQueen, 1999a). These losses have been estimated at $19.5 billion (Cadot, Melo and Olarreaga, 1999).

Economic geography models predict that the formation of an FTA between any of the ACP groupings and the EU would cause de-industrialization in the ACP countries. This de-industrialization would occur because reciprocal trade liberalization by the ACP states to the EU will lead industry into the larger market and away from the smaller, less-developed countries (Cadot, Melo and Olarreaga, 1999). There are some positive effects of establishing a REPA. First, trade liberalization could provide incentives for needed fiscal reforms in the ACP states, providing some alleviation of the loss in government revenue. Second, the REPAs can help in the formation and development of institutional bodies similar to those in the EU and provide security through providing closer political and economic bonds in each of the ACP regions (Cadot, Melo and Olarreaga, 1999; Lecomte, 1998).

Not only is the economic impact relevant information in the decision to join a REPA, but issues regarding the feasibility of a REPA are important. First, all of the ACP states are at different levels of development and have different interests when negotiating with the EU on the structure of a REPA with the EU. Furthermore, 39 of the ACP member states are classified as LDCs by the European Union, making them eligible to keep Lomé type preferences under commitments made by the EU (Lecomte, 1998), thus making it difficult to establish the will to form a REPA. LDCs would have to sacrifice their current position with the EU to enter into a REPA where preferences would become reciprocal (six of the eight members of the WAEMU are LDCs). Second, unless a strong aid dimension is maintained, supply side constraints existent in the ACP states could be a barrier to any positive stimulus a REPA could provide. Furthermore, aid needs to be directed toward infrastructural investments and capital to improve the conditions of infrastructure and low levels of human capital in most of the ACP states. If these supply-side constraints are to be resolved then a long-term commitment needs to be made to ensure that action is taken, otherwise the result of a REPA will be marginal at best (Watts. 1998).

Other economic arrangements between the EU and non-ACP countries could have a significant effect on the effectiveness of a REPA as well. An agreement signed in 1995 started negotiations between MERCOSUR and the EU on the first trans-Atlantic FTA. Argentina, a member of MERCOSUR, is the largest exporter of groundnut products in the world, exporting seventy-five percent of their crop as various groundnut products. Under the terms of this agreement, seventy percent of Argentina's groundnut crop will be destined for the EU in the future and Argentina may be able to avoid aflatoxin sampling and sanitary inspection processes in the EU, due to prior Certification in the Origin under the Agreement of Common Phytosanitary Recognition. This prior certification would definitely give them an advantage over other competitors in the international market that export to the EU, such as Senegal (Watts, 1998;Whiteclaw, 2000). For Senegal, the competition with Argentina is a very pertinent issue since Argentina is second only to Senegal in the export of groundnut oil to the EU and the top exporter of unshelled/shelled groundnuts to the EU.

If the ACP states decide to enter into a REPA with the EU, they need to consider the economic impacts of such a decision. The ACP states need to try and obtain benefits above and beyond the formation of an FTA, minimize the variation of any agreement with respect to product coverage and rules of origin, resist any attempt to use such an agreement as a policy anchor to enforce domestic policy change, be more active in the WTO, and focus their efforts on building a stronger development component into the agreement (McQueen, et al., 1997b). If these states feel

this is beyond their ability or capacity, they can enter into an alternative economic arrangement, which is most likely to be an enhanced form of the GSP.

2.4.4 Enhanced Form of the Generalized System of Preferences (GSP) Option

For non-LDC ACP countries not willing to enter into a REPA with the EU, the most viable economic arrangement proposed at this time is an enhanced form of the Generalized System of Preferences (GSP). The GSP is a set of non-reciprocal non-negotiable preferences that were established in 1971 as an exemption clause in the General Agreement on Tariffs and Trade (GATT). The GSP offers significant preferences for manufacturing products, but considerably less for agricultural products. The tariff on goods is determined via their level of sensitivity vis-à-vis EU domestic competition. These tariff levels are based on the Most Favored Nation (MFN) level and are grouped into four categories: very sensitive, sensitive, semi-sensitive, and non-sensitive, with the following being the percentage of the MFN tariff used as the tariff level for each category: 85%, 70%, 35%, and 0%, respectively. The EU can unilaterally withdraw these preferences since there is no contractual nature built into the agreement (Watts, 1998). The GSP also has a graduation mechanism. Once a country reaches a certain level of development in a particular sector of its economy, the preferences granted to products from that sector are gradually withdrawn until the tariff reaches MFN levels. The GSP agreement is reviewed every ten years, and the next review will begin in 2004. At this review, the EU will add the clause to the GSP guaranteeing all LDCs (as characterized by the EU) Lomé style preferences as mentioned in previous sections (European Commission, 1999a).

The meaning of the word “enhanced” in the title of this section takes on two variations. The first is a direct alteration of the preferences provided under the GSP. A decrease in the tariff levels (or in this case, the percentages of the MFN tariff levels) would be the most direct route to alter preferences. Any alteration will likely occur in 2004 with the review of the GSP, but the extent of this alteration is unclear. EU studies thus far have been conducted using a 25% decrease in current GSP levels (European Commission, 1999b), but no other levels have been indicated as of yet.

The GSP can also be enhanced by differentiating between countries of origin and this is already underway. The commitment by the EU to guarantee Lomé type preferences to all LDC countries by 2005 is a definite step in that direction. The Enabling Clause in the GATT does not allow differentiation between non-LDC countries (which Senegal is classified as by the EU), but this could change when the GATT comes under review again in the near future (European Commission 1999a). Differentiation between countries of origin would be based on the notion of

a vulnerability index. The vulnerability index would be based upon openness of trade, size, per capita GDP, geographical location, vulnerability to natural disasters, export stability and the other criteria. The problem is that no consensus can be reached internationally on what criteria should be included in such an index. Furthermore, the indices proposed thus far have dealt with macroeconomic indicators and have ignored important microeconomic indicators, such as problems for businesses operating in small economies (European Commission, 1999a; Kuster and Becker, 1999). If differentiation were based on a country's share of world trade, and the threshold for maintaining Lomé-type preferences were 0.03 % then Senegal would maintain "globally equivalent" type preferences (European Commission, 1999a). The political feasibility of any such type of differentiation based on the measures discussed above is at best difficult. This difficulty arises due to the high possibility of opposition by other developing countries, especially LDCs, since they would be facing new competition under such a situation (European Commission, 1999a). Evidence of this opposition can be seen when Brazil challenged the EU-GSP for the special treatment of the Andes and Central American countries.

The literature confirms that there will be negative economic impacts of moving to the GSP for any of the ACP states. The two likely effects of moving to an enhanced form of the GSP is that (i) Senegal's margin of preference might be maintained at a reduced level or (ii) its margin of preference might be extinguished. Under (i), Senegal faces deterioration in their margin of preference for groundnut oil as discussed in Chapter 1. Under (ii), Senegal could lose their advantage in particular markets due to the existence of other arrangements being made, e.g. the EU-MERCURSOR FTA (Kennan and Stevens, 1998). Sixty-eight percent of ACP goods and services would be duty free compared to 97% under the Lomé Convention. Senegal, under the assumption there is no differentiation in the GSP, would experience a 6.5% increase in tariff levels on various products (groundnut oil included). The increase in tariffs will occur for other ACP countries as well, having a significant impact in sectors where a high level of competitiveness has not been achieved (European Commission, 1999a). A movement to the GSP will cause a transfer of $840 million from the supply-chain of the non-LDC ACP countries to the EU. This transfer is equal to 40% of the funds disbursed from the European Development Fund to the ACP states in 1994 (Watts, 1998). In addition, the GSP can be unilaterally withdrawn for various reasons, hence it could discourage further foreign direct investment into the ACP countries, which is contrary to the purpose of the NPA (McQueen, et al., 1997b).

The NPA has opened the way to negotiate not only a new trade agreement between the EU and ACP states, but also a new relationship. The change from the previous Lomé Conventions to the New Partnership Agreement will definitely not be a fluid transition if the

issues touched on in this section are not addressed in future negotiations concerning the future economic arrangements between the EU and ACP.

2.5 Concluding Remarks

This chapter has provided the needed background for the analysis that will be conducted in subsequent chapters. The information provided is helpful in the formulation of the conceptual and empirical models discussed in chapters three and four. In the next chapter, a simple conceptual framework is developed. This conceptual framework utilizes economic theory and the background information provided in this chapter. Some conclusions and expected results of the model are developed from the conceptual model to help in the construction of the empirical model in Chapter 4 and the discussion of the model results in Chapter 5.

Chapter 3: Theoretical Foundations

This chapter presents the conceptual foundation upon which the empirical model will be built, utilizing the overview and historical information provided in the previous chapter. A theoretical foundation for the model is presented, and the theoretical implications of the policy options open to the Senegalese government are examined. The chapter is divided into several sections. The first three sections lay out the theoretical model and, the next four sections compare the status quo, REPA and GSP options. The final section provides some concluding remarks.

3.1 Conceptual Framework

Before moving to the formulation of the conceptual model, a number of simplifying assumptions are presented. Several of these assumptions will be relaxed in the formulation of the empirical model in the next chapter. For the conceptual model, a three-region, one-commodity, partial-equilibrium model is assumed. The three regions are Senegal (S), Argentina (A), and the European Union (EU), and the commodity is groundnut oil. The simplifying assumptions are:

1. Total groundnut oil imports in the EU are equal to Senegalese exports plus Argentine exports. These two countries are the largest exporters of groundnut oil to the EU, accounting for 69% of EU oil imports.
2. Senegal and Argentina do not trade groundnut oil with each other. The trade data supports this assumption (see Appendix A, Section A.3).
3. The EU demand curve will be equal to the EU excess demand curve, because the EU does not produce a significant amount of groundnut oil (Organization for Economic Co-operation and Development, 1994; see Appendix A, Section A.2).
4. Inventories of groundnut oil are assumed to be zero or held constant.
5. The international marketplace for groundnut oil is assumed to be perfectly competitive.

These assumptions will allow us to construct a conceptual framework that provides a simplified theoretical analysis of the problem presented in the first chapter.

To simplify mathematical derivations of the model, all demand and supply relationships are assumed to be linear (this assumption is relaxed in the empirical model). The above assumptions give rise to the following conceptual model formulation:

Supply Side: Senegal: $S_S = a + bP_S$ (3.1)

Argentina: $S_A = e + fP_A$ (3.2)

Demand Side: Senegal: $D_S = c - dP_S$ (3.3)

Argentina: $D_A = g - hP_A$ (3.4)

EU: $D_{EU} = j - kP_{EU}$ (3.5)

Market Clearing: $S_S + S_A = D_S + D_A + D_{EU}$ (3.6)

$P_S + \theta_S = P_{EU}(1 - \tau_S)$ (3.7)

$P_A + \theta_A = P_{EU}(1 - \tau_A)$ (3.8)

Variable Definitions:

S_S	Quantity supplied of groundnut oil in Senegal
S_A	Quantity supplied of groundnut oil in Argentina
D_S	Quantity demanded domestically of groundnut oil in Senegal
D_A	Quantity demanded domestically of groundnut oil in Argentina
D_{EU}	Quantity demanded domestically of groundnut oil in the EU
P_S	Price of groundnut oil in Senegal
P_A	Price of groundnut oil in Argentina
P_{EU}	Price of groundnut oil in the EU

Parameter Definitions:

θ_S	Transportation cost from Senegal to the EU
θ_A	Transportation cost from Argentina to the EU
τ_S	Import tariff on Senegalese imports coming into the EU
τ_A	Import tariff on Argentine imports coming into the EU

Note: $(a, b, c, d, e, f, g, h, j, k) \geq 0$.

Equations (3.1) and (3.2) are the groundnut supply equations in the conceptual model. The slope parameters of the supply equations (demand equations) have the following relationship with the own-price elasticity of supply (demand):

$$slope\ coefficient = \frac{(\varepsilon_i Q_i)}{P_i}, \text{ where i = region and } \varepsilon \text{ = own-price elasticity} \qquad (3.9).$$

The larger the own-price elasticity of supply (demand) the flatter the supply (demand) curve. The supply and demand curves for all regions of the conceptual model are assumed inelastic. This assumption is supported by data provided in Appendix A, section A.1 and by the fact that groundnut oil is a primary food commodity. Equations (3.3) – (3.5) are the demand equations for the model, and as noted in the model assumptions, equation (3.5) is the demand and excess demand equation for the EU. Equation (3.6) is a market clearing quantity condition that requires that all groundnut oil produced be consumed. Furthermore, equation (3.6) rules out the possibility of inventories or free disposal in this model. Equations (3.7) and (3.8) are the price clearing conditions at which equilibrium is reached and all the groundnut oil produced is consumed. These conditions are the only non-linear conditions in the model, since the ad-valorem import tax instituted by the European Union in this case causes the prices in Senegal and Argentina to be some multiple of the EU price minus transportation costs.

The above theoretical framework is a closed model in which all prices are determined endogenously. Deriving the prices will allow comparative statics to be completed to determine the effects of the options open to the Senegalese government of either establishing a REPA with the EU and WAEMU or moving to some enhanced form of the GSP.

3.2 Derivation of the Price Relationships in the Conceptual Framework

From the above conceptual framework, the prices in the model can be determined as functions of the parameters $(\theta_A, \theta_S, \tau_A, \tau_S)$. The price relationships are:

$$P_S(\theta_A, \theta_S, \tau_A, \tau_S) = \frac{(f+h)[\theta_A(1-\tau_S) - \theta_S(1-\tau_A)] + (1-\tau_S)(-a+c-e+g+j) - \theta_S k}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k} \qquad (3.10)$$

$$P_A(\theta_A, \theta_S, \tau_A, \tau_S) = \frac{(b+d)[\theta_S(1-\tau_A) - \theta_A(1-\tau_S)] + (1-\tau_A)(-a+c-e+g+j) - \theta_A k}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k} \qquad (3.11)$$

$$P_{EU}(\theta_A, \theta_S, \tau_A, \tau_S) = \frac{\theta_S(b+d) + \theta_A(f+h) - a + c - e + g + j}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k} \qquad (3.12)$$

Analyzing the impact of changes in transportation costs and import tariffs on prices is critical when considering policy options. Table 3.2.1 summarizes the signs of each of the relevant derivations.

Table 3.2.1 Signs of the Price Derivatives With Respect to the Parameters: $(\theta_A, \theta_S, \tau_A, \tau_S)$ [1]

	$/\partial\theta_S$	$/\partial\theta_A$	$/\partial\tau_S$	$/\partial\tau_A$
∂P_S	< 0	> 0	< 0	> 0
∂P_A	> 0	< 0	> 0	< 0
∂P_{EU}	> 0	> 0	> 0	> 0

[1] see Appendix B, Section B.1 for the derivations

Using equations (3.9) – (3.12), the derivatives of the quantity variables with respect to the parameters $(\theta_A, \theta_S, \tau_A, \tau_S)$ can be determined. These are shown in Table 3.2.2. Tables 3.2.1 and 3.2.2 give all of the relationships that are needed for the comparative static analyses that are conducted in the next three sections.

Table 3.2.2 Signs of the Quantity Derivatives With Respect to the Parameters: $(\theta_A, \theta_S, \tau_A, \tau_S)$ [1]

	$/\partial\theta_S$	$/\partial\theta_A$	$/\partial\tau_S$	$/\partial\tau_A$
∂S_S	< 0	> 0	< 0	> 0
∂S_A	> 0	< 0	> 0	< 0
∂D_S	> 0	< 0	> 0	< 0
∂D_A	< 0	> 0	< 0	> 0
∂D_{EU}	< 0	< 0	< 0	< 0

[1] See Appendix B, Section B.2 for the derivations

Before moving into the analysis of the options open to the Senegalese government, there is one theoretical issue dealing with the conceptual framework that should be addressed. The issue is best stated via the following claim: *Let* $\theta_S = \theta_A = \theta > 0$ *and* $\tau_A > \tau_S$. *If* θ_S *and* θ_A *increase by the same amount then* P_S *will increase, if* τ_A *is sufficiently large.* If Argentina's and Senegal's transportation costs increase by the same amount and the import tariff imposed on Argentine groundnut oil entering the EU is sufficiently large, e.g. 0.50, while Senegalese

groundnut oil enters the EU duty free, then the price of groundnut oil in Senegal could increase. This claim can be shown by the following argument.

Using (3.10) and the fact that $\theta_S = \theta_A = \theta$, the price of groundnut oil in Senegal is:

$$P_S(\theta, \tau_A, \tau_S) = \frac{(f+h)[\theta(\tau_A - \tau_S)] + (1-\tau_S)(-a+c-e+g+j) - \theta k}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k}. \tag{3.13}$$

The derivative of the price of groundnut oil with respect to θ is:

$$\frac{\partial P_S}{\partial \theta} = \frac{(f+h)(\tau_A - \tau_S) - k}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k}. \tag{3.14}$$

Note that $(b, d, f, h, k, \tau_A, \tau_S) \geq 0$ and $0 \leq (\tau_A, \tau_S) \leq 1$ by construction. Thus, the denominator of (3.14) is greater than zero (otherwise $\partial P_S/\partial \theta$ would not exist), and the sign of the numerator is dependent on the values of (k, τ_A, τ_S). Relationship (3.14) is greater than zero when $(f+h)(\tau_a - \tau_S) - k > 0$, or

$$\tau_A > \frac{k}{(f+h)} + \tau_S, \; and \; (f+h) > 0. \tag{3.15}$$

Given τ_S, condition (3.15) implies P_S will increase with an increase in θ, when τ_A is at least greater than τ_S by an amount greater than $\frac{k}{(f+h)}$. Note that "sufficiently large" is defined by condition (3.15).

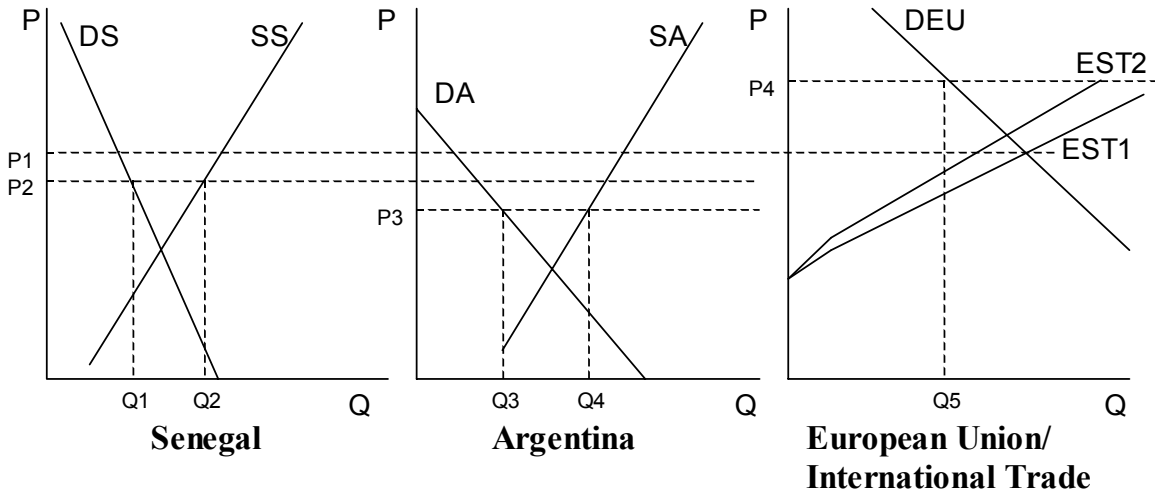
The above result is interesting as it provides insight into unexpected results that occur in the simulations conducted utilizing the empirical model (see Chapter 5). The derivation of the result is helpful, given that the derivations required in the empirical model do not provide a convenient closed form expression and therefore will not be made. Completing the above derivations allows the evaluation of the status quo and the options under the NPA using comparative statics.

3.3 Evaluation of the Status Quo Under the Fourth Lomé Convention

Graphical techniques along with the mathematical formulation derived in the previous two sections will be used in the analyses conducted in the next four sections. It is assumed in the graphical analyses that $\theta_A = \theta_S$, but the other cases $\theta_A > \theta_S$ and $\theta_A < \theta_S$ will be discussed. The values of the tariff parameters τ_S and τ_A will vary depending on the case being examined. In this section, $\tau_S = 0$ (as under the fourth Lomé Convention) and $\tau_A > 0$, since Argentina is subject to

the GSP (European Union, 1999). In addition, the following notation is used in the graphical analyses: 'Di' is the demand curve in region i, 'Si' is the supply curve in region i, and 'EST' is the total excess supply curve for Argentina and Senegal, where 'i' refers to 'A' for Argentina, 'S' for Senegal and 'EU' for the European Union. With the parameters and notation in mind, Figure 3.3.1 provides the base graphical representation that will be utilized in this and the next three sections.

Figure 3.3.1 Graphical Analysis of the Status Quo Under the Fourth Lomé Convention



From the graphical analysis we can see the prevailing prices and quantities demanded, supplied, and exported/imported in each market. This information is summarized in Table 3.3.1.

Table 3.3.1 Summary of Figure 3.3.1

Region	**Quantity Supplied**	**Quantity Demanded**	**Quantity Exported**	**Quantity Imported**	**Price in Market**
Senegal	Q2	Q1	(Q2 – Q1)	0	P2
Argentina	Q4	Q3	(Q4 – Q3)	0	P3
European Union	0	Q5	0	(Q2 – Q1) + (Q4 – Q3)	P4

The prices that prevail in each market in the status quo at equilibrium are given in the above table. The determination of these prices is important because they represent the prices at which the market clears and there is no further trade. P1 is the prevailing price in all three

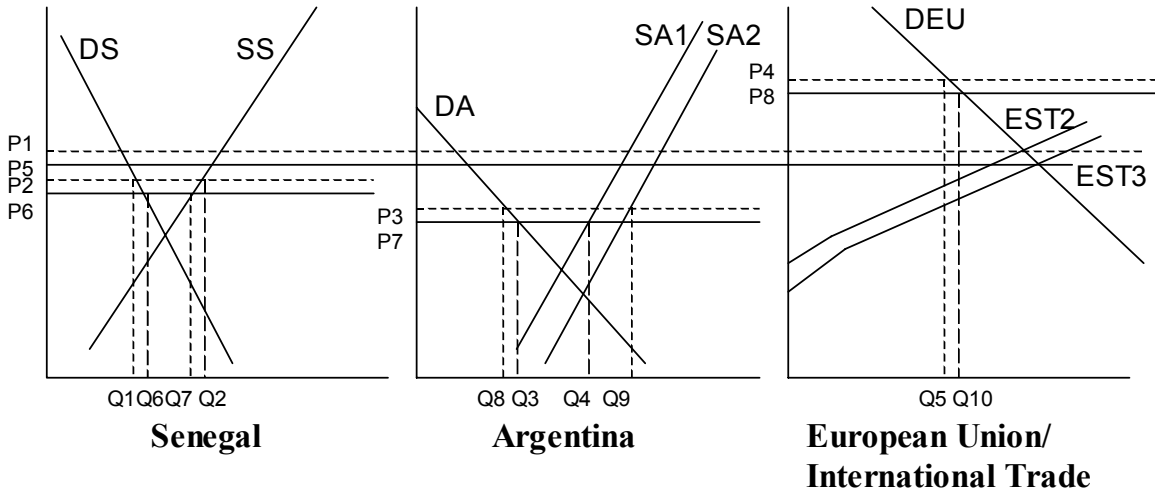
markets when there are no transportation costs or tariffs imposed by the EU on Senegal or Argentina. When transportation costs are added and the EU imposes import tariffs on Argentina (as mentioned above), then the prevailing prices are $P_S = P2$, $P_A = P3$, and $P_{EU} = P4$.

The tariff rate imposed on Senegalese exports of groundnut oil going to the EU is equal to zero. Using condition (3.7), then $\theta_S = P4 - P2$. Given that $\partial P_S/\partial\theta_S < 0$, then P_S decreases below P1 to P2. If $\theta_A = \theta_S$ and $\tau_A > 0$, P_A decreases below P1 to P3, since $\partial P_A/\partial\tau_A < 0$ and $\partial P_A/\partial\theta_A < 0$. Using (3.8), $\tau_A = (P2 - P3)/P4$, and the amount of the price that is transferred per unit of groundnut oil to the EU as an import duty is equal to P2 – P3. These conditions also cause P_{EU} to increase above P1, since $\partial P_{EU}/\partial\theta > 0$ and $\partial P_{EU}/\partial\tau_A > 0$, making the prevailing price in the EU equal to P4. If $\theta_A > \theta_S$, according to Table 3.2.1, P_S and P_{EU} would increase and P_A would decrease, and vice versa for $\theta_A < \theta_S$. Furthermore, P_S could increase in this case as well, due to the tariff imposed on Argentina, since $\partial P_S/\partial\tau_A > 0$, but it will be assumed that $\partial P_S/\partial\theta_S > \partial P_S/\partial\tau_A$ (see previous section), so $P_S = P2$.

The imposition of transportation costs on Senegalese groundnut products lowers the price producers receive for groundnut oil in the domestic market, thus decreasing the quantity supplied of groundnut oil. The lower price also induces an increase in domestic demand, now that groundnut oil is cheaper domestically. Overall, these two effects cause exports to decrease. The quantities supplied, demanded, and exported are provided in Table 3.3.1. The imposition of a tariff and transportation costs ($\theta_A = \theta_S$) have similar results in Argentina. The increase in P_{EU}, as a result of the imposition of the tariff and transportation costs in Senegal and Argentina, causes domestic demand in the EU to decrease, making the quantity imported and demanded in the EU equal to Q5. EST shifts from EST1 to EST2 with the imposition of the import tariff on Argentine groundnut oil by the EU. Using the basic analysis provided as a starting point some other issues and cases can now be addressed.

One of the reasons why trade preferences under the previous Lomé Conventions did not stimulate an increase in exports of agricultural and industrial products from the ACP countries was that primary commodity prices have trended down over time (McQueen, Phillips, Hallam, and Swinbank, 1997a). The downward trend in these prices can be seen using Figure 3.3.2 as a shift in Argentina's supply curve.

Figure 3.3.2 Graphical Analysis of a Fall in World Commodity Prices (for Groundnut Oil)



A fall in commodity prices could be spurred by an increase in supply in one of the non-ACP countries (in this case Argentina) due to infrastructure investments or research and development that reduce production costs. This is shown by a shift out of SA in Argentina from SA1 to SA2 and a shift of EST2 to EST3. (Note: The tariff is taken into account by using EST2). The results of these shifts are summarized in Table 3.3.2.

Table 3.3.2 Summary of Figure 3.3.2

Region	**Quantity Supplied**	**Quantity Demanded**	**Quantity Exported**	**Quantity Imported**	**Price in Market**
Senegal	Q7	Q6	(Q7 – Q6)	0	P6
Argentina	Q9	Q8	(Q9 – Q8)	0	P7
European Union	0	Q10	0	(Q7 – Q6) + (Q9 – Q8)	P8

The outward shift of SA causes Argentina's supply of groundnut oil to increase from Q4 to Q9 due to the lower cost as a result of investments made in their groundnut oil sector. The shift in SA1 to SA2 also results in an outward shift of EST2 to EST3, and a fall in the price level for groundnut oil in the EU. With no transportation costs or tariffs, this decrease in price would be represented by a decrease from P1 to P5. With the transportation costs and tariffs as discussed above the prevailing prices in the market are shown in Table 3.3.2 and can be verified using the price clearing conditions (3.7) and (3.8). The resulting outcome for Senegal (and for the majority

of ACP states in this situation) is that exports of groundnut oil decrease, due to the decrease in P_S. Further, with no change in transportation costs, the lower price in Senegal causes domestic demand to increase from Q1 to Q6, supply to decrease from Q2 to Q7, and exports to decrease from (Q2 – Q1) to (Q7 – Q6). The decrease in exports also decreases export revenues that Senegal relies upon to fund its annual governmental budget, in turn affecting investments and the funding of projects in the groundnut sector (see Chapter 2, Section 2.2). The decrease in Argentina's price is not as great as the decrease in Senegal's, because for Senegal $\partial P_S = \partial P_{EU}$ and for Argentina $\partial P_A = \partial P_{EU}(1 - \tau_A)$, under the assumption that $\theta_A = \theta_S$. Thus in the end, Argentina gains a larger share of the exports, and Senegal's share of total groundnut exports decreases. Export diversification in Senegal becomes more difficult as well, because export revenues needed for investments in the groundnut sector decrease with the decrease in exports.

Argentina's groundnut sector is endowed with a better infrastructure than Senegal's, making Argentina a significant competitor, as Senegal's margin of preference decreases in Argentina's favor (George, 2000). This difference is shown in Figures 3.3.1 and 3.3.2 by the fact that Argentina's autarchy equilibrium price (where domestic supply and demand are equal) is less than Senegal's autarchy equilibrium price. A decrease in Senegal's margin of preference can only have adverse effects on its groundnut sector. For Senegal to compete in the global marketplace, a higher level of investment in infrastructure is needed (George, 2000). Senegal is currently planning to invest 2.3 billion CFA francs in programs to stimulate the production of confectionery groundnuts for export, which should help export diversification (World Trade Organization, 1998). Investments of this type are beneficial by pushing costs down allowing Senegal to increase its exports and export revenue. The increase in export revenues can be used to stimulate future investment in the areas of export diversification and infrastructure. Further, these types of investments could be used to help offset adverse economic impacts the REPA might have on the Senegalese economy (see Chapter 2, Section 2.4.3).

3.4 Evaluation of the Regional Economic Partnership Agreement Option

The REPA option, which would establish a free trade arrangement between WAEMU and the European Union, is similar to the status quo, since Senegal would face no import duties on groundnut oil under this scenario, i.e. $\tau_S = 0$. Thus, the examination of this scenario focuses on other economic arrangements that could have an economic impact on Senegal's decision to enter into a REPA with the EU. A study conducted by CERDI showed that, under a REPA, Senegal is likely to see a decrease in government revenues, due to lower export earnings

(European Commission, 1999b). The drop in export earnings would be primarily due to factors outside of the Senegalese groundnut sector, since Senegal holds a definitive competitive advantage in the export of groundnut oil to the EU when compared to the other nations that export groundnut oil.

One of the factors that is of paramount importance is the continuing tariff liberalization in the global marketplace. As discussed previously, the EU is committed to further reducing the ad-valorem tariff levels in the GSP universally, of which the tariff on groundnut oil would be included (European Union, 1999). Any reduction would have a direct impact on Senegal's margin of preference for groundnut oil in comparison with Argentina. As the GSP becomes more liberalized, Senegal's margin of preference will continually decrease and Argentina will become more competitive with Senegal in the international market (European Union, 1999). The possibility of Argentina facing a zero tariff is also highly likely, given the continued negotiations for a EU/MERCUSOR free trade zone (Whiteclaw, 2000). Thus, the analysis in this section focuses on the position where Senegal's margin of preference decreases due to tariff liberalization that affects Argentina.

The first case to be examined is where $\tau_A > 0$ and $\tau_S = 0$, but $\partial \tau_A < 0$, i.e. Senegal's margin of preference with respect to Argentina decreases. To simplify the following analysis it is assumed that transportation costs do not change. Figure 3.4.1 illustrates this case and Table 3.4.1 summarizes the results from Figure 3.4.1. The decrease in τ_A causes P_A to increase from P3 to P10. Using Table 3.2.1, one can determine that Senegal's price falls from P2 to P9, since $\partial P_S/\partial \tau_A > 0$, and the price in the European Union falls from P4 to P11, since $\partial P_{EU}/\tau_A > 0$. Note that the changes in Figure 3.4.1 for Senegal are relatively small and are not shown. The assignment of two prices and quantities to each point for Senegal is to represent this small change. The tariff decrease increases the quantity supplied in Argentina from Q4 to Q14 and decreases the quantity demanded from Q3 to Q13. Thus, Argentine exports increase from (Q4 – Q3) to (Q14 – Q13), since producers receive a higher price in Argentina and demand in the EU has increased. The decrease in P_{EU} increases the quantity demanded of groundnut oil in the EU from Q5 to Q15, since the purchase of groundnut oil is relatively cheaper for consumers. The decrease in P_S increases the quantity demanded domestically in Senegal from Q1 to Q11 and decreases the quantity supplied from Q2 to Q12, thus Senegalese exports decrease from (Q2 – Q1) to (Q12 – Q11). A change in the tariff rates of the GSP that benefits Argentina will have a negative economic impact on Senegal by decreasing its exports of groundnut oil and the amount of export earnings received.

Figure 3.4.1 Graphical Analysis of the REPA Option: A Decrease in Senegal's Margin of Preference.

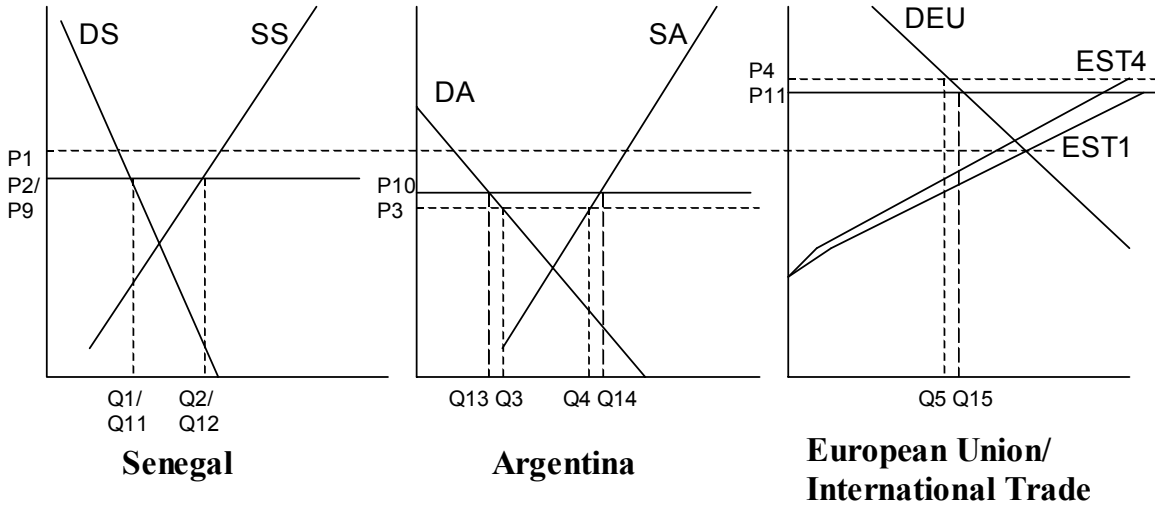


Table 3.4.1 Summary of Figure 3.4.1

Region	**Quantity Supplied**	**Quantity Demanded**	**Quantity Exported**	**Quantity Imported**	**Price in Market**
Senegal	Q12	Q11	(Q12 – Q11)	0	P9
Argentina	Q14	Q13	(Q14 – Q13)	0	P10
European Union	0	Q15	0	(Q12 – Q11) + (Q14 –Q13)	P11

The final analysis in this section is the case where $\tau_A = \tau_S = 0$. The price clearing conditions (3.7) and (3.8) above become:

$$P_S + \theta_S = P_A + \theta_A = P_{EU} \qquad (3.16).$$

This analysis provides the opportunity to evaluate what would happen if Argentina formed a free trade area with the EU via MERCUSOR. Under this agreement, Argentina would export groundnut oil to the EU duty free. For simplicity, it is still assumed that $\theta_A = \theta_S$. The graphical analysis of this case is provided in Figure 3.4.2 and the results are summarized in Table 3.4.2.

Figure 3.4.2 Graphical Analysis of the REPA Option: $\tau_S = \tau_A = 0$

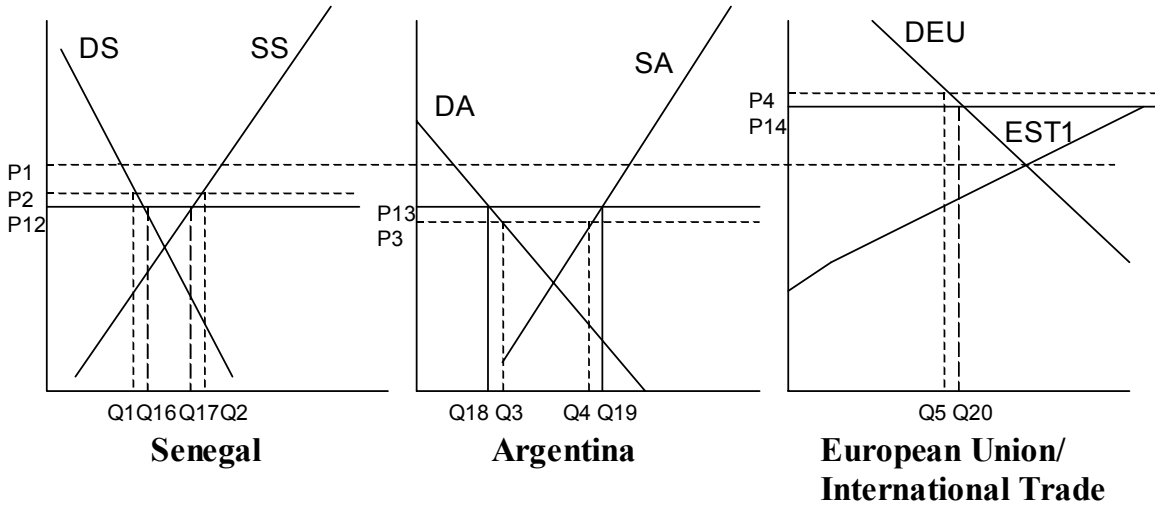


Table 3.4.2 Summary of Figure 3.4.2

Region	**Quantity Supplied**	**Quantity Demanded**	**Quantity Exported**	**Quantity Imported**	**Price in Market**
Senegal	Q17	Q16	(Q17 – Q16)	0	P12
Argentina	Q19	Q18	(Q19 – Q18)	0	P13
European Union	0	Q20	(Q17 – Q16) + (Q19 – Q18)	0	P14

With $\tau_A = 0$, the price of groundnut oil in Argentina increases from P3 to P13 since the tariff no longer discourages an increase in supply ($\partial P_A/\partial \tau_A < 0$). When the tariff is eliminated, the quantity supplied of groundnut oil increases in Argentina from Q4 to Q19 and domestic consumption decreases from Q3 to Q18. Thus, the quantity exported increases by the amount (Q19 – Q18) – (Q4 – Q3). The price for groundnut oil in Senegal decreases from P2 to P12, since $\partial P_S/\partial \tau_A > 0$. The decrease in price is accompanied by a reduction in the quantity supplied of groundnut oil in Senegal from Q2 to Q17. The fall in price further induces an increase in domestic consumption from Q1 to Q16. Thus, overall exports from Senegal to the EU decrease from (Q2 – Q1) to (Q17 – Q16). These changes in Argentina and Senegal have a positive impact overall on EU imports of groundnut oil, increasing imports from Q5 to Q20. The decrease in the price for groundnut oil in the EU is the result of an increase in the excess supply of groundnut oil in the EU market. This excess supply arises from the increase in exports from Argentina, causing

the EU price for groundnut oil to decrease from P4 to P14. The decrease in the EU price increases demand in the EU, absorbing the excess supply in the market. Overall, Argentina's terms of trade improves and Senegal's terms of trade worsens.

The two cases discussed provide a detailed theoretical analysis of the REPA option open to the Senegalese government, if chosen as a replacement for the nonreciprocal trade preferences provided under the fourth Lomé Convention. The two cases examined show that if Senegal's margin of preference decreases, its terms of trade will worsen, hurting the Senegalese groundnut sector. As was discussed in section 3.3, the two above cases could be examined in conjunction with increases in investments in the groundnut sector. This examination could help gauge the effectiveness of such investments to offset some of the adverse economic impacts of the REPA. Simulation models are needed to examine these options and provide a deeper analysis of the cases examined here. The last possibility that needs to be analyzed is the option where Senegal moves to some enhanced form of the General System of Preferences.

3.5 Evaluation of the Enhanced Generalized System of Preferences Option

Recall that Chapter 2 presented two different options for enhancement of the GSP. The first was based on a decrease in the ad valorem tariff levels and the second was the introduction of product differentiation (see Chapter 2, Section 2.4.4). These two options give rise to three possible results for Senegal's position in the international groundnut oil market: (1) Senegal maintains a margin of preference over its international competitors, (2) Senegal retains no margin of preference, or (3) Senegal's competitors gain a margin of preference over Senegal. To examine these cases it is now assumed that Senegal faces some import tariff, i.e. $\tau_S > 0$, and $\tau_A \geq 0$.

The first possibility mentioned above where Senegal still has a margin of preference with respect to its international competitors has been analyzed. In Section 3.4, the possibility of Senegal facing no import tariff and Argentina facing a decreasing import tariff on groundnut oil entering the EU was discussed. The analysis there is pertinent to this case. The only difference is that $\tau_S > 0$. The imposition of the tariff on Senegalese imports would cause P_S to decrease and P_A and P_{EU} to increase (see Table 3.2.1). In Senegal, the decrease in P_S would cause the quantity supplied and quantity exported of groundnut oil to decrease, and the quantity demanded to increase (see Table 3.2.2). In Argentina, the increase in P_A would cause the exact opposite response of what occurred in Senegal, as evidenced by the derivations in section 3.2. Finally, the increase in P_{EU} would cause the demand for groundnut oil in the EU to decrease. The graphical analysis would be similar to Figure 3.4.2, except that the change in tariff is reversed. The price in

Senegal would fall from P2 to P12 due to the imposition of a tariff, the price in Argentina would increase from P3 to P13 and the price in the EU would increase above P4. The increase in the price in the EU is the only one that is not shown in Figure 3.4.2. The quantity changes would be the same as indicated in Table 3.4.2, except that EU demand would decrease below Q5.

The second possibility is the case where Senegal loses its margin of preference over its competitors and is on equal footing in the international market. The extreme case of this is where $\tau_A = \tau_S = 0$ and was analyzed in Figure 3.4.2 and Table 3.4.2. The results are the same for any other level of import tariff under the GSP, since $\tau_S = \tau_A = \tau$ in this modeling framework. The major difference would be the degree of the differences in the prices from the EU price, i.e. $P_A = P_S = P_{EU}(1-\tau) - \theta$, when $\theta_A = \theta_S = \theta$. If the transportation costs are different, then $P_A + \theta_A = P_S + \theta_S = P_{EU}(1-\tau)$ and thus $P_S - P_A = \theta_A - \theta_S$. The difference between P_A and P_S would be constant, assuming that the transportation costs are not changing over time. The last possibility is the most interesting for analysis given the previous results.

The third possibility under some enhanced form of the GSP is that Senegal not only loses its margin of preference with respect to its competitors, but in fact its competitors gain a margin of preference with respect to Senegal. In this case, two assumptions are made: 1) $\tau_S > 0$ and 2) $\tau_S > \tau_A$. It will still be assumed that $\theta_A = \theta_S$ in the following analysis. For simplicity, let $\partial\tau_S > 0$ and $\partial\tau_A < 0$ such that $\partial P_{EU} = 0$. Figure 3.5.1 graphically summarizes the result of such a situation and Table 3.5.1 summarizes them.

Senegal is now faced with an import tariff, which causes P_S to decrease (since $\partial P_S/\partial\tau_S < 0$), but since τ_A decreases (note that $\partial P_S/\partial\tau_A > 0$), P_S is even pushed down further from P2 to P15. The imposition of the tariff on Senegalese groundnut oil by the EU causes the quantity supplied in Senegal to fall from Q2 to Q22 and the quantity domestically demanded to increase from Q1 to Q21. Thus, the quantity exported decreases from (Q2 – Q1) to (Q22 – Q21). In Argentina, the exact opposite happens. The decrease in τ_A coupled with the increase in τ_S causes P_A to increase from P3 to P16. The increase in P_A causes domestic demand to decrease from Q3 to Q23 and supply to increase from Q4 to Q24. Thus, exports from Argentina to the EU increase from (Q4 – Q3) to (Q24 – Q23). Since it is assumed τ_S and τ_A are changed such that P_{EU} remains equal to P4, domestic demand in the EU remains equal to Q5. Thus, (Q2 – Q1) – (Q22 – Q21) = (Q24 – Q23) – (Q4 – Q3), or the decrease in exports from Senegal is exactly offset by the increase

Figure 3.5.1 Graphical Analysis of the Enhance GSP Option: $\partial \tau_S > 0$ and $\partial \tau_A < 0$.

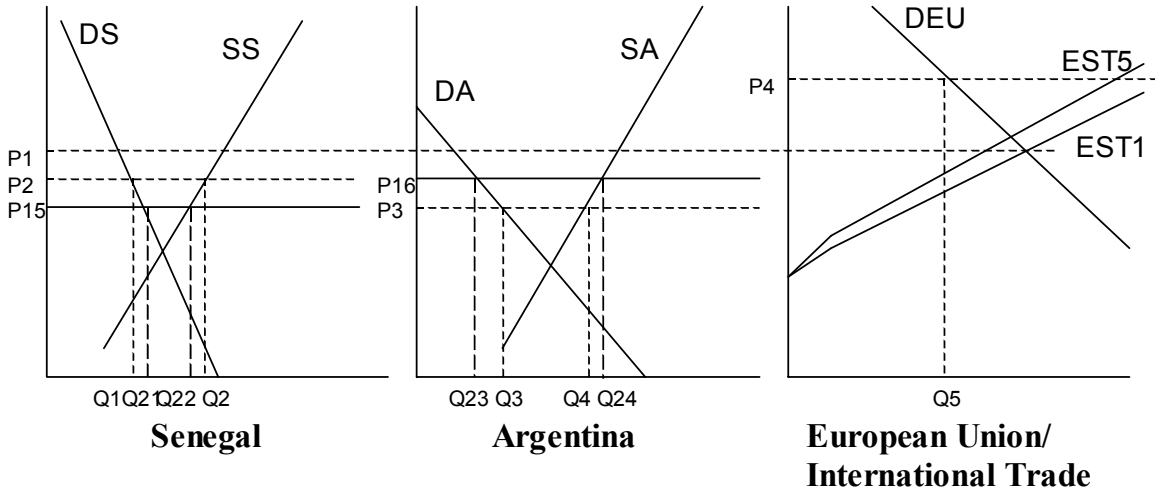


Table 3.5.1 Summary of Figure 3.5.1

Region	**Quantity Supplied**	**Quantity Demanded**	**Quantity Exported**	**Quantity Imported**	**Price in Market**
Senegal	Q22	Q21	(Q22 – Q21)	0	P15
Argentina	Q24	Q23	(Q24 – Q23)	0	P16
European Union	0	Q5	0	(Q22 – Q21) + (Q24 – Q23)	P4

in exports from Argentina so total exports to the EU are unaffected. In this case, the share of total exports increases for Argentina and decreases for Senegal. If Senegal wants to retain their position in the international groundnut market in such a situation, either concessions need to be made on Senegalese imports in the EU (e.g. differentiation) or an increase in investments is needed in the Senegalese groundnut sectors. Differentiation, such as the introduction of a vulnerability index in the GSP could be used to counteract such a situation, but due to the complexities of such an index (see Chapter 2), it is only presented as an option in the conceptual model.

Under the scenario of moving to an enhanced form of the GSP, Senegal could maintain a margin of preference over its international competitors, but it would be in a worse position when compared to the REPA or status quo. The magnitude of this difference may not be enough to offset the decision to move to the enhanced form of the GSP, if investments can be made that

make Senegal more competitive in the confectionery groundnut sector. Thus, the empirical model will be used to provide a deeper examination of these and other cases.

3.6 Welfare Analysis of the REPA and Enhanced GSP Options in the Senegalese Groundnut Sector.

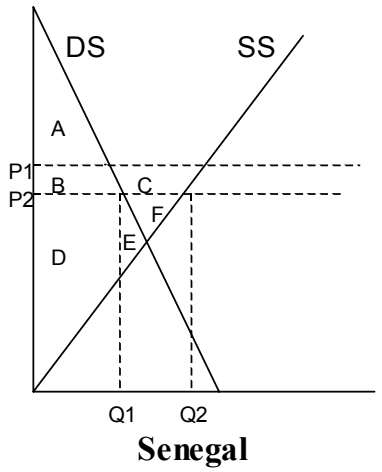
The calculation of consumers' and producers' surplus is utilized as another tool to examine the economic impact of the two options under the NPA. The decision about which measure of consumer surplus to utilize is based upon findings in E.J. Mishan's text, *Introduction to Normative Economics*. Mishan states that the difference between the Compensating Variation (CV), Equivalent Variation (EV) and the Marshallian measures of consumer surplus "taken from any conceptually accurate demand curve," is not likely to be significant in most plausible circumstances (Mishan, 1981; 183). Thus the Marshallian measures for producer and consumer surplus are utilized in the model.

Partial welfare analysis measures changes in consumers' and producers' surplus. Since the conceptual model only examines the production of groundnut oil, the consumers in the conceptual model are primarily the Senegalese farmers and families as well as the domestic urban population. The producers in the conceptual model are the publicly and privately held firms that produce groundnut oil, e.g. SONACOS and NOVASEN. (In the empirical model, three separate groundnut markets are examined, so it is important that the producers and consumers in each market are correctly identified. In the groundnuts (in-shell and shelled) market the consumers are the Senegalese government and domestic consumers in urban centers, and the producers are the farmers and processors of seed and confectionery products. In the groundnut meal market the consumers and producers are similar to those in the groundnut oil market.) The consumers' surplus (CS) is equal to the aggregate summation of the difference between the consumers' reservation price and the prevailing market price. The surplus is the amount by which the consumers' benefit from purchasing at the prevailing market price (Varian, 1999). Consumer Surplus is equal to the area to the left of the demand curve above the prevailing market price. The producers' surplus (PS) is equal to the aggregate of all the firms total revenue producing a particular good, minus their aggregate variable costs for producing that particular good. This measure is related to the profit received by those firms if the total of the fixed costs for the firms is subtracted out (Varian, 1999). In the case of Senegal, part of this producer surplus is made up of export revenue, which was mentioned in the previous and current chapters.

Before looking at the effect of the options (examined earlier) on consumers' and producers' surplus, the evaluation of these two welfare measures will be examined in the context

of the status quo under the fourth Lomé Convention. Figure 3.6.1 provides a graphical analysis of the consumers' and producers' surplus. Without a tariff, the prevailing market price is P1. In this situation consumers' surplus equals area A and producers' surplus equals area B + C + D + E + F. When international transportation costs are added (or you could think of this as a tariff in this case) consumers' surplus increases from area A to area A + B, since the prevailing market price has decreased from P1 to P2. Producers' surplus decreases from area B + C + D + E + F to area D + E + F. The gain in consumer surplus, area B is due to the lower market price and is transferred

Figure 3.6.1 Consumer and Producer Surplus Under the Fourth Lomé Convention



Note: Consumer and producer surplus are measured here for all of Senegal. This terminology will be used in subsequent chapters instead of consumers' and producers' surplus.

from producers to consumers in this case. The loss in producers' surplus equal to B + C is due to the higher cost imposed on producers by higher transportation costs (import tariff). The loss in area C is also equal to the loss in export revenue received by the Senegalese economy and government.

Referring to the graphical analysis in Figure 3.6.1 and the system of equations provided in section 3.1 the exact amounts of consumers' and producers' surplus can be expressed mathematically. They are equal to: (evaluated at the prevailing price given the transportation cost/import tariff)

Consumers' Surplus:

$$CS_S = \int_{P2}^{\frac{c}{d}} [c - dP_S]dP_S = cP_S - \frac{1}{2}dP_S^2 \,|_{p^2}^{\frac{c}{d}} = \frac{c^2}{d} - \frac{1}{2}\frac{c^2}{d} - c(P2) + \frac{1}{2}d(P2)^2 = \frac{1}{2}d(P2)^2 - c(P2) + \frac{c^2}{2d} \quad (3.18)$$

Producers' Surplus:

$$PS_S = \int_0^{P2} [a + bP_S]dP_S = aP_S + \frac{1}{2}bP_S^2 \,|_0^{P2} = a(P2) + \frac{1}{2}b(P2)^2 \quad (3.19)$$

Equations (3.18) and (3.19) can be used to calculate the consumers' and producers' surpluses at different price levels under each case mentioned in the previous sections, and then the changes can be calculated by comparing them with the base case as seen in section 3.4. This method is used to determine the changes in consumer and producer surplus that would arise under the different scenarios (see Chapter 4, Section 4.2.5).

The following table provides a summary of the changes in consumers' and producers' surplus given changes in the parameters (τ_A, τ_S), under each of the cases presented in previous sections. Table 3.6.1 lists all the cases and the corresponding effect on consumers' and producers' surplus in the Senegalese groundnut oil market.

Table 3.6.1 Directions of Change in Consumer and Producer Surplus for the REPA and Enhanced GSP Options in the Senegalese groundnut oil market.

	Changes in consumers' surplus, CS_S	**Changes in producers' surplus, PS_S**
REPA Option		
$\tau_S=0$; $\partial\tau_A<0$	**$\partial CS_S > 0$**	**$\partial PS_S < 0$**
$\tau_S=0$; $\tau_A=0$ ($\partial\tau_A=0$)	**$\partial CS_S > 0$**	**$\partial PS_S < 0$**
Enhanced GSP Option		
$\partial\tau_S > 0$; $\partial\tau_A > 0$	**∂CS_S <=> 0** [1]	**∂PS_S <=> 0** [1]
$\partial\tau_S > 0$; $\tau_A=0$ ($\partial\tau_A=0$)	**$\partial CS_S > 0$** [2]	**$\partial PS_S < 0$**
$\partial\tau_S > 0$; $\partial\tau_A < 0$	**$\partial CS_S > 0$** [2]	**$\partial PS_S < 0$**

[1] It is not apparent what the change is, since it depends on the changes in the respective tariff levels for each country, i.e. both changes have an effect on the price level in Senegal.

[2] Derived from the graphical analysis, since it is not readily apparent using (3.18)

Table 3.6.1 shows that neither of the options is necessarily preferred to the status quo. If one looks at total surplus, which is equal to consumers' surplus plus producers' surplus, then one can gauge the total welfare effect on the Senegalese economy of any of the above options, which is done in Chapter 5. This partial welfare analysis will help the Senegalese government in its evaluation of each of the options open to them under the NPA.

3.7 Concluding Remarks

The preceding discussion provides a theoretical analysis of the likely economic impact of the two viable options under the new partnership agreement between the EU and the ACP states on the Senegalese groundnut sector. The REPA option, although not very different from the status quo, seems to be the most viable option of the two being analyzed in the study. Under the enhanced form of the GSP option, Senegal may be in a worse position, but the welfare analysis makes this inconclusive, since it depends on the change in import tariffs between Senegal and its international competitors. The worsening position is primarily due to the decrease in Senegal's margin of preference. The conceptual framework has provided a theoretical analysis of the impact of the two options, but what is needed is the ability to do multi-parametric analysis (sensitivity analysis) and to evaluate the magnitude of the changes that are taking place. Even though the direction of change can be determined theoretically, the quantitative effects must be analyzed to adequately determine the extent of the economic impact of these options. The construction of the empirical model in the next chapter begins this process.

Chapter 4: The Empirical Model

Any model is only an abstraction of reality. Due to the overriding complexity of the economic system, certain assumptions need to be made to establish an operational model. The primary goal of this chapter is to create a realistic working model to analyze the possible choices under the NPA faced by the Senegalese government. The first section of this chapter will lay out the explicit assumptions that are needed to provide an applicable and operational modeling framework. Section two will then develop the empirical model used to analyze the problem statement in Chapter 1 and illustrate how the model is solved using the GAMS (General Algebraic Modeling System) software. Then the third section will examine the baseline data utilized in the formulation of the model. The fourth section will examine the scenarios and cases used to analyze the problem statement and achieve the proposed research objectives. Finally, section five will provide concluding remarks.

4.1 Model Assumptions

The model assumptions can be placed into two groups. The first group of assumptions deals directly with the formulation of the empirical model. The second group of assumptions helps to refine the empirical model and integrate specific aspects of the real world into the modeling framework.

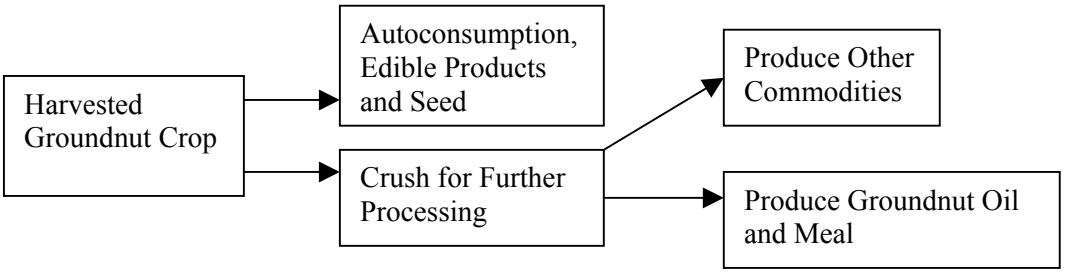
The first set of assumptions relates to the regions and commodities used to construct the model.

Assumption 1: There are three primary groundnut product groupings:
(i) groundnuts (in-shell and shelled), (ii) groundnut oil, and (iii) groundnut meal.

These three groupings arise from the decision process illustrated in Figure 4.1. The figure depicts the decisions that have to be made after the groundnut crop is harvested. It suggests that the production process occurs in two-stages. First, the groundnut crop is produced. Then the a portion of the harvested groundnut crop is sent on for further processing, i.e. to be crushed, to produce other groundnut products, such as oil and meal. The groundnuts that are not sent on for further processing are used for domestic consumption, future seed, and sold as edible products on the domestic and international market.

The groundnut oil and meal product categories represent the portion of the groundnut

Figure 4.1.1 The Decision-making Process in the Groundnuts (In-shell and Shelled) Market



crop that is crushed and is then processed into oil and meal. These two categories are singled out since groundnut oil and meal are significant export commodities for Senegal, which primarily go to the EU (see Chapter 2, Section 2.2.2). The first groundnut product category, groundnuts (in-shell and shelled) is used as a broad grouping to capture a number of markets. Due to the difficulty of finding data for confectionery products exported and produced for all the regions of the empirical model, the groundnuts (in-shell and shelled) product category represents the groundnut crop produced by farmers. It is assumed a proportion of the crop is crushed and used for oil and meal and the rest is used for domestic consumption at the farm-level or in urban centers, export, seed, production of confectionery products, and production of other commodities, e.g. personal hygiene products. Since all Senegalese groundnuts (in-shell and shelled) exports are confectionery (see Chapter 2), the groundnuts product category captures the confectionery market in Senegal. Another benefit of utilizing this broader product category is its usefulness in helping to capture the "to crush or not to crush" decision (see section 4.2.2).

The technological relationship between the production of groundnut oil and groundnut meal gives rise to the second assumption.

Assumption 2: The extraction rate for groundnut oil and groundnut meal from crushed groundnuts is assumed to be constant at base year levels.

Assumption 2 implies the proportion of groundnut oil and meal produced from crushed is a constant percentage of the total amount crushed each year. Recall that groundnut meal is a byproduct from the production of groundnut oil. Thus, the quantity of groundnut meal produced is some fixed proportion (multiple) of the quantity of groundnut oil produced. This result is implied by assumption two.

Assumption 3: All supply regions export groundnut products to the European Union only.

The empirical model incorporates eight supply regions and nine demand regions in a partial equilibrium framework. The eight supply regions are the primary exporters of groundnut products to the EU. They are: Argentina, China, India, Nigeria, Senegal, Sudan, the United States (US), and the Rest of World (ROW). The rest of world category includes other major producers of groundnuts, such as the Gambia, South Africa, and Vietnam (see Chapter 2, Section 2.1). Since these countries are not major contributors to the groundnut trade with the EU, they are put in the ROW category. Assumption 3 is used to focus the analysis only on groundnut trade from the eight supply regions of the model to the European Union. Furthermore, this assumption requires the subtraction of exports to and imports from all other regions except the EU from the benchmark quantities of supply and demand for the eight supply regions.

Assumption 4: Domestic consumption of groundnut products in the EU is provided only by imports from the eight supply regions in the model.

The fourth assumption is drawn from the fact that the ratio of production to imports of groundnut products in the EU is relatively small. The EU produces less than 1% of their total supply of groundnuts (in-shell and shelled), with the rest being imported from other countries. Secondary processing provides less than ten percent of the groundnut products in the other two groundnut product categories (see Appendix A, Section A.2).

The second group of assumptions is used to incorporate specific aspects of the international market for groundnuts. The first of these assumptions deals with the supply prices in specific regions and markets of the model.

Assumption 5: The international market does not determine the domestic supply prices for groundnuts and groundnut oil in India and the United States, and groundnuts in Senegal.

This assumption is included because of price-setting or heavy market regulation that is prevalent in these countries and is further discussed in subsequent sections of the chapter (Chen and Fletcher, 1998; Pomeroy and Govindan, 1998).

Assumption 6: Inventories are assumed to be held constant at the base year levels.

Examination of the opening stocks of each of the product categories for each region shows they remain relatively constant from year to year. Assumption 6 primarily affects the way inventories are handled in the baseline data calculations. As noted in Appendix C, Section C.3, the total supply for each category of groundnut products includes opening stocks, and domestic demand includes ending stocks for each year.

Other assumptions that deal directly with the functional forms of the equations used in the empirical model are discussed in detail in the next section.

4.2 The Empirical Model

A partial equilibrium framework is used to assess the options open to the Senegalese government under the NPA. This framework is used due to the data intensity required for a general equilibrium framework of this magnitude, i.e. at a disaggregated sectoral level. The partial equilibrium framework is based upon the spatial price equilibrium model as stated by Harker and Pang (1990). They represent a spatial price equilibrium as:

$$S_i^n(P_i^n) - D_i^n(P_i^n) + \sum_{k \in I} Q_{ki}^n - \sum_{j \in I} Q_{ij}^n = 0, \quad P_i^n \geq 0, \quad \forall\, i \in I, n \in N \tag{4.1}$$

$$\left[P_i^n + \theta_{ij} - P_j^n\right] Q_{ij}^n = 0, \quad P_i^n + \theta_{ij} - P_j^n \geq 0, \quad Q_{ij}^n \geq 0, \quad \forall\, (i,j) \in I, n \in N, \tag{4.2}$$

where, P_i^n is the price of commodity n in region i, $S_i^n(P_i^n)$ is the supply of commodity n in region i, $D_i^n(P_i^n)$ is the demand for commodity n in region i, Q_{ij}^n is the quantity shipped of commodity n from region i to region j (or k to i), I is the set of regions, N is the set of commodities, and θ_{ij} is the transport cost for shipping a commodity from region i to region j.

Equation (4.1) represents the supply and demand side of the spatial price equilibrium model. Total supply plus imports minus exports for any commodity has to equal total demand for that commodity. Furthermore, "the spatial price equilibrium model states that if goods are shipped between two regions, then competition will bid the net profits down to zero; and if net profit is negative, then no shipments will occur between the regions (Harker and Pang, 1990; p. 204)." This condition is satisfied by equation (4.2), the pricing and arbitrage conditions. For the formulation of the empirical model below, it should be noted that (4.1) can be viewed as two separate equations, i.e.

$$S_i^n(P_i^n) - \sum_{j \in I} Q_{ij}^n - Q_i = 0, \quad D_i^n(P_i^n) - \sum_{k \in I} Q_{ki}^n - Q_i = 0, \quad P_i^n \geq 0, \quad \forall\, i \in I, n \in N, \tag{4.3}$$

where Q_i is the domestic quantity supplied in region i.

Given assumptions three and four in section 4.1, the spatial price equilibrium framework used in this study is a restricted form of the model presented by (4.3) and (4.2). Recall, that the empirical model will only examine trade between the EU and each of the supply regions of the model and that supply in the EU is completely determined by imports from the supply regions. Based on equations (4.3) and (4.2) the restricted model takes the following general form:

$$S_i^n(P_i^n) - Q_{iEU}^n - Q_i = 0, \quad D_i^n(P_i^n) - Q_i = 0, \quad P_i^n \geq 0, \quad \forall\, i \neq EU, i \in I, n \in N \tag{4.4}$$

$$D_{EU}^n(P_{EU}^n) - \sum_{i \in I, i \neq EU} Q_{iEU}^n = 0, \quad P_{EU}^n \geq 0, \quad \forall\, n \in N \tag{4.5}$$

$$\left[P_i^n - P_j^n\right] Q_i^n = 0, \quad P_i^n - P_j^n \geq 0, \quad Q_i^n \geq 0, \quad \forall\, i \neq EU, i \in I, n \in N \tag{4.6}$$

$$\left[P_i^n + \theta_{iEU} - P_{EU}^n\right] Q_{iEU}^n = 0, \quad P_i^n + \theta_{iEU} - P_{EU}^n \geq 0, \quad Q_{iEU}^n \geq 0, \quad \forall\, i \neq EU, i \in I, n \in N \tag{4.7}$$

Assumption three gives rise to the formulations of (4.4), 4.6 and (4.7). The restriction of examining only trade between the supply regions of the model and the EU eliminates all trade between the supply regions of the model in (4.3) giving us the formulation in (4.4). Furthermore, the restriction only requires the inclusion of the international arbitrage and pricing conditions between the supply regions and the EU from (4.2) and the domestic arbitrage conditions in the individual supply regions, thus providing the formulations in (4.6) and (4.7). Assumption four restricts the EU to just being a demand region and gives rise to the formulation in (4.5). The system of equations and inequalities represented by (4.4) through (4.7) provides the basic framework upon which the empirical model will be constructed in the following sub-sections.

4.2.1 Functional Form Assumption

Before providing the formulations of the supply and demand sides of the empirical model, the functional forms used for the supply and demand equations needs to be addressed. There were two major requirements that needed to be met when choosing the functional form. The first requirement was that the functional form had to be able to directly include own-prices, prices of the other commodities used in the model, own-price elasticities, and cross-price elasticities of the other commodities. The cross-price relationships arise due to the substitutability between the three product groupings and the technological relationships between the groupings. The second requirement was the ability to include benchmark price and quantity values (calculated from data in the base year) directly into the supply and demand equations. The inclusion of these points is to subsume other factors not examined by the model and to directly include the production relationships discussed in the previous section.

These requirements give rise to the seventh assumption in the model:

Assumption 7: The supply and demand equations take the following functional form:

$$y = \alpha \prod_t \left(\frac{X_t}{\overline{X}_t} \right)^{\beta_t}, t = 1,...,T.,$$

where y is a quantity variable, α is the benchmark quantity of y, X_t is a factor variable, e.g. price variable, $\overline{X}_t$ is the benchmark value of X_t, and β_t is an elasticity.

This functional form is the calibrated share form of a constant-elasticity-of-substitution (CES) function (Rutherford, 1998), and benchmark values are included explicitly in the functional form. The calibration is done by dividing each of the variables in the function by its benchmark value, i.e. X_t becomes $\frac{X_t}{\overline{X}_t}$. If one starts with the CES function: $y = \prod_t X_t^{\beta_t}$ and calibrates each variable then one gets the following functional form: $\frac{y}{\overline{y}} = \prod_t \left(\frac{X_t}{\overline{X}_t} \right)^{\beta_t}$. By setting $\overline{y} = \alpha$ and multiplying both sides by α the calibrated share form is obtained. One desirable property of this functional form assumption is that changes in prices or factors result in a percentage change in the benchmark quantity amount

4.2.2 Supply Side

Before moving into the formulation of the supply side, it will be helpful to delineate some index sets and notation that will be utilized in the model. The index sets are:

i supply regions: Argentina, China, India, Nigeria, Senegal, Sudan, US, ROW.

j demand regions: Argentina, China, EU, India, Nigeria, Senegal, Sudan, US, ROW.

n commodities: groundnuts (in-shell and shelled), groundnut oil, groundnut meal.

t factors: development funding.

The following subscript notation, $i.j$, will be used to denote exports from region i to region j. The superscript l will be used to denote all cross-price effects from the other commodities in the index set n in a given supply or demand equation. Finally, the following abbreviations are used to denote the three product categories: g for groundnuts (in-shell and shelled), go for groundnut oil, and gm for groundnut meal.

Using the formulation in (4.4) and the functional form assumption, the following formulation for the supply side of the empirical model is derived. For each supply region *i* and each commodity *n*, the supply equation is given by equation (4.8).

$$Q_i^n + Q_{i.EU}^n = \alpha_i^n \left(\frac{P_i^n}{\overline{P}_i^n} \right)^{\varepsilon_i^n} \prod_l \left(\frac{P_i^l}{\overline{P}_i^l} \right)^{\sigma_i^l} \prod_t \left(\frac{X_i^t}{\overline{X}_i^t} \right)^{\varsigma_i^t} \tag{4.8}$$

where: Q_i^n = quantity domestically consumed of commodity *n* in market *i* = *j*,

$Q_{i.EU}^n$ = quantity exported of commodity *n* from market *i* to the EU,

α_i^n = benchmark quantity supplied of commodity *n* in market *i*

P_i^n = the supply price of commodity *n* in market *i*,

P_i^l = the supply price of commodity *l* in market *i*,

$\overline{P}$ = benchmark prices,

X_i^t = factor *t* in market *i*, e.g. development funding,

$\overline{X}_i^t$ = benchmark amount of factor *t* in market *i* in the base year,

ε_i^n = own-price elasticity of supply for commodity *n* in market *i*,

σ_i^l = cross-price elasticity of supply for commodity *l* in market *i*, and

ς_i^t = factor elasticity of supply for factor *t* in market *i*.

4.2.2.1 Development Funding

A component of the supply equation not discussed in detail up to this point is the inclusion of the development funding factor. One of the research objectives of this study is to measure the ability of increases in development funding to offset the negative economic impacts of the REPA and enhanced GSP options of the NPA in the Senegalese groundnut sector. In Chapters 2 and 3, investments in the Senegalese groundnut sector were stressed as a significant component to the future success of the sector. Thus, the inclusion of development funding is included only in the Senegalese groundnuts (in-shell and shelled) supply equation.

The addition of the development-funding factor to the Senegalese groundnuts supply equation is based on a single-supply equation model (as discussed by Alston, Norton, and Pardey (1998)), i.e. development funding is directly included as a variable in the supply equation. One way to measure investments in these models is through the use of research and extension expenditures, government funds, and other financial sources (Alston, Norton and Pardey, 1998). This convention is adopted in this study. Development funding in this study refers to the total amount of STABEX funding received by the Senegalese government in the base year (1998). It is

assumed that this same type of funding will continue under the grant envelope in the cases that will be discussed in the latter half of this chapter. Recall in Chapter 2 that STABEX type funds were used for seed programs, diversification of confectionery groundnut products, privatization efforts, price stabilization, research and development, and credit programs. A benefit of using STABEX funds as a measure is that all of these funds were primarily received for use in the groundnuts sector (see Chapter 1, Section 1.1). The major drawback from the use of this measure is that it is an aggregate measure and thus ignores the distribution of the funds, making it harder to trace the effects of investments (derived from these funds) in the groundnut sector. In addition, STABEX funds do not provide a complete representation of the actual resources utilized, and it ignores the possibilities of monies being carried over to the next year. In essence, the measure used for the development funding factor does not capture the dynamic aspects of investments as a result of the funding in the groundnut sector (Alston, Norton and Pardey, 1998).

There are some other issues about the method used to incorporate development funding in the empirical model that are discussed by Alston, Norton and Pardey in their text, *Sceince Uncder Scarcity* (1998). The first issues deal with time lags in investment research and adoption. Alston, Norton and Pardey (1998) state that

> "there are long, variable, and uncertain lags in the interval between commencing a research activity and generating useful knowledge, as well as between generating new technology and seeing it adopted. Further, once research leads to an increment in the stock of knowledge or an improvement in technology, that increment to knowledge or improvement in technology yields a stream of future benefits that continues until the knowledge or new technology becomes obsolete (p. 29)."

Other dynamic issues mentioned in the text include depreciation, maintenance research and adjustment costs (Alston, Norton and Pardey, 1998). Due to the comparative static nature of this study these issues cannot be adequately addressed. Therefore, it is implicitly assumed that development funds are a positive stimulus in the Senegalese groundnut sector for the purposes of the simulations conducted. The other primary issues discussed by Alston, Norton, and Pardey (1998) include uncertainty, measurement error, transactions costs, technology and price spillovers, the effects of marketing and processing research, market distortion, government intervention, and the list goes on. Thus, to deal with these issues it is assumed that the factor elasticity of supply for development funding in the groundnuts supply equation for Senegal is relatively inelastic, i.e. the proportionate effect of an increase in development funding will be small in relation to the increase in development funding. The derivation of this elasticity is

discussed further in Appendix A, Section A.1. An in-depth analysis of these issues is left as a suggestion for future research.

The inclusion of the development funding factor in Senegal's groundnuts supply equation is for the purpose of measuring the ability of increases in development funding to offset the negative effects of the two trade options under the NPA. The way development funding is incorporated in the empirical model doesn't completely address all the issues that arise when examining these types of investments in the Senegalese groundnut sector, but delving into such topics is beyond the scope of this study. Therefore, the procedure laid out above is the one adopted in subsequent sections of this text.

4.2.2.2 The Groundnut Oil and Meal Supply Equations

This section discusses the specific formulation of the groundnut oil and meal supply equations due to the technological linkage between groundnut oil and meal and the two-stage production process discussed in section 4.1.

It was suggested earlier that the groundnuts production process occurs in two stages. First, the groundnut crop is grown and harvested. Then it has to be decided what portion of the harvested groundnut crop will be crushed for use in producing groundnut oil and meal (see Figure 4.1.1). The important aspect of this decision process that needs to be captured here is the decision of what percentage of the groundnut harvest or equivalently the groundnuts (in-shell and shelled) product category should be crushed. This decision needs to be reflected in the groundnut oil and meal supply equations. To accomplish this task the following method is used: Recall that assumption 2 states that the extraction rate for groundnut oil and groundnut meal are a constant percentage of crushed groundnuts. Let c_{go} and c_{gm} represent these extraction rates for groundnut oil and meal from the total amount of groundnuts crushed. Now, let c_{gc} equal the percentage of groundnuts that are crushed for further processing from the total amount of groundnuts produced (this percentage is not fixed), and let α_g, α_{gc} α_{go}, and α_m denote the benchmark quantities supplied of groundnuts, crushed groundnuts, groundnut oil and groundnut meal respectively. Note that α_{gc} is not known. From assumption 2 and the fact that crushed groundnuts can be represented as a constant percentage of total groundnut production the following relationships can be defined.

$$c_{gc} \cdot \alpha_g = \alpha_{gc} \tag{4.9}$$

$$c_{go} \cdot \alpha_{gc} = \alpha_{go} \tag{4.10}$$

Equations (4.9) and (4.10) further imply that $c_{go}\alpha_{gc} = c_{go}c_{gc}\alpha_g = \alpha_{go}$. Rearranging this last equation provides,

$$c_{go}c_{gc} = \frac{\alpha_{go}}{\alpha_g} \tag{4.11}.$$

If one substitutes the subscript *gm* for *go* in (4.11), then the same relationship can be defined for groundnut meal, i.e. $c_{gm}c_{gc} = \frac{\alpha_{gm}}{\alpha_g}$. Since c_{go} is a known constant, the decision of how many groundnuts (in-shell and shelled) to crush can be represented by determining c_{gc}, the only unknown element in (4.11). By assuming that expectations/preferences are adaptive, i.e. they are dependent on the last period, equation (4.11) provides a mechanism to determine this decision (percentage) by utilizing the benchmark quantities of groundnuts and groundnut oil and meal. When building this into the supply side framework, the benchmark quantities of groundnut oil and groundnut meal will be a percentage of total groundnuts (in-shell and shelled) production e.g. in the supply equation for groundnut oil $\alpha_{go} = \frac{\alpha_{go}}{\alpha_g}(Q_i^g + Q_{i.EU}^g)$ for all i. Thus, the two-stage production process represented by the direct inclusion of the crush decision in the supply equations for oil and meal, which makes the crush decision price responsive to the price of the three groundnut product categories examined in the model. The supply equations for groundnut oil and meal take the following form for each supply region of the model: For convenience let m = groundnut meal or groundnut oil,

$$Q_i^m + Q_{i.EU}^m = \frac{\alpha_i^m}{\alpha_i^g}\left(Q_i^g + Q_{i.EU}^g\right)\left(\frac{P_i^m}{\overline{P}_i^m}\right)^{\varepsilon_i^m}\prod_l\left(\frac{P_i^l}{\overline{P}_i^l}\right)^{\sigma_i^l}\prod_t\left(\frac{X_i^t}{\overline{X}_i^t}\right)^{\varsigma_i^t} \quad . \tag{4.12}$$

In section 4.1, it was mentioned that there is a technological relationship between groundnut oil and groundnut meal. More specifically, that groundnut meal is a by-product from the production of groundnut oil. Given assumption two, it should make sense that the quantity of groundnut meal produced should be equal to a constant multiple of groundnut oil, i.e. using equations (4.9) and (4.10): $\alpha_{gm} = \frac{c_{gm}}{c_{go}}\alpha_{go}$ or

$$\frac{c_{go}}{c_{gm}} = \frac{\alpha_{go}}{\alpha_{gm}} \quad . \tag{4.13}$$

Equation (4.13) states that the ratio of groundnut oil production to groundnut meal production should be constant. Thus, any changes in the prices of the three commodity categories in the model should not alter the relationship given by (4.13). This relationship is not built directly into the model, but is captured by the own-price and cross-price elasticities used in the groundnut oil and meal supply equations. For example, the own-price supply elasticities in the Senegalese groundnut oil and meal supply equations are equal to their respective cross-price supply elasticities in the other (oil or meal) supply equation, i.e. $\varepsilon^{go} = \sigma^{go}$ and $\varepsilon^{gm} = \sigma^{gm}$. Examining the supply elasticities in Appendix A, Section A.1 gives this result. A price change in any one of the product categories should cause the same percentage changes in both the groundnut oil and meal supply equations. Simulations and analyses of the production ratios at baseline and after the simulation have confirmed that most of the time the relationship defined by (4.13) holds within reasonable bounds[1].

This provides the base of the supply side of the empirical model.

4.2.3 Demand Side

Using the formulation in (4.4) and the functional form assumption, the demand side of the empirical model can be derived. Each region in the model is represented by the following demand equation:

$$Q_j^n = \beta_j^n \left(\frac{P_j^n}{\overline{P}_j^n} \right)^{\eta_j^n} \prod_l \left(\frac{P_j^l}{\overline{P}_j^l} \right)^{\kappa_j^l}, \tag{4.13}$$

where Q_j^n = quantity domestically consumed of commodity n in market j,
β_j^n = benchmark quantity demanded of commodity n in market j,
P_j^n = the demand price of commodity n in market j,
P_j^l = the demand price of commodity l in market j,
$\overline{P}$ = benchmark prices,
η_j^n = own-price elasticity of demand for commodity n in market j, and
κ_j^l = cross-price elasticity of demand for commodity l in market j.

Due to assumption four (giving rise the formulation in 4.5), the demand in the EU can be expressed as:

[1] Times when it did not hold corresponded to zero changes in one of the equations or changes that were very minute in scale, i.e. less than 0.01 percent. Reasonable bounds are defined as ± 0.05.

$$\sum_i Q^n_{i.EU} = \beta^n_{EU}\left(\frac{P^n_{EU}}{\overline{P}^n_{EU}}\right)^{\eta^n_{EU}} \prod_l \left(\frac{P^l_{EU}}{\overline{P}^l_{EU}}\right)^{\kappa^l_{EU}} . \tag{4.14}$$

4.2.4 Arbitrage and Pricing Conditions

Arbitrage and pricing conditions are necessary to ensure that an equilibrium point (or optimal solution) is obtained. These conditions are set-up both domestically and internationally. The partial equilibrium model being utilized does not include intercountry trade except with the EU (which is treated as a single homogenous region). Thus the arbitrage and pricing conditions need to be adjusted accordingly, so domestic arbitrage conditions are introduced and only the international arbitrage conditions between the EU and the eight supply regions remain. These conditions can be thought of as zero profit conditions as in a general equilibrium modeling framework (see Rutherford, 1998). Once a zero profit level is established for a product, the production of that product ceases. In addition, assumption five must also be incorporated into this framework. To accomplish this, a new variable will be introduced into the model, W^n_i, which is incorporated into the following three pricing and arbitrage conditions:

$$P^n_i + W^n_i \geq P^n_j \quad \forall \quad i = j\,, \tag{4.15}$$

$$W^n_i \geq P^n_j - \overline{P}^n_i \quad \forall \quad i = j \text{ , and} \tag{4.16}$$

$$P^n_i + W^n_i + \theta_i \geq (1-\tau^n_i)P^n_{EU} \quad \forall \quad i \text{ ,} \tag{4.17}$$

where W^n_i = price differential,

θ_i = transportation costs from region *i* to the EU, and

τ_i = the import tariff into the EU on commodity *n* from region *i*.

The variable W^n_i ensures that prices not determined by the international market are not affected by disturbances in that market. For example, in Senegal, certain prices are determined domestically, i.e. by price-setting, so the international market should not affect these prices in the model. If the domestic price is above the international price, then the product associated with that price is not exported due to relationship (4.17), but if it the domestic price were below the international price, then without (4.16) and the inclusion of W^n_i, the model would increase the domestic price to reach equilibrium. This outcome is undesirable if the international market does not play a direct role in determining the domestic price. Thus, the W^n_i variable is primarily of use when the price is substantially below the market price due to the nature of the market in the country being examined. In essence, the W^n_i variable fixes the supply price in certain domestic

markets due to either price-setting or other domestic regulatory institutions. The fixing of the supply price arises due to the complementarity condition:

$$W_i^n(W_i^n - P_j^n + \overline{P}_i^n) = 0, \quad W_i^n \geq 0 \ \ \forall\, i = j \tag{4.18}$$

(see section 4.2.6). The complementarity condition: $Q_i^n(P_i^n + W_i^n - P_j^n) = 0$ for $i = j$ (see section 4.2.6) implies $P_j^n - P_i^n = W_i^n > 0$ if $Q_i^n > 0$ for $i = j$ and $P_i^n \neq P_j^n$, otherwise $W_i^n = 0$[1]. This reasoning implies that if $W_i^n > 0$ and $Q_i^n > 0$ for $i = j$, then $P_i^n = \overline{P}_i^n$, since $P_j^n - W_i^n = P_i^n = \overline{P}_i^n$ under these conditions. See section four of this chapter for further discussion of the benchmark prices utilized by the model, and when the W_i^n variable is utilized.

The pricing and arbitrage conditions imply the following eighth assumption:

Assumption 8: The international marketplace for groundnut products is assumed to be perfectly competitive.

This assumption arises because the zero profit conditions still have to be met by the model. If one of these conditions is not met, it implies that a region does not either export or produce certain groundnut products associated with the constraint that is not met.

4.2.5 Calculation of Consumer and Producer Surplus

Measures of consumer and producer surplus were discussed in Chapter 3, Section 3.7. This section examines issues regarding the calculation of these measures due to the functional form assumption assumed above. Furthermore, due to the focus of the study, consumer and producer surplus is calculated only for Senegal.

To expedite this process define $\hat{P}_S^n$ as the prevailing supply price of commodity *n* in Senegal that is determined by the model, $\hat{P}_D^n$ as the prevailing demand price of commodity *n* in Senegal that is determined by the model, and $\left(\hat{Q}_S^g + \hat{Q}_{S.EU}^g\right)$ as the equilibrium quantity of supply

[1] Note that when $W_i^n = 0 \Rightarrow P_i^n \geq P_j^n$ and $P_j^n \leq \overline{P}_i^n$. Since at equilibrium $P_i^n = P_j^n$, then there is an implicit constraint that $P_i^n \leq \overline{P}_i^n$ i.e. P_i^n has an upper bound of $\overline{P}_i^n$. After repeated simulations of the empirical model with and without the use of W_i^n it was found that this implicit constraint was not binding and had no direct impact on baseline replication.

for groundnuts (in-shell and shelled) determined by the model, where *S* refers to Senegal. Now define:

$$\overline{QP_g} = \alpha_S^g \prod_l \left(\frac{\hat{P}_S^l}{\overline{P}_S^l} \right)^{\sigma_S^l} \prod_t \left(\frac{X_S^t}{\overline{X}_S^t} \right)^{\varsigma_S^t} \tag{4.19}$$

$$\overline{QP_m} = \frac{\alpha_S^m}{\alpha_S^g} \left(\hat{Q}_{SEN}^g + \hat{Q}_{SEN.EU}^g \right) \prod_l \left(\frac{\hat{P}_S^l}{\overline{P}_S^l} \right)^{\sigma_S^l} \prod_t \left(\frac{X_S^t}{\overline{X}_S^t} \right)^{\varsigma_S^t}, \text{ where m is defined above, and} \tag{4.20}$$

$$\overline{QD_n} = \beta_S^n \prod_l \left(\frac{\hat{P}_S^l}{\overline{P}_S^l} \right)^{\kappa_S^l}. \tag{4.21}$$

Using these simplifications and tools, one can now more easily show what consumer and producer surplus will equal.

By examination of the supply equations (equation (4.4)), $Q_S^n + Q_{S.EU}^n = 0$, when $P_S^n = 0$. Thus, the supply curve originates from the origin. Taking the definite integral from the origin to $\hat{P}_S^n$ will give the amount of producer surplus in market *n*, i.e.

for groundnuts:

$$PS_g = \int_0^{\hat{P}_S^g} S(P_S^g) dP_S^g = \frac{\overline{QP_g} \left(\hat{P}_S^g \right)^{\varepsilon_S^g + 1}}{\left(1 + \varepsilon_S^g \right) \left(\overline{P}_S^g \right)^{\varepsilon_S^g}}, \text{ and} \tag{4.22}$$

for groundnut oil and groundnut meal:

$$PS_m = \int_0^{\hat{P}_S^m} S(P_S^m) dP_S^m = \frac{\overline{QP_m} \left(\hat{P}_S^m \right)^{\varepsilon_S^m + 1}}{\left(1 + \varepsilon_S^m \right) \left(\overline{P}_S^m \right)^{\varepsilon_S^m}}, \tag{4.23}$$

where m = groundnut oil or meal. These results are derived fully in Appendix C, Section C.2.

The calculation of consumer surplus is not so straightforward. When $P_j^n = 0, Q_j^n = 0$ and $\sum_i Q_{i.EU}^n = 0$, making the demand curve asymptotic to both the price and quantity axes. Thus, the amount of consumer surplus will always be some constant approximation, given the prices of the other commodities, and is obtained by taking the limit of the integral over the demand curve along the price axis. This result is further discussed in Appendix C, Section C.2. If a reasonable $a < \infty$ is chosen, then the following definite integral and consumer surplus measure can be defined:

$$CS_n = \int_{\hat{P}_D^n}^{a} D(P_S^n)dP_S^n = \frac{\overline{QD}_n}{\left(1+\eta_S^n\right)\left(\overline{P}_S^n\right)^{\eta_S^n}}\left[a^{\eta_S^n+1} - \left(\hat{P}_D^n\right)^{\eta_S^n+1}\right], \text{ where } a < \infty. \tag{4.24}$$

The above calculation of consumer surplus does not provide a reasonable measure of consumer surplus in the base year, but does allow a reasonable calculation of changes in consumer surplus from the baseline replication of the model, i.e. one can calculate the change in consumer surplus as $\Delta_{CS}^n = CS_1 - CS_0$. These calculations though should only be taken as indications of the direction of change in consumer surplus when examining the results. See Appendix C, Section C.2 for a full explanation and derivation of these conditions. In the model then, only the changes in consumer and producer surplus in each of the groundnut product markets are examined.

4.2.6 The Complementarity Problem

The classical approach to modeling multi-commodity spatial (partial) price equilibrium models is via the optimization of a quasi - welfare function. To see this let $S_i^n = P_i^n(Q_i^n, Q_{i.EU}^n)$, denote the inverse supply equation of commodity *n* in region *i*. Then let $D_j^n = P_j^n(Q_j^n, Q_{i.EU}^n)$, denote the inverse demand equation of commodity *n* in region *j*. Further let $Z := (Q_{i.EU}^n \forall \text{ i})$ and $T := (\theta_i \forall\, i)$, which are defined in the previous sections. The associated optimization problem would then take the form (in the current modeling framework):

$$\begin{aligned}
\max \quad & W = \sum_n \sum_i \int_0^{Q_i^n} D_i^n d(Q_i^n) + \sum_n \int_0^{\sum_i Q_{i.EU}^n} D_{EU}^n d(\sum_i Q_{i.EU}^n) - \sum_n \sum_i \int_0^{Q_i^n + Q_{i.EU}^n} S_i^n d(Q_i^n + Q_{i.EU}^n) - \sum_n T'Z \\
\textit{subject to}: \quad & Q_i^n \geq D_i^n \quad \forall\, i,n \\
& \sum_i Q_{i.EU}^n \geq D_{EU}^n \quad \forall\, n, \\
& S_i^n \geq Q_i^n + Q_{i.EU}^n \quad \forall\, i,n \\
& (Q_i^n, Q_{i.EU}^n) \geq 0 \quad \forall\, i,n.
\end{aligned} \tag{4.25}$$

In essence one is maximizing total surplus in all *n* markets and *j* regions subject to supply, demand, and non-negativity constraints. The objective function is known as a 'quasi-welfare function' since it only measures the welfare for a limited number of products over a specific set of regions. Takayama and Judge developed this approach in their text, *Spatial and Temporal Price*

and Allocation Models. This modeling approach in the context of the empirical model defined in the previous section is of limited use for two main reasons. First, the demand curve is asymptotic to both axes making the integral over the inverse of the demand curve indefinite. Thus, only an approximation could be defined by taking the limit of the integral, and in that case the value of this measure is not meaningful (see section 4.2.5) for any given Q_i^n or $\sum_i Q_{i.EU}^n$, and does not provide a workable framework under which to simulate the model. The second issue is that the above formulation requires that the matrix of cross-price elasticities be symmetric for all regions of the model. This symmetry is not assumed in the context of the current model being examined and is not the case, as can be seen by examining the elasticities in Appendix A, Section A.1.

Rutherford (1998) suggests a more suitable framework for analyzing this problem. He notes,

> " Economic equilibrium models are typically used to assess the consequences of market distortions, typically in the form of taxes, tariffs, or other types of government policies. … When ad-valorem taxes are present, the NLP (Non-linear Programming) formulation of a market equilibrium problem is not straight-forward. No single optimization problem characterizes the equilibrium because the resulting allocation is inefficient. Such an equilibrium could be computed by solving a sequence of nonlinear programs, but in these cases an [mixed complementarity programming] formulation is certainly more transparent." (Rutherford, 1998; 125)

Given the issue of integrability, the mixed complementarity programming (MCP) approach to simulating the model is more desirable. In fact, the integrability issue is sidestepped since the MCP formulation does not formally involve the use of an objective function. The general MCP problem is defined as follows:

$$\begin{aligned} \textit{Given}: \quad & F: R^n \to R^n \quad \textit{and} \quad l, u \in R^n \\ & \textit{Find}: \quad (z, w, v) \in R^n \\ & \textit{s.t.} \quad F(z) - w + v = 0 \\ & \quad l \le z \le u, \quad w \ge 0, \quad v \ge 0, \\ & w'(z - l) = 0, \quad v'(u - z) = 0, \end{aligned} \tag{4.26}$$

where $-\infty \le l \le u \le +\infty$ and $F(z)$ is continuously differentiable (Rutherford, 1998; 119). This formulation provides an ideal framework for the empirical model as presented above, by addressing the problems encountered when examining the classical approach as presented by Takayama and Judge.

In the context of this study, the mixed complementarity problem can be illustrated in the following way (Rutherford, 1998). First one can define the transportation problem:

$$\begin{aligned}
&\text{(a)} \quad \min \quad \sum_n \sum_i \theta_i \cdot Q^n_{i.EU} \\
&\text{(b)} \quad s.t. \quad Q^n_i \geq D^n_i \quad \forall\, i,n \\
&\text{(c)} \quad \sum_i Q^n_{i.EU} \geq D^n_{EU} \quad \forall\, n \\
&\text{(d)} \quad S^n_i \geq Q^n_i + Q^n_{i.EU} \quad \forall\, i,n \\
&\text{(e)} \quad (Q^n_i, Q^n_{i.EU}) \geq 0 \quad \forall\, i,n.
\end{aligned} \tag{4.27}$$

Note that in this formulation S^n_i and D^n_j are specific quantities of supply and demand, not functions. If one examines the shadow prices that arise from the dual of (4.27), then one will find that the shadow prices associated with the first set of constraints, (4.27) (b), are $P^n_j \ \forall\ j,n$, where $i = j$. The shadow prices corresponding to the second set of constraints, (4.27) (c), are $P^n_{EU} \ \forall\ n$. The shadow prices associated with (4.27) (d) are $P^n_i \ \forall\ i,n$ where all these price variables were defined in the previous section.

Using the shadow prices (dual variables), one can now cast the problem as a system of inequalities and complementary slackness conditions. Both the primal and dual problems are utilized to yield the following linear complementarity formulation:

$$\begin{aligned}
&\text{(a)} \quad Find: \quad (Q^n_i, Q^n_{i.EU}, W^n_i, P^n_i, P^n_j) \ \forall\, i,j,n \\
&\text{(b)} \quad s.t. \quad Q^n_i \geq D^n_i, \quad P^n_j \geq 0, \quad P^n_j (D^n_i - Q^n_i) = 0 \quad \forall \quad i,n, j = i \\
&\text{(c)} \quad \sum_i Q^n_{i.EU} \geq D^n_{EU}, \quad P^n_{EU} \geq 0, \quad P^n_{EU} (D^n_{EU} - \sum_i Q^n_{i.EU}) = 0 \quad \forall \quad n \\
&\text{(d)} \quad S^n_i \geq Q^n_i + Q^n_{i.EU}, \quad P^n_i \geq 0, \quad P^n_i (S^n_i - Q^n_i - Q^n_{i.EU}) = 0 \quad \forall \quad i,n \\
&\text{(e)} \quad P^n_i + W^n_i \geq P^n_j, \quad Q^n_i \geq 0, \quad Q^n_i (P^n_i + W^n_i - P^n_j) = 0 \quad \forall \quad i,n, j = i \\
&\text{(f)} \quad W^n_i \geq P^n_j - \overline{P}^n_i, \quad W^n_i \geq 0, \quad W^n_i (W^n_i - P^n_j - \overline{P}^n_i) = 0 \quad \forall \quad i = j,n \\
&\text{(g)} \quad P^n_i + W^n_i + \theta_i \geq (1 - \tau^n_i) P^n_{EU}, \quad Q^n_{i.EU} \geq 0, \quad Q^n_{i.EU} (P^n_i - W^n_i - \theta_i - (1 - \tau^n_i) P^n_{EU}) = 0 \ \forall\, i,n
\end{aligned} \tag{4.28}$$

The above formulation has been modified from (4.27), to include the pricing and arbitrage conditions previously discussed, instead of the ordinary profit conditions that are usually used in this formulation (Rutherford, 1998).

Instead of using fixed quantities of supply and demand, the supply and demand equations can be substituted into (4.28) to make the model price responsive. Once this is done, the above

linear complementarity problem will become a nonlinear complementarity problem. The revised formulation is shown in (4.29).

(a) $\quad Find: \quad (Q^n_{i=j}, Q^n_{i.EU}, W_i{}^n, P^n_i, P^n_j) \; \forall \, i, j, n$

(b) $\quad s.t. \quad Q^n_i \geq \beta^n_j \left(\frac{P^n_j}{\overline{P}^n_j} \right)^{\eta^n_j} \prod_l \left(\frac{P^l_j}{\overline{P}^l_j} \right)^{\kappa^l_j}, \quad P^n_j \geq 0,$

$$P^n_j \left(\beta^n_j \left(\frac{P^n_j}{\overline{P}^n_j} \right)^{\eta^n_j} \prod_l \left(\frac{P^l_j}{\overline{P}^l_j} \right)^{\kappa^l_j} - Q^n_i \right) = 0 \quad \forall \quad i = j, n$$

(c) $$\sum_i Q^n_{i.EU} \geq \beta^n_{EU} \left(\frac{P^n_{EU}}{\overline{P}^n_{EU}} \right)^{\eta^n_{EU}} \prod_l \left(\frac{P^l_{EU}}{\overline{P}^l_{EU}} \right)^{\kappa^l_{EU}}, \quad P^n_{EU} \geq 0,$$

$$P^n_{EU} \left(\beta^n_{EU} \left(\frac{P^n_{EU}}{\overline{P}^n_{EU}} \right)^{\eta^n_{EU}} \prod_l \left(\frac{P^l_{EU}}{\overline{P}^l_{EU}} \right)^{\kappa^l_{EU}} - \sum_i Q^n_{i.EU} \right) = 0 \quad \forall \quad n \qquad (4.29)$$

(d) $$\alpha^g_i \left(\frac{P^g_i}{\overline{P}^g_i} \right)^{\varepsilon^g_i} \prod_l \left(\frac{P^l_i}{\overline{P}^l_i} \right)^{\sigma^l_i} \prod_t \left(\frac{X^t_i}{\overline{X}^t_i} \right)^{\varsigma^t_i} \geq Q^g_i + Q^g_{i.EU}, \quad P^g_i \geq 0,$$

$$P^g_i \left(\alpha^g_i \left(\frac{P^g_i}{\overline{P}^g_i} \right)^{\varepsilon^g_i} \prod_l \left(\frac{P^l_i}{\overline{P}^l_i} \right)^{\sigma^l_i} \prod_t \left(\frac{X^t_i}{\overline{X}^t_i} \right)^{\varsigma^t_i} - Q^g_i - Q^g_{i.EU} \right) = 0 \quad \forall \quad i$$

(e) $$\frac{\alpha^m_i}{\alpha^g_i} \left(Q^g_i + Q^g_{i.EU} \right) \left(\frac{P^n_i}{\overline{P}^n_i} \right)^{\varepsilon^n_i} \prod_l \left(\frac{P^l_i}{\overline{P}^l_i} \right)^{\sigma^l_i} \prod_t \left(\frac{X^t_i}{\overline{X}^t_i} \right)^{\varsigma^t_i} \geq Q^m_i + Q^m_{i.EU}, \quad P^m_i \geq 0,$$

$$P^m_i \left(\frac{\alpha^m_i}{\alpha^g_i} \left(Q^g_i + Q^g_{i.EU} \right) \left(\frac{P^n_i}{\overline{P}^n_i} \right)^{\varepsilon^n_i} \prod_l \left(\frac{P^l_i}{\overline{P}^l_i} \right)^{\sigma^l_i} \prod_t \left(\frac{X^t_i}{\overline{X}^t_i} \right)^{\varsigma^t_i} - Q^m_i - Q^m_{i.EU} \right) = 0 \quad \forall \quad i, m$$

(f) $\quad P^n_i + W_i{}^n \geq P^n_j, \quad Q^n_i \geq 0, \quad Q^n_i (P^n_i + W_i{}^n - P^n_j) = 0 \quad \forall \quad i = j, n$

(g) $\quad W_i{}^n \geq P^n_j - \overline{P}^n_i, \quad W_i{}^n \geq 0, \quad W_i{}^n (W_i{}^n - P^n_j - \overline{P}^n_i) = 0 \quad \forall \quad i = j, n$

(h) $\quad P^n_i + W_i{}^n + \theta_i = (1 - \tau^n_i) P^n_{EU}, \quad Q^n_{i.EU} \geq 0,$

$$Q^n_{i.EU} (P^n_i - W_i{}^n - \theta_i - (1 - \tau^n_i) P^n_{EU}) = 0 \; \forall \, i, n$$

The problem shown here represents the formulation of the empirical model as an MCP. GAMS programming software will be used for the simulations needed to obtain the model results for the scenarios and cases that are discussed in the fourth section of this chapter. The MILES or Mixed Inequality and nonlinear Equation Solver is utilized in GAMS to solve the MCP formulation of the empirical model (see Rutherford, 1993).

The above discussion indicates how the problem is actually solved using the formulation of the empirical model in sections 4.2.2 - 4.2.4. In Appendix C, the GAMS code for the

simulation of the empirical model is provided. For further reading on complementarity problems please see Cottle, Pang and Stone 1992, Rutherford 1993 and 1998, and Harker and Pang 1990.

4.3 Benchmark Parameters

The calculation of the benchmark parameters is needed to specify the parameter values in the empirical model, i.e. $(\alpha_i^n, \beta_j^n, \varepsilon_i^n, \eta_j^n, \kappa_j^l, \sigma_i^l, \varsigma_i^t, \overline{P}_i^n, \overline{P}_j^n, \overline{X}_i^t, \theta_i, \sigma_i^n)$. This section will discuss issues associated with the collection and calculation of the benchmark parameters. These issues center on the elasticities, the prices used in the model, and the calculation of transportation costs. Table 4.3.1 gives the benchmark price, supply, and demand parameters used for each region of the model. A complete description of the parameter values used is provided in Appendix C, Section C.3 with a summary of how the values were calculated.

The first task in collecting information for the model was to acquire elasticity estimates for each region of the model. Own-price elasticities for each commodity and each region, as well as cross-price elasticities between each of the commodities in each region were collected. In total 154 elasticities were needed. Appendix A, Section A.1 provides all the elasticities utilized in the formulation of the empirical model. Due to the lack of recent studies that provide estimates of elasticities for groundnut products, elasticity estimates were obtained from the SWOPSIM database of the U.S. Department of Agriculture (Sullivan, et al., 1992). Although groundnuts are not directly offered as a category in the database, SWOPSIM has elasticity estimates for the category, "other oilseeds" (not including soybean products), for both the demand and supply side for each region of the model. When possible, SWOPSIM elasticity estimates were replaced with specific groundnut elasticity estimates from other studies, especially those estimated for the Senegalese groundnut sector.

The second issue relates to the use of domestically determined supply prices for groundnut products in India, Senegal, and the United States. The domestic supply prices in these regions are predominantly determined via price-setting, production quotas, and other domestic mechanisms. The decision to utilize the domestic supply price for a region of the model was done when data was available.

In Senegal, the producer price for groundnuts at the farmgate is set by CNIA, an interprofessional committee commissioned by the Senegalese government. Thus, this price is used as the supply price for Senegal's groundnuts supply equation in the empirical model.

Table 4.3.1 Benchmark Parameters Used for the Baseline Simulation of the Model for 1998

Region	Supply Price[1] ($/MT)	Demand Price[2] ($/MT)	Domestic Supply[3] (1000 MT)	Domestic Demand[4] (1000 MT)
	Groundnuts			
Argentina	1039.55	1039.55	560.2	309
China	1040.38	1040.38	7057.7	6956
European Union	N/A	1055	0	587.679
India	391.242	1038.22	7476	7430
Nigeria	1044.58	1044.58	1310	1310
Senegal	215.864	1042.5	525.5	521
Sudan	1042.45	1042.45	572	567
Unites States	610	1044.65	1363.6	1245
ROW[1]	1041.77	1041.77	3985	3898.6
	Groundnut Oil			
Argentina	897.458	897.458	47	10.6
China	898.288	898.288	1862.4	1862.4
European Union	N/A	964	0	190.229
India	1121.94	1121.94	1725	1725
Nigeria	953.58	953.58	309.7	305.5
Senegal	951.5	951.5	50.2	4
Sudan	951.45	951.45	167.3	122.7
Unites States	1080	1080	78.4	77.5
ROW[1]	909.318	909.318	564.3	515.5
	Groundnut Meal			
Argentina	118.55	118.55	109.7	65.6
China	119.38	119.38	2563.3	2563.3
European Union	N/A	134	0	204.1
India	117.22	117.22	2290	2290
Nigeria	123.58	123.58	368.4	368.4
Senegal	121.5	121.5	57.5	20
Sudan	121.45	121.45	271.6	163.8
Unites States	123.65	123.65	83.6	69
ROW[5]	120.77	120.77	654.9	654.9

Sources: See Appendix 1

[1] Supply Prices are calculated using data from Appendix A, Sections A.4 thru A.6 as follows: (EU Price)*(1 – tariff) – (transportation costs), except when the price is determined domestically.

[2] Demand Prices are calculated using data from Appendix A, Sections A.4 thru A.6 as follows: (EU Price)*(1 – tariff) – (transportation costs), except when the price is determined domestically.

[3] Supply is calculated using data from Appendix A, Sections A.2 and A.3 as follows: (Production) + (Opening Stocks) – (Exports to regions other than the EU)

[4] Domestic Consumption (Demand) is calculated using data from Appendix A, Section A.2 as follows: (Domestic Demand) – (Imports). In the EU it is equal to imports due to the assumption that the EU does not produce any of its own domestic demand. This calculation is done using data from Appendix A, Section A.3

[5] ROW = Rest of World

The US government establishes a production quota on groundnut production each year. Any groundnuts sold up to the set quota are guaranteed a support price. After the quota is met, any additional production receives a lower price, called the additionals price (Chen and Fletcher,1998). The average price received for additionals in 1998 was below the world average for groundnuts (in-shell and shelled) (Economic Research Service, 1999). A switch to growing additionals in place of quota peanuts is not deemed beneficial for farmers due to the loss in income that they would face (Chen and Fletcher, 1998). For the purpose of this study, it is assumed that the quota system is the most significant factor influencing the quantity supplied of groundnuts (in-shell and shelled) in the United States. Thus, the support price is deemed as the significant determinant of U.S. groundnuts (in-shell and shelled) supply. This assumption is further supported by the fact that the support price has been higher than the market price in the United States since 1992 (Economic Research Service, 1999). In addition, the U.S. domestic supply price for groundnut oil is utilized in the model, since the United States is a net importer of groundnut oil.

In India, the domestic prices for groundnuts and groundnut oil are used since the Indian government provides supports for their domestic farm prices, and India is not an exporter of groundnut oil to the EU. The domestic price for groundnut meal is not utilized due to data availability.

These are the three main regions where domestic prices were used to accommodate a more accurate viewpoint of the international groundnut market. The use of these domestic prices in the model led to the formulation of the altered pricing and arbitrage conditions encountered in section 4.2.4, i.e. these are the regions where the W_i^n variable was utilized. All other prices in the empirical model are determined via the international prices, and are adjusted accordingly to account for transportation costs and tariffs (see Table 4.4.1).

The final issue to discuss in relation to the baseline data used in the model is the calculation of transportation costs. Due to the difficulty of obtaining direct transportation costs from each supply region of the model to the EU, freight costs determined by the U.S. Department of Agriculture were used from select ports to the EU. Shipping lanes from regions close to the supply regions used in the model to the EU were utilized to determine these prices, by averaging over the cost of shipping along those lanes in 1998. See Appendix A, Section A.4, for further detail on the shipping lanes chosen for the derivation of the transportation costs used for each region in the model.

4.4 Scenarios and Cases

Two scenarios are examined in this study. Each scenario represents one of the options open to Senegal, the REPA and the enhanced GSP options. For each scenario, thirteen policy alternatives were examined, thus a total of twenty-six cases were analyzed. The policy alternatives are related to: (1) changes in international trade regimes and tariff schemes, (2) increases in development funding to Senegal, (3) changes in transportation costs in Senegal, and (4) domestic market liberalization in Senegal. The scenarios and policy alternatives are presented in Table 4.4.1. Appendix D presents the simulations results of each of the cases described.

The relationships between the other regions of the model and the EU need to be mentioned briefly. Argentina, China, and India are currently subject to the GSP, which has an import duty on groundnut oil of 5.3% (in 1998). The United States is granted most-favored nation status by the EU giving them a 7.6% ad valorem import tariff rate on groundnut oil entering the EU (in 1998). Nigeria and the Sudan are ACP states and are currently subject to the provisions of the Lomé Convention until 2008 under the NPA, thus all of their groundnut products enter the EU duty free. The rest of world category has an array of countries that are subject to all three of the agreements mentioned above, thus an average ad valorem import tariff rate of 4.3% is used for this region of the model (see Appendix A, section A.5). Remember that all confectionery groundnut products and groundnut meal enter the EU duty free. When any of these agreements are altered or enhanced, such as under the GSP scenario, all countries subject to that agreement will be affected. These changes will be indicated in the following subsections as well.

4.4.1 REPA and Enhanced GSP Scenarios

The first scenario is the REPA under which it is assumed that Senegal chooses to enter into a regional economic partnership agreement between the EU and WAEMU, as a member of WAEMU. As mentioned earlier, the REPA scenario is very similar to the status quo, under the fourth Lomé Convention. Senegal faces no import tariffs on groundnut products entering the EU under Lomé and thus no tariff situation would continue under the REPA due to the FTA. Thus, the policy alternatives that are examined relate to alternative economic arrangements that need to be considered when Senegal makes a decision to enter into a REPA between the EU and WAEMU. In addition, changes in development funding, transportation infrastructure, and domestic market liberalization are also examined.

The second scenario is the Enhanced GSP option. Under this scenario, Senegal would face an increase in the import tariff only on Senegalese groundnut oil entering the EU. This increase affects oil only because confectionery groundnut products and groundnut meal from any

country enter the EU duty free. Under the GSP, groundnut oil is subject to an ad-valorem import duty rate of 5.3% (in 1998). The cases examined under this scenario relate to Senegal moving directly to the current GSP and to an enhanced form with lower duties, which would probably occur in 2004 at the next ten-year review of the GSP (see Chapter 2, Section 2.4.4). These enhancements would benefit all countries subject to the GSP, e.g. Argentina, China, India, and the Rest of World. The cases also include alternative economic arrangements that could have an impact on this decision.

4.4.2 Changes in Trade and Tariff Regimes

The first set of cases examine only the trade aspects of the two options and assume that the aid and development aspects of the NPA, as well as domestic policies remain unchanged. The trade aspects are related to direct changes in the trade arrangements between Senegal and the EU, and other economic trading arrangements that could have a significant economic impact.

Under a REPA, Senegal will be part of an FTA between the EU and WAEMU. Thus, Senegal will face no import duties on any groundnut products entering the EU, which is currently the case under the status quo (or current Lomé Convention). Therefore, the simulations focus on additional economic arrangements that could have an impact on Senegal's decision in 2004. The first two cases under the REPA scenario concern Argentina moving to an FTA (as a member of MERCOSUR) with the EU, and countries currently under the GSP (Argentina, China, India, and Rest of World) receiving an enhanced form of the GSP. These are presented in Table 4.4.1

Under an enhanced form of the GSP, the base cases are represented by the first four cases under the enhanced GSP scenario in Table 4.4.1. The first case is Senegal moving to the current GSP, i.e. Senegal's import tariff on groundnut oil entering the EU would increase from 0 to 5.3%. The second case examines the potential impact of Argentina moving to an FTA between the EU and MERCOSUR, while at the same time Senegal moves to the GSP. The third case expands on the first case by allowing differentiation in the tariff rates between countries of origin, i.e. Senegal's import tariff on groundnut oil entering the EU would be a percentage of the GSP duty rate in the base year (all GSP countries would benefit from this reduction). The fourth case examines an expansion of case three, by assuming that Nigeria and the Sudan (ACP states) move to the enhanced form of the GSP (instead of choosing to move to a REPA). This last case is interesting since it examines the case where the REPA option is found to be infeasible for other ACP countries (Sudan and Nigeria in particular).

4.4.3 Increases in Development Funding

Development funding is very important for the future of the Senegalese confectionery groundnut sector. Development funding in this context refers to the types of funds received by Senegal under the STABEX program. In the modeling framework previously described, a mechanism was provided to evaluate the impact of increases in development funding on the Senegalese groundnut sector. Incorporating development funding as a factor in the Senegalese groundnuts supply equation achieved this objective.

Cases 3 and 4 under the REPA scenario are used to examine the impact of an increase in development funding, ceteris paribus. This examination is done by increasing development funding (based on STABEX levels) in the baseline case by 5% and 10% respectively, and holding everything else constant. Cases 3 and 4 suggest what the direct impact of development funding might be, independent of any other changes in the model. The ability (if any) of development funding to offset any negative economic impacts of the REPA or enhanced GSP scenarios is also analyzed (Cases 5 and 6 under the REPA scenario and Cases 5 - 7 under the enhanced GSP scenario).

4.4.4 Decreases in Transportation Costs from Senegal to the EU

Investments made in transportation and export diversification in Senegal play a vital role in the future of the groundnut sector. Cases dealing with a decrease in transportation costs from Senegal to the EU relate to infrastructural investments, the lack of which might present a barrier to the feasibility of both the REPA or enhanced GSP. These cases are modeled as an alternative to an increase in development funding and are incorporated in the model by decreasing transportation costs in the pricing and arbitrage conditions. The reason for using the transportation costs is that investments made in the transportation sector in Senegal (see Chapter 2, Section 2.3) have a direct effect on the export of groundnut products to the EU from Senegal. Cases 7 and 8 under the REPA scenario examine a direct decrease in transportation costs by 5% and 10% respectively, ceteris paribus. Cases 9 and 10 under the REPA scenario look at how a decrease in Senegal's transportation costs can be used to offset any negative economic impact on the Senegalese groundnut sector, given the baseline cases mentioned above. Cases 8 - 10, under the Enhanced GSP scenario, analyze how investments in infrastructure can mitigate the effects of the GSP option.

Table 4.4.1 Scenarios and Cases Used for the Simulation of the Empirical Model

Case	REPA Scenario	Case	Enhanced GSP Scenario
Changes in Trade and Tariff Regimes			
1	Argentina moves to an FTA between MERCOSUR and the EU. This amounts to the import tariff on groundnut oil from Argentina going to the EU decreasing from 5.3 % to 0 %.	**1**	Senegal's import tariff on groundnut oil entering the EU increases to the GSP level of 5.3%.
2	Senegal chooses to move to a REPA and import duties are decreased by 20 % for all countries subject to the GSP.	**2**	Senegal's import tariff on groundnut oil entering the EU increases to the GSP level of 5.3% and Argentina moves to an FTA.
		3	Senegal's import tariff on groundnut oil entering the EU increases to a level for some enhanced form of the GSP. In this case, all GSP countries are affected. GSP duties are decreased by 20% for all groundnut products.
		4	Case 3 with the Sudan and Nigeria moving to the enhanced form of the GSP instead of a REPA.
Increases in Development Funding			
3	A 5 % increase in development funding to Senegal.	**5**	An increase in development funding of 5% in combination with Case 1.
4	A 10 % increase in development funding to Senegal	**6**	An increase in development funding of 5% in combination with Case 2.
5	A combination of Case 1 and Case 3.	**7**	An increase in development funding of 5% in combination with Case 3.
6	A combination of Case 2 and Case 3.		
Decreases in Transportation Costs from Senegal to the EU			
7	A decrease in Senegal's transportation costs by 5 %.	**8**	A decrease in Senegal's transportation cost by 5 % in combination with Case 1.
8	A decrease in Senegal's transportation costs by 10%	**9**	A decrease in Senegal's transportation costs by 5 % in combination with Case 2.
9	A combination of Case 1 and Case 7.	**10**	A decrease in Senegal's transportation cost by 5 % in combination with Case 3.
10	A combination of case 2 and case 7.		
Domestic Market Liberalization in the Senegalese Groundnut Sector			
11	Senegal lets the producer price for groundnuts to be set by the market.	**11**	Senegal lets the producer price for groundnuts to be set by the market in combination with Case 1.
12	A combination of Case 1 and Case 11.	**12**	Senegal lets the producer price for groundnuts to be set by the market in combination with Case 2.
13	A combination of Case 2 and Case 11.	**13**	Senegal lets the producer price for groundnuts to be set by the market in combination with Case 3.

4.4.5 Alternative Pricing Mechanisms in the Senegalese Groundnut Sector. (Domestic Market Liberalization)

The transition from the producer price for groundnuts in Senegal set by CNIA to a market determined price could have a significant effect on the Senegalese groundnut sector, and should be considered given the continuing structural adjustment policies in the country. The true market price is unknown, and the market has never determined the producer price for groundnuts in Senegal since 1960. The baseline supply price for groundnuts is recomputed using the ROW price and substituted into the model. This substitution has the effect of making $W^{g}_{SEN} = 0$, and the supply function is assumed to then be price responsive. Note that the quantity supplied of groundnuts was non-responsive to the price for groundnuts (determined by CNIA), but now it will be responsive, allowing one to gauge the effect of such a change in the pricing structure in the Senegalese groundnut sector. This analysis is conducted in much the same fashion as was done in 4.4.3 and 4.4.4. Case 11 looks at the baseline case where the pricing mechanism is altered to a market-determined price. Case 12 and 13 re-examine the two baseline cases under the REPA option in the context of case 11. Cases 11 - 13 re-examine the three baseline cases under the Enhanced GSP option in the context of Case 11.

4.5 Concluding Remarks

The road taken in this chapter has led us to a working empirical framework under which the problem statement and research objectives stated in chapter one can be analyzed. The formulation of the empirical model is the key part of this chapter, and therefore consisted of the majority of the discussion. The discussion on mixed complementarity programming provided a brief analysis of how the model is solved in GAMS and provided an alternative way to view the model as a complementarity problem. The third section of the chapter discussed issues pertaining to the baseline data used in the model to specify the needed parameters to make the model operational. The fourth section provides the scenarios and cases that will be utilized to analyze the two options open to the Senegalese government under the NPA. This chapter has completed the empirical model. The results of the simulations conducted using that model are examined next in Chapter 5.

Chapter 5: Model Results

This chapter presents the results of the simulation of the empirical model under each of the scenarios and cases presented in the preceding chapter (see Chapter 4, Section 4.4). The simulation of these cases is an example of multi-parametric analyses, meaning one or more parameters were changed in the empirical model for each simulation conducted. This multi-parametric examination allows a sensitivity analysis of the model to be completed, in addition to the economic evaluation of the model results. Thus, these analyses will allow us to examine the model results in two ways, economically and structurally. The structural examination focuses on the sensitivity of the model to changes in the exogenous parameters.

The chapter is organized as follows. Section one presents the results of the baseline replication. Sections two and three examine cases dealing with different trade and tariff regimes that could arise under the REPA and GSP scenarios respectively. Section four looks at the economic impact of an increase in development funding in conjunction with the different trade and tariff regimes examined in sections two and three. Sections five and six mirror section four, but examine a decrease in transportation costs and a change in the pricing mechanism in the Senegalese groundnut sector. Finally, section seven provides some overall conclusions from the twenty-six cases simulated using the empirical model. Any structural issues that arose during the simulations will be discussed as necessary. The model results for all the simulations of the twenty-six cases for all nine regions examined in the model are provided in Appendix D.

5.1 Baseline Replication

Due to the nature of an economic equilibrium model, baseline replication is a very important aspect of the modeling procedure. Baseline replication is the modeler's starting point for simulations, and replication of the baseline signifies that the model can adequately represent the reality it is purporting to examine. Thus, it is important to briefly examine the results of the baseline replication of the empirical model constructed in Chapter 4.

Baseline replication results are provided in Table 5.1.1 for Argentina, Senegal, and the EU and in Appendix D, Section D.1 for the remaining regions. When these results are compared

Table 5.1.1 Results of Baseline Replication for Argentina, Senegal, and the European Union

Results	**Senegal**	**Argentina**	**European Union**
Groundnuts			
Supply Price[1]	251.864	1036.763	N/A
Demand Price[1]	1039.713	1036.763	1052.213
Domestic Supply[2]	525.5	559.148	0
Domestic Demand[2]	521.412	309.366	588.794
Exports to the EU[2]	4.088	249.782	0
Groundnut Oil			
Supply Price[1]	955.517	901.262	N/A
Demand Price[1]	955.517	901.262	968.017
Domestic Supply[2]	50.252	47.011	0
Domestic Demand[2]	3.997	10.556	189.786
Exports to the EU[2]	46.255	36.455	0
Groundnut Meal			
Supply Price[1]	121.214	118.264	N/A
Demand Price[1]	121.214	118.264	133.714
Domestic Supply[2]	57.559	109.725	0
Domestic Demand[2]	20.009	65.686	204.454
Exports to the EU[2]	37.55	44.039	0

[1] Dollars per MT

[2] 1000 MT

to the original baseline data in Table 4.3.1 in Chapter 4 (see also Appendix D, Table D.1.2), the results show that the replication of the baseline case (i.e. the status quo) was accurate within approximately one percent of the calculated benchmark parameters. The greatest percentage difference was 1.09 %, with the majority of the remaining results deviating by less than 0.42 %. After numerous simulations, it was determined that these deviations arose due to the inclusion of the production relationships in the supply equations for groundnut oil and meal (see Chapter 4, Section 4.2.2.2). The inclusion of the quantity variables for groundnuts (in-shell and shelled) in the supply equations for oil and meal (equation (4.12) in Chapter 4) caused the other price and quantity variables to adjust, so these supply equations would be satisfied as equalities. (This equality condition arises due to the positive values associated with the price variables that are

complementary to the respective supply equations in the MCP formulation of the empirical model (see Chapter 4, Section 4.2.6)). Thus, the empirical model is deemed adequate for simulating and being used to examine the twenty-six cases under the REPA and enhanced GSP scenarios.

5.2 Changes in Trade and Tariff Regimes Under the REPA Scenario

This section examines the two cases that are the foundation for the analyses of a REPA between Senegal and the EU. Case 1 examines the situation where Argentina enters into an FTA with the European Union, and Case 2 examines the situation where duties decrease by twenty percent for all products subject to the GSP. The model results for these two cases are provided in Tables 5.2.1 and 5.2.2 for Argentina, Senegal, and the European Union. Results for all regions are provided in Appendix D, Tables D.2.1 and D.2.2.

5.2.1 Case 1: Argentina moves to an FTA between MERCOSUR and the EU.

If Argentina enters into a free trade arrangement with the EU, via MERCOSUR, the import duty on Argentine groundnut oil would decrease from 5.3% (the baseline level in 1998) to 0%. Following the model results for this case in Table 5.2.1, the lower tariff on groundnut oil increases the price of groundnut oil in the Argentine market, causing the domestic supply of oil to increase, domestic demand for oil to decrease, and exports of groundnut oil to increase. As seen in Chapter 3, the effect of a decrease in Argentina's ad-valorem import tariff on groundnut oil decreases the price of groundnut oil in Senegal. This result arises due to the international arbitrage conditions in the empirical model, examined in Chapter 4. The decrease in Senegal's price for groundnut oil induces a decrease in their domestic supply of groundnut oil and in turn a decrease in Senegalese exports of groundnut oil going to the EU. Domestic demand for oil in Senegal remains unchanged. Since the EU is only a demand region in the model, a decrease in Argentina's tariff results in a decrease in the EU's price for oil, which increases domestic demand in the EU. The increase in domestic demand is satisfied solely by an increase in oil imports from Argentina.

Due to the technological relationship between groundnut oil and groundnut meal, which is captured by the cross-price elasticities in the groundnut oil and meal supply equations, the price for groundnut meal decreases in all regions of the model. In Argentina, the increase in oil production induces a surplus of meal in the Argentine market, which is denoted by the increase in groundnut meal production. The surplus induces a decrease in the price for meal, which results in an increase in domestic demand. The increase in demand is not enough to offset the increase in supply, so the surplus is exported to the EU. In Senegal, the decrease in the domestic supply of

Table 5.2.1 Model Results for Case 1 Under the REPA Scenario

		Amount Change from Baseline Case		
Results	**Baseline (1998): Senegal**	**Senegal**	**Argentina**	**European Union**
Groundnuts				
Supply Price[1]	251.864	0	0.116	N/A
Demand Price[1]	1039.713	0.116	0.116	0.116
Domestic Supply[2]	525.5	0	0.044	0
Domestic Demand[2]	521.412	-0.083	2.498	-0.215
Exports to the EU[2]	4.088	0.083	-2.454	0
Change in Consumer Surplus[3]	N/A	-92.731	N/A	N/A
Change in Producer Surplus[3]	N/A	0	N/A	N/A
Groundnut Oil				
Supply Price[1]	955.517	-0.499	50.806	N/A
Demand Price[1]	955.517	-0.499	50.806	-0.499
Domestic Supply[2]	50.252	-0.024	0.819	0
Domestic Demand[2]	3.997	0	-0.558	0.055
Exports to the EU[2]	46.255	-0.024	1.377	0
Change in Consumer Surplus[3]	N/A	1.995	N/A	N/A
Change in Producer Surplus[3]	N/A	-36.375	N/A	N/A
Groundnut Meal				
Supply Price[1]	121.214	-0.37	-0.37	N/A
Demand Price[1]	121.214	-0.37	-0.37	-0.37
Domestic Supply[2]	57.559	-0.026	1.911	0
Domestic Demand[2]	20.009	0.013	0.111	0.459
Exports to the EU[2]	37.550	-0.039	1.8	0
Change in Consumer Surplus[3]	N/A	2.237	N/A	N/A
Change in Producer Surplus[3]	N/A	-22.302	N/A	N/A

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

groundnut oil results in a decrease in the production of groundnut meal. The increase in exports of meal from Argentina induces an excess supply of meal in the world market at baseline prices, thus inducing the price for meal to decrease in all supply regions of the model. This price decrease induces a decrease in domestic demand in Senegal and an increase in demand in the EU. Thus, Senegalese exports of meal decrease. Overall, the markets in all regions of the model adjust so Argentina's excess supply of groundnut meal is absorbed by the European Union.

The groundnuts market in the empirical model represents the whole of the groundnut crop produced in each region of the model. It was assumed that the groundnut crop was harvested and then utilized for further processing (i.e. crushed), domestic purposes (such as seed and domestic consumption) or confectionery products. Furthermore, it was assumed that the groundnut crop (or groundnuts product category) is first harvested and then the decision of what portion of the crop to use for further processing is made (see Chapter 4 for a detailed discussion). For Argentina, the increase in the domestic supply of groundnut oil results in an increase in the domestic demand for groundnuts (to be crushed). The increase in the domestic demand for groundnuts is a result of a shift from exporting groundnuts to consuming them domestically, and from an increase in Argentina's domestic supply, due to an increase in the price for groundnuts. The price increases for groundnuts due to the excess demand in the international market as a result of the large decrease in Argentine exports. Thus, exports in the other supply regions of the model (Senegal included) increase, and domestic demand in these regions decreases. The changes in Senegalese exports of groundnuts going to the EU (given in Table 5.2.1), represent changes in the export of confectionery groundnut products (see Chapter 4).

Another way to examine the impact on the Senegalese groundnut sector is via the use of welfare analysis or the effects on consumer and producer surplus. Using the results provided in Table 5.2.1, consumer and producer surplus (in all three markets combined) decrease by $88,499 and $50,677 respectively. These results indicate that if Argentina does enter into a FTA with the EU, the overall net effect on the Senegalese groundnut sector would be essentially zero. The decreases in consumer and producer surplus are negligible, given that groundnut production accounts for half of Senegal's agricultural output, which is roughly estimated at about $400 - $500 million (SESRTCIC, 2001; U.S. Department of State, 1998). This result indicates that consumers and producers would be relatively unharmed by Argentina's choice of whether or not to enter into an FTA with the EU. Overall, exports of confectionery products from Senegal increase, but trade in groundnut meal and oil is dampened.

5.2.2 Case 2: The GSP is enhanced by a 20% decrease in import duties.

This case examines the situation where Senegal enters into a REPA, and concurrently duties on all products subject to the GSP are decreased by twenty percent. The decrease in import duties only directly affects the price of groundnut oil, since all other groundnut products enter the EU duty free. Thus, the import duty on groundnut oil decreases in Argentina, China, India, and the ROW region. Overall, the decrease in tariffs for GSP countries has the same economic impact in Argentina (and consequently China, India, and the ROW) as in Case 1, but of a lesser magnitude, i.e. the decrease in the ad valorem tariff is only 20%, not 100% (as in Case 1). The outcome in Senegal (and other ACP countries, e.g. Nigeria and Sudan) and the European Union is the same as under Case 1, but of a larger magnitude, due to the greater number of regions that are affected by the decrease in GSP duties.

The regions that experienced a decrease in import duties under the GSP increased their production of groundnut oil, and in turn decreased their exports of groundnuts (in-shell and shelled) to the EU. This result is expected, given the implication of the production relationship between groundnuts and groundnut oil discussed in the previous sub-section (and in Chapter 4). The decrease in groundnuts exports results in an excess demand for groundnuts in the EU that has to be satisfied by the other supply regions, so groundnuts exports increase in Senegal, Nigeria, Sudan, and the United States. The model results for Senegal, Argentina, and the European Union are provided in Table 5.2.2.

The overall effects of this case for the Senegalese groundnut sector are the same as in section 5.2.1, but of a greater magnitude. The changes in the export levels of each of the commodity categories is about four times greater then under case #1. Producers who export confectionery groundnut products might benefit more from a decrease in tariff levels under the GSP, but overall this is not evident. Consumer and producer surplus (in all three markets combined) both decrease under this case. Consumer surplus decreases by $167,131 and producer surplus by $398,727, but these changes are insignificant overall (as seen in the previous sub-section). Thus, consumers and producers although affected slightly, overall will not feel the impact of an enhanced GSP if Senegal remains in a REPA with the EU.

5.3 Changes in Trade and Tariff Regimes Under the Enhanced GSP Scenario.

This section examines four cases that analyze the impact of Senegal moving to an enhanced form of the GSP. Case 1 examines what would happen if Senegal were subject to baseline (1998) GSP tariff levels. Case 2 examines the situation where Argentina enters into a

Table 5.2.2 Model Results for Case 2 Under the REPA Scenario

		Amount Change from Baseline Case		
Results	**Baseline (1998): Senegal**	**Senegal**	**Argentina**	**European Union**
Groundnuts				
Supply Price[1]	251.864	0	0.054	N/A
Demand Price[1]	1039.713	0.054	0.054	0.054
Domestic Supply[2]	525.5	0	0.021	0
Domestic Demand[2]	521.412	-0.385	0.144	-1.181
Exports to the EU[2]	4.088	0.385	-0.123	0
Change in Consumer Surplus[3]	N/A	-197.633	N/A	N/A
Change in Producer Surplus[3]	N/A	0	N/A	N/A
Groundnut Oil				
Supply Price[1]	955.517	-7.497	3.082	N/A
Demand Price[1]	955.517	-7.497	3.082	-7.497
Domestic Supply[2]	50.252	-0.122	0.048	0
Domestic Demand[2]	3.997	0.006	-0.036	0.829
Exports to the EU[2]	46.255	-0.128	0.084	0
Change in Consumer Surplus[3]	N/A	29.987	N/A	N/A
Change in Producer Surplus[3]	N/A	-378.865	N/A	N/A
Groundnut Meal				
Supply Price[1]	121.214	-0.085	-0.085	N/A
Demand Price[1]	121.214	-0.085	-0.085	-0.085
Domestic Supply[2]	57.559	-0.14	0.114	0
Domestic Demand[2]	20.009	0.003	0.025	0.105
Exports to the EU[2]	37.550	-0.143	0.088	0
Change in Consumer Surplus[3]	N/A	0.515	N/A	N/A
Change in Producer Surplus[3]	N/A	-19.862	N/A	N/A

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

FTA with the EU and Senegal moves to the GSP (no change). Case 3 examines the case where Senegal moves to an enhanced form of the GSP (tariffs decreased by twenty percent on all products subject to the GSP). Case 4 examines the situation where Nigeria and the Sudan, as well as Senegal move to some enhanced form of the GSP. Model results for the simulations of each of the cases are provided for in Tables 5.3.1 thru 5.3.4, for Senegal, Argentina, and the EU and in Appendix D, Tables D.3.1 thru D.3.4 for all regions of the model.

5.3.1 Case 1: Senegal's import duty on groundnut oil increases to GSP (1998) levels

Under this case, Senegalese groundnut oil being exported to the EU would be subject to an ad valorem import duty rate of 5.3%. As seen in Chapter 3, Section 3.5, Senegal's margin of preference in the groundnut oil market is reduced putting Senegal is on an equal footing with a number of its competitors, e.g. Argentina, China, and India. The Sudan and Nigeria actually gain a margin of preference over Senegal under this case, but their gain is not significant when the actual magnitudes of the changes are examined (see Appendix D, Section D.3.1).

When Senegalese groundnut oil becomes subject to ad-valorem import duties under the GSP, the price for groundnut oil in Senegal decreases (by 5.3%), a portion of the difference between the oil and new price now going to the EU as tariff revenue. The price decrease results in a decrease in the domestic supply of oil and an increase in domestic demand for oil, making exports of Senegalese groundnut oil to the EU decrease. Due to the technological relationship between oil and meal, the decrease in the supply of oil results in an excess demand for groundnut meal in Senegal, bidding the price of meal up. The increased price of meal decreases domestic supply and exports of meal, bringing the market back into equilibrium. Furthermore, the decrease in groundnut oil consumption decreases the demand for crushed groundnuts, resulting in a excess supply of groundnuts (in-shell and shelled) in the Senegalese market. The excess supply pushes the price for groundnuts down, thereby decreasing domestic demand and increasing exports of groundnuts, since supply is fixed (due to price-setting policies in the sector). Overall, Senegal becomes less competitive in the groundnut oil and meal markets, but becomes more competitive in the confectionery market. (Recall that the increase in groundnuts exports is in edible groundnut products.)

For Senegal, the severity of the overall economic impact is dependent upon the viewpoint adopted by the Senegalese government. Changes in consumer surplus in all of the groundnut markets are essentially zero when compared to the overall size of the groundnut sector in Senegal. There is a significant change in producer surplus for the groundnut oil market, about a $50 million industry (estimated using data in Appendix A). The decrease in producer surplus in this

Table 5.3.1 Model Results for Case 1 Under the Enhanced GSP Scenario

		Amount Change from Baseline Case		
Results	**Baseline (1998): Senegal**	**Senegal**	**Argentina**	**European Union**
Groundnuts				
Supply Price[1]	251.864	0	-0.236	N/A
Demand Price[1]	1039.713	-0.236	-0.236	-0.236
Domestic Supply[2]	525.5	0	-0.089	0
Domestic Demand[2]	521.412	-2.545	0.035	0.1
Exports to the EU[2]	4.088	2.545	-0.124	0
Change in Consumer Surplus[3]	N/A	-1018.525	N/A	N/A
Change in Producer Surplus[3]	N/A	0	N/A	N/A
Groundnut Oil				
Supply Price[1]	955.517	-51.039	0.266	N/A
Demand Price[1]	955.517	-51.039	0.266	0.28
Domestic Supply[2]	50.252	-0.82	0.002	0
Domestic Demand[2]	3.997	0.044	-0.003	-0.03
Exports to the EU[2]	46.255	-0.864	0.005	0
Change in Consumer Surplus[3]	N/A	205.101	N/A	N/A
Change in Producer Surplus[3]	N/A	-2543.303	N/A	N/A
Groundnut Meal				
Supply Price[1]	121.214	0.025	0.025	N/A
Demand Price[1]	121.214	0.025	0.025	0.025
Domestic Supply[2]	57.559	-0.939	0.004	0
Domestic Demand[2]	20.009	0	-0.008	-0.032
Exports to the EU[2]	37.550	-0.938	0.012	0
Change in Consumer Surplus[3]	N/A	-0.153	N/A	N/A
Change in Producer Surplus[3]	N/A	-102.163	N/A	N/A

[1] Dollars per MT

[2] 1000 MT

[3] Millions of dollars (Not calculated for Argentina and the European Union)

market, $2,543,303, is about 5.3 % of total industry output, a substantial decrease. More interesting is the fact that the decrease is about equal to the rate of the ad valorem import tariff under the GSP. This result seems to signify that the burden of the tariff is primarily put on the producers in the market. In addition, the decrease in producer surplus in the groundnut meal market is also noticeable (about 1.5% of total output, calculated using baseline results), which is expected given the technological relationship between oil and meal. The benefit of the increase in groundnut exports has to be weighed against this outcome when the option of an enhanced GSP is considered, making the position of the Senegalese government with regards to the future of the groundnut sector important.

The other regions of the model react to the decrease in Senegal's margin of preference by increasing exports of groundnut oil and meal to the EU, but decrease exports of groundnuts (in-shell and shelled). In the groundnut oil market, the decrease in exports of oil from Senegal results in an excess demand for groundnut oil at existing world prices, so the groundnut oil price bids up in the other supply regions and these regions begin producing more oil. The increase in oil is accompanied by a decrease in domestic demand (due to the higher price of oil) in all demand regions except Senegal, resulting in an increase in groundnut oil exports from the other supply regions, which brings the market back to equilibrium. Due to the excess demand for groundnut meal in the market, as a result of the tariff imposed on Senegal, the price of groundnut meal increases in all regions, inducing an increase in the domestic supply, decrease in domestic demand and increase in exports of groundnut meal The increase in the price of groundnuts is due to an excess supply of groundnuts in the international market as a result of the increase in exports from Senegal. Thus, domestic supply and export to the EU of groundnuts from all the other supply regions decrease, while domestic demand in all these regions (and the EU) increase. Senegal's exports of groundnuts increase by enough to offset the decrease in exports from the other supply regions and satisfy the increase in the quantity demanded in the EU.

5.3.2 Case 2: Senegal is subject to GSP tariff levels and Argentina enters into an FTA with the EU.

This case examines the economic impact of Senegal moving to the GSP (under the status quo), while at the same time Argentina decides to enter into an FTA with the EU. The interesting aspect of this case is that two tariffs are changing simultaneously in the model. The import duty on groundnut oil from Argentina being exported to the EU decreases, while the duty on oil from Senegal increases. The model results for Senegal and Argentina are the same as those under the

cases examined in sections 5.2.1 and 5.3.1, but in some instances the magnitudes of the changes in the price and quantity variables are greater in this case.

For the other regions in the empirical model, the results are dependent upon the magnitudes of the changes in the import tariffs on Argentine and Senegalese groundnut oil going to the EU, i.e. the outcome in any of the other regions of the model is somewhat uncertain ex ante. The groundnuts (in-shell and shelled) market in China is a good example of this uncertain outcome (see Appendix D, Section D.3.2). Using the results of Case 1 under the REPA and enhanced GSP scenarios as a foundation, it would be expected that the changes in the price, domestic supply, and domestic demand of groundnuts is uncertain. Under Case 1 of the REPA scenario, China's price for groundnuts increased, domestic supply increased, domestic demand decreased, and exports increased. Under Case 1 of the enhanced GSP scenario, the price for groundnuts decreased, domestic supply decreased, domestic demand increased, and exports decreased. Thus, the expected results in China's groundnut market are uncertain ex ante, i.e. they are dependent upon the magnitude of the changes and the resulting economic impact of the import tariff changes for Senegal and Argentina.

The model results for this simulation are provided in Table 5.3.2. The changes in Senegal and Argentina are for the most part consistent with the model results for the cases examined in sections 5.3.1 and 5.3.2, respectively. The only changes that need further explanation are the decrease in the price of groundnuts and groundnut meal. Due to the technological relationship between groundnuts oil and meal, the changes in the import tariff on oil results in an excess supply of groundnut meal in the international market, which bids the price of groundnut meal down. The excess supply arises since the increase in oil supply in Argentina increases the supply of meal in the world market by an amount greater than the decrease in the supply of meal from Senegal, and the excess meal in Argentina is exported. The price for groundnuts increases in all regions of the model. Examining the elasticities in Appendix A, Section A.1 will show that for consumers, groundnut oil is a substitute for groundnuts (in-shell and shelled), i.e. an increase in the price of groundnut oil increases the demand for groundnuts. Furthermore, the cross-price elasticity of demand for groundnut oil is significant when compared to the own-price elasticity of demand for groundnuts in the groundnuts supply equation. In most supply regions of the model (not affected by tariff changes) the price for groundnut oil declines, resulting in an inward clockwise shift of the groundnuts demand curve, putting downward pressure on the price for groundnuts. In addition, the international arbitrage and pricing conditions discussed in Chapter 4 must be satisfied. Recall that regions that trade with the EU must satisfy the conditions and require that the price in each of

Table 5.3.2 Model Results for Case 2 Under the Enhanced GSP Scenario

		Amount Change from Baseline Case		
Results	**Baseline (1998): Senegal**	**Senegal**	**Argentina**	**European Union**
Groundnuts				
Supply Price[1]	251.864	0	-0.088	N/A
Demand Price[1]	1039.713	-0.088	-0.088	-0.088
Domestic Supply[2]	525.5	0	-0.033	0
Domestic Demand[2]	521.412	-2.593	2.569	-0.03
Exports to the EU[2]	4.088	2.593	-2.602	0
Change in Consumer Surplus[3]	N/A	-1110.75	N/A	N/A
Change in Producer Surplus[3]	N/A	0	N/A	N/A
Groundnut Oil				
Supply Price[1]	955.517	-51.476	51.125	N/A
Demand Price[1]	955.517	-51.476	51.125	-0.18
Domestic Supply[2]	50.252	-0.831	0.833	0
Domestic Demand[2]	3.997	0.044	-0.561	0.02
Exports to the EU[2]	46.255	-0.875	1.394	0
Change in Consumer Surplus[3]	N/A	206.864	N/A	N/A
Change in Producer Surplus[3]	N/A	-2567.558	N/A	N/A
Groundnut Meal				
Supply Price[1]	121.214	-0.069	-0.069	N/A
Demand Price[1]	121.214	-0.069	-0.069	-0.069
Domestic Supply[2]	57.559	-0.951	1.945	0
Domestic Demand[2]	20.009	0.003	0.02	0.086
Exports to the EU[2]	37.550	-0.954	1.924	0
Change in Consumer Surplus[3]	N/A	0.419	N/A	N/A
Change in Producer Surplus[3]	N/A	-108.428	N/A	N/A

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

these supply regions equal the EU price minus transportation costs. Putting all the changes in the groundnuts market together resulted in the price for groundnuts in all supply regions of the model declining. (Note: the absolute value of the price changes in the groundnut oil market for most of the regions were of a greater magnitude than the changes in the groundnuts market.) Thus, in the EU domestic demand for groundnuts declines as well, due to the leftward shift in demand.

The changes in exports for the other supply regions in the groundnuts market varied. Exports of groundnuts increased in China and the United States, while they decreased in India, Sudan, and the Rest of World. The increased competitiveness of Argentina in the groundnut oil and meal markets resulted in a decrease in exports of oil and meal for the other supply regions of the model. These results provide an illustration of the type of outcomes that can arise in multi-parametric analyses.

The economic impact on the Senegalese groundnut sector is mixed. While exports of groundnuts (in-shell and shelled) increase, the effects on consumer and producer surplus are not positive. Overall the changes in consumer and producer surplus in all three markets combined are negligible, but examining the markets individually reveals that the change in producer surplus for the oil and meal markets are significant. These decreases make the producers of oil and meal worse off in the Senegalese economy. Furthermore, Senegal becomes less competitive in the groundnut oil and meal markets. Increases in investments in infrastructure and export diversification, as was examined in Chapter 3, could help Senegal overcome any adverse economic impacts caused by this situation. These options are examined further in subsequent sections.

5.3.3 Case 3: The GSP is enhanced by decreasing import duties by 20% and Senegal moves to the GSP.

In this examination, import duties on all products covered by the GSP decrease by twenty percent, while at the same time the government of Senegal decides to decline the REPA option and move to the GSP. Thus, Senegal's import tariff on groundnut oil increases to 4.24% (instead of 5.3% under the status quo). Countries already subject to the GSP, e.g. Argentina, China, and India, also receive this rate. The absolute value of the change in the import duty in Senegal is greater that the change in the other regions, i.e. in terms of the conceptual model $|\tau_S| > |\tau_A|$. Model results are reported in Table 5.3.3.

The economic impact of the imposition of the tariff on Senegal is the same as in Case 1 in Section 5.3.1. In the groundnut oil market, the price for groundnut oil declines resulting in a

decrease in domestic supply, an increase in domestic demand, and a decrease in the export of groundnut oil. Due to the technological relationship between oil and meal, the domestic supply of meal declines. The requirement that the international arbitrage and pricing conditions be satisfied results in a decline in the price for groundnut meal. This decrease results in an increase in the domestic consumption of meal in Senegal and a decrease in meal exports to the EU from Senegal. In the groundnuts market, the price of groundnuts declines resulting in a decrease in the domestic demand for groundnuts and an increase in groundnuts exports. The explanation for the decline in the price of groundnuts in the previous sub-section applies here as well.

The model results for the remaining regions subject to the GSP, i.e. Argentina, China, and India, were similar to the results in Case 2 under the REPA scenario (see section 5.2.2). The only difference is that the price for groundnuts in this case declined resulting in a decrease in the domestic supply of groundnuts in these regions. The model results for the other supply regions are somewhat unexpected ex ante. The results indicate that Nigeria, Sudan, the US, and the Rest of World become more competitive in the international groundnuts market, while exports of groundnut oil and meal decline. This decline is a result of the increased competition faced in the market due to the enhancement of the GSP.

An interesting result from this simulation was the larger decrease in the price for groundnut oil in the EU. The large price decrease suggests that the price for groundnut oil in the EU absorbed a significant share of the decrease in the import duties on groundnut oil entering the EU. Furthermore, the decrease seemed to carry over to other ACP regions not subject to the GSP e.g. in Nigeria and Sudan. One possible explanation is that a number of regions in the model experienced a decrease in import duties (four), and only one region experienced an increase. Thus, four of the eight international pricing and arbitrage conditions called for a decrease in the EU price.

The overall economic impact on the Senegalese groundnut sector is relatively the same as was seen in the previous two cases. Senegal becomes more competitive internationally in the groundnuts market (exports increase), but less competitive in the groundnut oil and meal markets (exports decrease). The changes in consumer and producer surplus (in all three markets combined) are essentially zero overall, but the change in producer surplus in the oil and meal markets is noticeable. These results tend to provide evidence against the enhanced GSP option if the Senegalese government is still concerned with the performance of these individual markets.

Table 5.3.3 Model Results for Case 3 Under the Enhanced GSP Scenario

		Amount Change from Baseline Case		
Results	**Baseline (1998): Senegal**	**Senegal**	**Argentina**	**European Union**
Groundnuts				
Supply Price[1]	251.864	0	-0.132	N/A
Demand Price[1]	1039.713	-0.132	-0.132	-0.132
Domestic Supply[2]	525.5	0	-0.049	0
Domestic Demand[2]	521.412	-2.409	0.172	-1.099
Exports to the EU[2]	4.088	2.409	-0.222	0
Change in Consumer Surplus[3]	N/A	-1008.037	N/A	N/A
Change in Producer Surplus[3]	N/A	0	N/A	N/A
Groundnut Oil				
Supply Price[1]	955.517	-48.008	3.297	N/A
Demand Price[1]	955.517	-48.008	3.297	-7.273
Domestic Supply[2]	50.252	-0.774	0.05	0
Domestic Demand[2]	3.997	0.041	-0.038	0.804
Exports to the EU[2]	46.255	-0.815	0.089	0
Change in Consumer Surplus[3]	N/A	192.858	N/A	N/A
Change in Producer Surplus[3]	N/A	-2395.745	N/A	N/A
Groundnut Meal				
Supply Price[1]	121.214	-0.057	-0.057	N/A
Demand Price[1]	121.214	-0.057	-0.057	-0.057
Domestic Supply[2]	57.559	-0.886	0.118	0
Domestic Demand[2]	20.009	0.002	0.017	0.07
Exports to the EU[2]	37.550	-0.888	0.101	0
Change in Consumer Surplus[3]	N/A	0.343	N/A	N/A
Change in Producer Surplus[3]	N/A	-100.553	N/A	N/A

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

5.3.4 Case 4: The GSP is enhanced by decreasing import duties by 20% and Nigeria, Senegal, and Sudan move to the GSP.

This case takes the examination in section 5.3.3 one step further. One could assume here that no REPAs are formed with the ACP states. Thus, all of the ACP states decide to be subject to an enhanced form of the GSP. To simulate this situation, Nigeria and the Sudan move to the enhanced GSP, as well as Senegal, and then all GSP import duties are decreased by 20%.

Model results are reported in Table 5.3.4 below for Senegal, Argentina and the European Union. These results are relatively consistent with the explanation provided in the previous sub-section, except that the regions with similar tariff changes experience the same directions of change, e.g. the directions of change for the price and quantity variables in Senegal and the Sudan are the same. The economic impact on the EU of such a move is similar in this case to the economic impact of Case 2 in Section 5.3.2, except that domestic demand for groundnuts in the EU increases as a result of the decrease in the price for groundnuts.

The overall economic impact on Senegal is mixed as in the previous three cases. Groundnuts exports increase making this part of the Senegalese groundnut sector more competitive, but at the same time producer surplus in the groundnut oil and meal markets decreases by a noticeable amount. Of all the trade and tariff regimes examined under the GSP scenario this is the least harmful economically to the Senegalese groundnut sector. This result is in conjunction with the fact that this case is also the most extreme case of the four examined under the Enhanced GSP scenario. The likelihood of the ACP states all deciding to move to the GSP is small, given the push for the REPA option by the European Union (see Chapters 1 and 2).

5.4 Increases in Development Funding

As discussed in Chapter 4, an increase in development funding is represented in the empirical model by an increase in STABEX funds in the groundnuts (in-shell and shelled) supply equation. Thus, an increase in development funding will result in an outward clockwise shift of Senegal's groundnuts supply equation. This outward expansion will put downward pressure on the price of groundnuts and upward pressure on the quantity supplied. Furthermore, increases in development funding are assumed to be determined exogenously and ex ante. This assumption is not too far off, given the untimely receipt of funds in Senegal in the past. This is not to say that the performance in the Senegalese groundnut sector in the future will not affect future funding under the new aid regimes of the NPA (see Chapter 2).

Table 5.3.4 Model Results for Case 4 Under the Enhanced GSP Scenario

		Amount Change from Baseline Case		
Results	**Baseline (1998): Senegal**	**Senegal**	**Argentina**	**European Union**
Groundnuts				
Supply Price[1]	251.864	0	-0.134	N/A
Demand Price[1]	1039.713	-0.134	-0.134	-0.134
Domestic Supply[2]	525.5	0	-0.05	0
Domestic Demand[2]	521.412	-2.03	0.549	0.094
Exports to the EU[2]	4.088	2.03	-0.6	0
Change in Consumer Surplus[3]	N/A	-838.565	N/A	N/A
Change in Producer Surplus[3]	N/A	0	N/A	N/A
Groundnut Oil				
Supply Price[1]	955.517	-40.152	11.153	N/A
Demand Price[1]	955.517	-40.152	11.153	0.931
Domestic Supply[2]	50.252	-0.653	0.173	0
Domestic Demand[2]	3.997	0.034	-0.128	-0.102
Exports to the EU[2]	46.255	-0.688	0.301	0
Change in Consumer Surplus[3]	N/A	161.161	N/A	N/A
Change in Producer Surplus[3]	N/A	-2011.977	N/A	N/A
Groundnut Meal				
Supply Price[1]	121.214	-0.246	-0.246	N/A
Demand Price[1]	121.214	-0.246	-0.246	-0.246
Domestic Supply[2]	57.559	-0.748	0.405	0
Domestic Demand[2]	20.009	0.009	0.073	0.304
Exports to the EU[2]	37.550	-0.756	0.331	0
Change in Consumer Surplus[3]	N/A	1.484	N/A	N/A
Change in Producer Surplus[3]	N/A	-95.123	N/A	N/A

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

Seven cases are examined in this section, four under the REPA scenario and three under the enhanced GSP scenario. The first two cases examined correspond to Cases 3 and 4 under the REPA scenario. These two cases look at what would happen in the status quo given an increase in development funding. These cases are utilized to gauge the total economic impact of just the increase in development funding on the Senegalese groundnut sector. Model results for these two cases are provided in Table 5.4.1 (for Senegal) and Appendix D, Tables D.2.3 and D.2.4. The other cases examined in this section relate to the impact an increase in development funding would have in conjunction with changes in different trade and tariff regimes between the EU and the supply regions of the model, under the REPA and enhanced GSP scenarios. These model results are provided in Table 5.4.2 (for Senegal) and Appendix D, Tables D.2.5, D.2.6 and D.3.5 thru D.3.7. Cases 5 and 6 under the REPA scenario in Table 5.4.2 correspond to a 5% increase in development funding in conjunction with Cases 1 and 2 under the REPA scenario, respectively. Cases 5 thru 7 under the Enhanced GSP Scenario in Table 5.4.2 correspond to a 5% increase in development funding in conjunction with Cases 1 thru 3 under the Enhanced GSP scenario.

5.4.1 Examination of the Model Results in Table 5.4.1

According to the results in Table 5.4.1, an increase in development funding is a positive stimulus to all markets in the Senegalese groundnut sector. An increase in development funding, *ceteris peribus*, shifts the supply curve outward resulting in a decrease in the price of groundnuts and an increase in the quantity supplied. The increase in domestic demand for groundnuts is a result of the increase in the domestic supply of oil and meal (i.e. the increase in the intermediate demand for crushed groundnuts). The lower price for groundnuts makes it cheaper to produce oil and meal, thus increasing profits from their production. (Notice that the fall in the price for oil and meal is less than the decrease in the price for groundnuts.) Cheaper groundnuts also put downward pressure on the price of groundnut oil and meal inducing an increase in the domestic consumption of groundnut meal. Furthermore, Table 5.4.1 indicates that a 10% increase in development funding has twice the impact in the Senegalese groundnut sector of a 5% increase.

Examining the case of a 5% increase in development funding on the grounds of welfare improvements for consumers and producers, one finds that consumer and producer surplus both increase by $379,537 and $1,276,508, respectively. Both consumers and producers benefit by further injections of development aid into the Senegalese groundnut sector, but the overall net effect is essentially zero when compared to the size of the groundnut sector. A 10% increase in development funding increases consumer and producer surplus by $744,947 and $2,504,279,

Table 5.4.1 Model Results for an Increase in Development Funding to Senegal (Cases 3 and 4 Under the REPA Scenario)

		Amount Change from Baseline Case	
Results	**Baseline (1998): Senegal**	**5 % Increase**	**10 % Increase**
Groundnuts			
Supply Price[1]	251.864	0	0
Demand Price[1]	1039.713	-0.743	-1.458
Domestic Supply[2]	525.5	5.153	10.113
Domestic Demand[2]	521.412	0.047	0.091
Exports to the EU[2]	4.088	5.106	10.022
Change in Consumer Surplus[3]	N/A	378.084	742.05
Change in Producer Surplus[3]	N/A	871.678	1710.757
Groundnut Oil			
Supply Price[1]	955.517	-0.303	-0.597
Demand Price[1]	955.517	-0.303	-0.597
Domestic Supply[2]	50.252	0.486	0.954
Domestic Demand[2]	3.997	0	0
Exports to the EU[2]	46.255	0.486	0.953
Change in Consumer Surplus[3]	N/A	1.212	2.386
Change in Producer Surplus[3]	N/A	345.568	677.624
Groundnut Meal			
Supply Price[1]	121.214	-0.04	-0.085
Demand Price[1]	121.214	-0.04	-0.085
Domestic Supply[2]	57.559	0.557	1.093
Domestic Demand[2]	20.009	0.002	0.003
Exports to the EU[2]	37.550	0.555	1.09
Change in Consumer Surplus[3]	N/A	0.241	0.51
Change in Producer Surplus[3]	N/A	59.262	115.898

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

respectively (in all three markets combined).

Given the beneficial nature of an increase in development funding for the Senegalese groundnut sector, the pertinent question to ask at this junction is: Can an increase in development funding offset the negative economic impacts of the varying tariff and trade regimes analyzed under the REPA and enhanced GSP scenarios? The answer to this question is provided in Table 5.4.2, which is examined in the next sub-section.

5.4.2 Examination of a 5% Increase in Development Funding in Conjunction with the Varying Trade and Tariff Regimes Under the REPA and Enhanced GSP Scenarios.

The model results in Table 5.4.2 show that an increase in development funding can help offset some of the adverse economic impacts from the various tariff and trade regimes examined under the REPA and enhanced GSP scenarios. The boost in exports provided by an increase in funding (see Table 5.4.1) makes all the groundnut product markets more competitive in the international groundnut product markets for both cases examined under the REPA scenario. The boost in exports in the groundnuts market of the three cases examined under the enhanced GSP scenario is in addition to the boost already provided by the imposition of the import duty on groundnut oil being exported to the EU. Thus, overall development funding makes Senegal more competitive in the international marketplace. Another way to measure the economic impact of the changes is to examine changes in consumer and producer welfare.

Overall, the changes in consumer and producer surplus for the cases examined under the REPA scenario are essentially zero when compared to the overall size of the groundnut sector in the Senegalese economy, accounting for 8.5% of Senegal's GDP in 1998 (SESRTCIC, 2001; U.S. State Deparment, 1998). For the cases examined under the enhanced GSP scenario, an increase in development funding partially offset the decrease in producer surplus in the groundnut oil market and made the decrease in the groundnut meal market vanish or become relatively insignificant. Given the results in Table 5.4.2 it would seem that the adverse economic impacts of the REPA (as seen in section 5.2) could be offset by increases in development funding via investments directly in the Senegalese groundnut sector. In the empirical model, these investments were injected into the groundnuts market, under the supposition that they would be used for investments pertaining to confectionery groundnut products, which in Chapter 2 was seen to be an important component to the future vitality of the Senegalese groundnut sector. These investments could also help to offset changes in international prices for groundnuts products that plagued the successfulness of past Lomé Conventions.

Table 5.4.2 Model Results for a 5% Increase in Development Funding in Senegal Coupled with Changes in External Trade and Tariff Regimes (cases examined are indicated in the table)

		Amount Changed from Baseline Case				
		REPA Scenario		GSP Scenario		
Results	**Baseline (1998)**	**Case 5**	**Case 6**	**Case 5**	**Case 6**	**Case 7**
Groundnuts						
Supply Price[1]	251.864	0	0	0	0	0
Demand Price[1]	1039.713	-0.641	-0.689	-0.976	-0.843	-0.874
Domestic Supply[2]	525.5	5.153	5.153	5.153	5.153	5.153
Domestic Demand[2]	521.412	-0.051	-0.339	-2.498	-2.562	-2.363
Exports to the EU[2]	4.088	5.204	5.492	7.651	7.714	7.516
Change in Consumer Surplus[3]	N/A	285.328	180.428	-643.351	-735.001	-631.857
Change in Producer Surplus[3]	N/A	871.678	871.678	871.678	871.678	871.678
Groundnut Oil						
Supply Price[1]	955.517	-0.819	-7.799	-51.324	-51.776	-48.296
Demand Price[1]	955.517	-0.819	-7.799	-51.324	-51.776	-48.296
Domestic Supply[2]	50.252	0.457	0.362	-0.342	-0.358	-0.295
Domestic Demand[2]	3.997	0	0.006	0.044	0.044	0.041
Exports to the EU[2]	46.255	0.457	0.356	-0.386	-0.402	-0.337
Change in Consumer Surplus[3]	N/A	3.276	31.198	206.251	208.078	194.019
Change in Producer Surplus[3]	N/A	304.213	-37.12	-2221.30	-2250.12	-2072.74
Groundnut Meal						
Supply Price[1]	121.214	-0.532	-0.131	-0.011	-0.229	-0.103
Demand Price[1]	121.214	-0.532	-0.131	-0.011	-0.229	-0.103
Domestic Supply[2]	57.559	0.524	0.416	-0.391	-0.41	-0.338
Domestic Demand[2]	20.009	0.018	0.005	0.001	0.008	0.004
Exports to the EU[2]	37.550	0.506	0.411	-0.391	-0.418	-0.342
Change in Consumer Surplus[3]	N/A	3.216	0.793	0.065	1.383	0.62
Change in Producer Surplus[3]	N/A	29.63	38.852	-43.627	-57.048	-42.564

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars

5.5 Decreases in Transportation Costs from Senegal to the EU

Given the success of aid projects in the area of transportation infrastructure and to the seventy million ECU the EU has already invested into Senegalese transportation projects, the analysis of the impact of a decrease in transportation costs (due to these investments) is examined (see Chapter 2, Section 2.3). These types of investments are somewhat different then the types of investments examined in the previous section. Instead of directly affecting the production process of groundnut products, these types of investments have an indirect effect on the production of the products by affecting the prices of the products. This examination is done by directly altering the transportation costs specified in the model (in the pricing and arbitrage conditions) (see Chapter 4, Section 4.2.4).

Seven cases are examined in this section. The first two cases examined are Cases 7 and 8 under the REPA scenario. These two cases analyze the isolated effect a five and ten percent decrease in Senegal's transportation cost would have on the Senegalese groundnut sector. The model results for these two cases are provided in Table 5.5.1 (for Senegal) and Appendix D, Tables D.2.7 and D.2.8. The remaining five cases examine the effect of a decrease in Senegal's transportation costs in conjunction with the varying tariff and trade regimes under the REPA and GSP scenarios examined in sections 5.2 and 5.3. The model results for these cases are given in Table 5.5.2 (for Senegal) and in Appendix D, Tables D.2.9, D.2.10, and D.3.8 thru D.3.10. The format for the rest of this section mirrors that in the previous section.

5.5.1 Examination of the Model Results in Table 5.5.1

The decrease in transportation costs directly results in an increase in the prices of all three groundnut products examined by the model, given the international arbitrage and pricing conditions. Since there is no economic stimulus that would result in a change of the EU price in these simulations, the prices for all three groundnut products in Senegal must increase. The price increase in the oil and meal markets has the expected result of increasing domestic supply, decreasing domestic demand, and increasing exports to the EU. The increase in the domestic supply of oil and meal requires that an increased proportion of groundnuts be crushed, thus resulting in an increase in the domestic demand for groundnuts (in-shell and shelled). Since the groundnuts supply is fixed, due to the setting of the supply price for groundnuts, exports of groundnuts to the EU have to decrease.

A 5% decrease in Senegal's transportation costs decreases consumer surplus by $284,186 and increases producer surplus by $86,855. A 10 % decrease decreases consumer surplus by $568,516 and increases producer surplus by $173,695 (in all three markets combined). These

Table 5.5.1 Model Results for a Decrease in Senegal's Transportation Costs (Cases #7 and #8 Under the REPA Scenario)

		Amount Change from Baseline Case	
Results	**Baseline (1998): Senegal**	**5 % Decrease**	**10 % Decrease**
Groundnuts			
Supply Price[1]	251.864	0	0
Demand Price[1]	1039.713	0.626	1.253
Domestic Supply[2]	525.5	0	0
Domestic Demand[2]	521.412	0.054	0.107
Exports to the EU[2]	4.088	-0.054	-0.107
Change in Consumer Surplus[3]	N/A	-277.885	-556.035
Change in Producer Surplus[3]	N/A	0	0
Groundnut Oil			
Supply Price[1]	955.517	0.614	1.228
Demand Price[1]	955.517	0.614	1.228
Domestic Supply[2]	50.252	0.035	0.07
Domestic Demand[2]	3.997	-0.001	-0.001
Exports to the EU[2]	46.255	0.036	0.072
Change in Consumer Surplus[3]	N/A	-2.453	-4.905
Change in Producer Surplus[3]	N/A	49.784	99.521
Groundnut Meal			
Supply Price[1]	121.214	0.622	1.245
Demand Price[1]	121.214	0.622	1.245
Domestic Supply[2]	57.559	0.041	0.081
Domestic Demand[2]	20.009	-0.02	-0.04
Exports to the EU[2]	37.550	0.061	0.122
Change in Consumer Surplus[3]	N/A	-3.758	-7.513
Change in Producer Surplus[3]	N/A	37.071	74.174

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

results provide evidence that producer's benefit from a decrease in transportation costs and consumers are worse off. This is expected, given that producers pay the transportation costs directly, not the consumers. Thus, the producers of groundnut products benefit by being able to charge higher domestic prices for the various groundnut products (due to the lower transportation costs), which makes consumers worse off. Overall though, the impact on producer and consumer surplus is relatively small when compared to the value of total output from the groundnut sector in Senegal, i.e. $400 - $500 million. The next sub-section analyzes the ability of decreases in Senegal's transportation costs to offset any negative economic impacts that may arise from the two option under the NPA open to the government of Senegal.

5.5.2 Examination of a 5% Decrease in Senegal's Transportation Costs in Conjunction with the Varying Trade and Tariff Regimes Under the REPA and Enhanced GSP Scenarios

The model results in Table 5.5.2 indicate that a 5% decrease in Senegal's transportation costs have a minimal offsetting, if not exaggerating effect on the economic impact of the various tariff and trade regimes examined in sections 5.2 and 5.3. The gains of trade in the groundnuts market under Cases 1 and 2 and Cases 1 - 3 under the REPA and enhanced GSP scenarios respectively, is compromised by the decrease in Senegal's transportation costs. The decrease in groundnuts exports is due to the increased production of oil and meal as discussed in the previous sub-section. On the other hand, Senegal's terms of trade for groundnut oil and meal are better off due to the decrease in transportation costs. The only case that the decrease actually helped in offsetting any adverse economic impacts from the varying tariff and trading regimes was Case 9 under the REPA scenario. This case is where Senegal enters into a REPA with the EU and Argentina moves to an FTA with the EU.

Overall the results in Table 5.5.2 show that the welfare gains and losses are relatively the same for the cases examined in sections 5.2 and 5.3 without the decrease in Senegal's transportation costs. This result stems from the fact that the changes in consumer and producer surplus attributed to the change in Senegal's transportation costs are insignificant overall (see Table 5.5.1), when compared to the overall size of the Senegalese groundnuts sector.

An interesting point related to the welfare analysis is that Senegalese consumers are worse off when transportation costs decrease, according to the model results presented in this thesis. Future examinations could find this course of action could make consumers better off. It has been shown at least under one case, where this could be a possibility, given Senegal does

Table 5.5.2 Model Results for a 5% Decrease in Transportation Costs in Senegal Coupled with Changes in External Trade and Tariff Regimes (cases examined are indicated in the table)

		Amount Changed from Baseline Case				
		REPA Scenario		GSP Scenario		
Results	**Baseline (1998)**	**Case 9**	**Case 10**	**Case 8**	**Case 9**	**Case 10**
Groundnuts						
Supply Price[1]	251.864	0	0	0	0	0
Demand Price[1]	1039.713	0.741	0.681	0.391	0.537	0.495
Domestic Supply[2]	525.5	0	0	0	0	0
Domestic Demand[2]	521.412	-0.031	-0.332	-2.49	-2.54	-2.354
Exports to the EU[2]	4.088	0.031	0.332	2.49	2.54	2.354
Change in Consumer Surplus[3]	N/A	-370.473	-475.165	-1294.37	-1386.55	-1283.95
Change in Producer Surplus[3]	N/A	0	0	0	0	0
Groundnut Oil						
Supply Price[1]	955.517	0.112	-6.883	-50.425	-50.864	-47.394
Demand Price[1]	955.517	0.112	-6.883	-50.425	-50.864	-47.394
Domestic Supply[2]	50.252	0.011	-0.087	-0.785	-0.796	0.738
Domestic Demand[2]	3.997	0	0.005	0.043	0.044	0.041
Exports to the EU[2]	46.255	0.012	-0.092	-0.828	-0.84	-0.779
Change in Consumer Surplus[3]	N/A	-0.448	27.531	202.619	204.391	190.378
Change in Producer Surplus[3]	N/A	12.786	-329.365	-2495.30	-2520.16	-2347.66
Groundnut Meal						
Supply Price[1]	121.214	0.235	0.537	0.648	0.536	0.565
Demand Price[1]	121.214	0.235	0.537	0.648	0.536	0.565
Domestic Supply[2]	57.559	0.013	-0.099	-0.898	-0.912	-0.845
Domestic Demand[2]	20.009	-0.007	-0.017	-0.021	-0.017	-0.018
Exports to the EU[2]	37.550	0.021	-0.082	-0.877	-0.895	-0.827
Change in Consumer Surplus[3]	N/A	-1.419	-3.24	-3.911	-3.235	-3.411
Change in Producer Surplus[3]	N/A	13.748	17.087	-65.627	-72.887	-64.028

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars

desire to increase exports in their confectionery groundnut sector (see Chapter 2, Section 2.2.5). Since the informal sector primarily provides for the domestic consumption of groundnuts in the Senegalese economy, a decrease in Senegal's transportation costs could actually be a benefit for this sector under some situations, e.g. Case 9 under the REPA scenario, since the international arbitrage and pricing conditions would have relatively little impact on the domestic prices of groundnut products. This result arises only if the informal sector were modeled, but this is not quantitatively possible at this point (see Chapter 2, Section 2.2.4) In conjunction with other investments, such as increases in development funding, decreases in transportation costs could be a positive stimulus.

5.6 Domestic Market Liberalization in the Senegalese Groundnut Sector

In Chapter 2, Section 2.1.3, the setting of the producer price for groundnuts in Senegal is an important issue that has to be considered when Senegal makes a decision of whether to enter into a REPA or move to an enhanced GSP, under the NPA. In Chapter 4 (Section 4.3), it was decided that the producer price for groundnuts was the main determinant of the supply of groundnuts, and thus was utilized as the own-price for groundnuts, in Senegal's groundnuts supply equation. The use of these fixed prices (i.e. determined by domestic policy instruments) is what gave rise to the altered arbitrage and pricing conditions used in the empirical model. In this section, it is assumed that the markets in the Senegalese groundnut sector have been liberalized, i.e. producer price are now set by the market, which relaxes the additional arbitrage/pricing conditions imposed in Chapter 4 (now $W_{SEN}^{n} = 0$ for all n).

All of the cases examined under the REPA and GSP scenarios in sections 5.2 and 5.3 are examined in this section of the chapter, in conjunction with market liberalization in the Senegalese groundnut sector. The first case examined is the economic impact of market liberalization in the status quo. The model results for this case are provided in Table 5.6.1 (for Senegal) and Appendix D, Table D.2.11. The model results for the cases examining the economic impact of market liberalization in conjunction with the varying tariff and trade regimes examined under the REPA and enhanced GSP scenarios in sections 5.2 and 5.3 are provided in Table 5.6.2 (for Senegal) and Appendix D, Tables D.2.12, D.2.13, and D.3.11 thru D.3.13.

5.6.1 Examination of the Model Results in Table 5.6.1

Market liberalization in the Senegalese groundnuts (in-shell and shelled) market seems to be a beneficial move for producers. Examining the changes in consumer and producer surplus in all three markets, it seems domestic market liberalization has relatively no economic impact on

consumers in all three groundnut markets and on producers in the oil and meal markets. The change in producer surplus in the groundnuts market needs to be discussed further. Recall that the fixed producer price used in the empirical model is replaced by a market determined price with market liberalization. This change increases the price of groundnuts by $787.939 per metric ton. This large change in price causes the amount of producer surplus in the market to increase by a significant amount, i.e. $277,634,551. The large increase would seem to indicate that market liberalization would overwhelmingly benefit groundnuts producers in the Senegalese groundnut sector, while at the same time decreasing exports in the groundnuts market. The benefit to the groundnuts producers arises because the government of Senegal would no longer be able to indirectly tax the producers of groundnuts products by setting the producer price below the international price. The results for producer surplus in the groundnuts market should be takes as a relative measure, given the method used to simulate market liberalization.

5.6.2 Examination of Domestic Market Liberalization in the Senegalese Groundnut Sector in Conjunction with the Varying Trade and Tariff Regimes Under the REPA and Enhanced GSP Scenarios

The model results for the cases examining the economic impact of market liberalization in conjunction with the varying tariff and trade regimes under the REPA and enhanced GSP scenarios, indicate that market liberalization dampens supply, domestic demand, and exports in all three groundnut product markets in the Senegalese groundnut sector. Again the increase in producer surplus in the groundnuts market indicates that producers of groundnuts will be better off, but the producers in the groundnut oil market, under an enhanced GSP, will still be worse off under market liberalization. These results are confirmed by comparing the results with the cases examined in sections 5.2 and 5.3.

In the short-run, market liberalization would decrease Senegal's competitiveness in the international marketplace and benefit producers. Furthermore, investments such as increases in development funding could be utilized to offset some of these adverse economic impacts of market liberalization, given the results in section 5.4.1. In the long run, market liberalization should benefit both consumers and producers by alleviating the market distortions from government intervention. A dynamic model though is needed to analyze this hypothesis, and is beyond the scope of this study.

Table 5.6.1 Model Results of Domestic Market Liberalization in the Senegalese Groundnut Sector (Case 11 under the REPA Scenario)

Results	**Baseline (1998): Senegal**	**Amount Changed from Baseline**
Groundnuts		
Supply Price[1]	251.864	787.939
Demand Price[1]	1039.713	0.09
Domestic Supply[2]	525.5	-0.665
Domestic Demand[2]	521.412	-0.007
Exports to the EU[2]	4.088	-0.658
Change in Consumer Surplus[3]	N/A	-46.314
Change in Producer Surplus[3]	N/A	277634.551
Groundnut Oil		
Supply Price[1]	955.517	0.022
Demand Price[1]	955.517	0.022
Domestic Supply[2]	50.252	-0.018
Domestic Demand[2]	3.997	0
Exports to the EU[2]	46.255	-0.018
Change in Consumer Surplus[3]	N/A	-0.087
Change in Producer Surplus[3]	N/A	-12.113
Groundnut Meal		
Supply Price[1]	121.214	0.003
Demand Price[1]	121.214	0.003
Domestic Supply[2]	57.559	-0.02
Domestic Demand[2]	20.009	0
Exports to the EU[2]	37.550	-0.02
Change in Consumer Surplus[3]	N/A	-0.017
Change in Producer Surplus[3]	N/A	-2.077

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars (Not calculated for Argentina and the European Union)

Table 5.6.2 Model Results for Domestic Market Liberalization in Senegal Coupled with Changes in External Trade and Tariff Regimes (cases examined are indicated in the table)

		Amount Changed from Baseline Case				
		REPA Scenario		GSP Scenario		
Results	**Baseline (1998)**	**Case 12**	**Case 13**	**Case 11**	**Case 12**	**Case 13**
Groundnuts						
Supply Price[1]	251.864	788.051	787.992	787.71	787.854	787.812
Demand Price[1]	1039.713	0.202	0.143	-0.139	0.005	-0.037
Domestic Supply[2]	525.5	-0.637	-0.652	-0.722	-0.686	-0.696
Domestic Demand[2]	521.412	-0.089	-0.392	-2.553	-2.6	-2.416
Exports to the EU[2]	4.088	-0.548	-0.26	1.831	1.914	1.719
Change in Consumer Surplus[3]	N/A	-137.168	-243.071	-1068.48	-1158.33	-1056.36
Change in Producer Surplus[3]	N/A	277693.7	277662.4	277514.8	277590.1	277568.0
Groundnut Oil						
Supply Price[1]	955.517	-0.478	-7.475	-51.017	-51.455	-47.987
Demand Price[1]	955.517	-0.478	-7.475	-51.017	-51.455	-47.987
Domestic Supply[2]	50.252	-0.04	-0.14	-0.839	-0.849	-0.792
Domestic Demand[2]	3.997	0	0.006	0.044	0.044	0.041
Exports to the EU[2]	46.255	-0.04	-0.146	-0.883	-0.893	-0.833
Change in Consumer Surplus[3]	N/A	1.911	29.902	205.011	206.778	192.771
Change in Producer Surplus[3]	N/A	-47.905	-390.597	-2555.54	-2579.13	-2407.59
Groundnut Meal						
Supply Price[1]	121.214	-0.366	-0.082	0.028	-0.065	-0.053
Demand Price[1]	121.214	-0.366	-0.082	0.028	-0.065	-0.053
Domestic Supply[2]	57.559	-0.046	-0.159	-0.96	-0.972	-0.907
Domestic Demand[2]	20.009	0.013	0.003	-0.001	0.003	0.002
Exports to the EU[2]	37.550	-0.058	-0.163	-0.96	-0.974	-0.909
Change in Consumer Surplus[3]	N/A	2.21	0.494	-0.172	0.39	0.321
Change in Producer Surplus[3]	N/A	-24.182	-21.857	-104.381	-110.43	-102.658

[1] Dollars per MT

[2] 1000 MT

[3] Thousands of dollars

5.7 Conclusions

This chapter presented the model results for the simulation of the twenty-six cases discussed at the conclusion of Chapter 4. This section summarizes these results for each of the individual groundnut markets and overall for the Senegalese groundnut sector, as well as, summarizing some of the pertinent issues that arose during the analyses of these results.

Before getting into the individual market analyses, there is one issue that needs further explanation, the relatively small magnitudes of the changes for the majority of the price and quantity variables in each simulation. Reasons for the small changes in the price variables will be examined first, because they have a direct effect on the determination of the changes in the quantity variables. Changes in the price variables that are not directly affected by a change in tariff rates or transportation costs will tend to follow the direction of the corresponding price change in the EU, so the international arbitrage and pricing conditions are satisfied. In addition, the model results in section 5.2 and 5.3 provide evidence that most of the time changes in transportation costs and tariff rates were absorbed by the prices in regions directly affected by the change and not the price in the EU, e.g. a tariff rate increase on exports of Senegalese groundnut oil to the EU was primarily absorbed by the decrease in the price for Senegalese groundnut oil. The cases that did not exhibit this absorption were cases involving an enhancement of the GSP, but overall the change in EU prices for groundnut products in these cases was relatively small (less than one percent). Thus, the indirect impact of tariff rate and transportation cost changes on the prices of groundnut products was relatively small. There were significant changes in price variables directly affected by changes in tariff rates and transportation costs, the greatest of which was 5.3% (see section 5.3.1). None of the changes though had a significant affect on the magnitudes of the quantity variables, which is discussed next.

The relatively small changes in the quantity variables under each of the varying scenarios can primarily be traced to two factors. The first factor is the small changes in prices that arise due to the indirect effect of tariff rate and transportation cost changes discussed above. The second and primary factor is the relative inelastic response of supply and demand to changes in the prices for all the groundnut products. This conclusion is supported by the elasticities in Appendix A, Section A.1. Furthermore, simulations conducted have shown that the larger the elasticity or more elastic the response of supply and demand to changes in groundnut product prices the larger the absolute value of the change in the amount supplied or demanded. For example, a simulation was conducted utilizing Case 1 under the Enhanced GSP scenario. In this examination, the own-price groundnut oil supply elasticity and the cross-price elasticity of groundnut meal in the groundnut oil supply equation for Senegal are increased twice from 0.3 to 0.6 and 1.3, and 0.1 to 0.2 and 1.1

respectively. (Since the groundnuts price is fixed, the cross-price elasticity of groundnuts in the groundnut oil supply equation was not examined). The changes in the domestic supply and quantity exported of groundnut oil were –1.567 and –1.611 for the elasticities less than one and –3.314 and –3.366 for the elasticities greater than one, respectively. Compared to the results in Table 5.3.1, these changes were about twice as much for the first set of elasticities tested and four times as much for the elasticities greater than one. These changes arise due to the nature of the functional form of the supply and demand equations utilized in the empirical model. The imposition of an import tariff (or increase in the rate of one) would leave the price ratio for groundnut oil in the groundnut oil supply equation in the above example smaller than it was at baseline (about equal to one). Furthermore, the price ratio in the supply equation is raised to the value of the corresponding elasticity value i.e. in this case the own-price supply elasticity for groundnut oil. For elasticities less than one in absolute value the value of the price ratio after it is raised to the corresponding elasticity value is closer to one than for elasticities greater than one in absolute value, and the same can be argued for any two elasticities not of the same size. The farther the absolute value of the elasticity from zero the farther away this value of the price ratio raised to the corresponding elasticity value is from unity. This result provides the reasoning for the second factor of why there were relatively small changes in the quantity variables. Due to the relatively small absolute value of the elasticities, even with significant changes in the price ratios, after they are raised to their corresponding elasticity value and then multiplied by the benchmark quantity, the overall change is relatively small. With this in mind, the analyses of the individual markets can now be conducted.

The groundnuts (in-shell and shelled) market included all the production at the farm level, thus subsuming the confectionery groundnuts portion of the sector by assuming that the portion of the production not going to further processing for oil or meal went to seed or into the production of confectionery products (see Chapter 4, section 4.1). Furthermore, all groundnuts exports from Senegal to the EU are confectionery. The importance of this sector was stressed in both Chapters 1 and 2 as vital for the future vitality of the Senegalese groundnut sector, but policymakers need to keep in mind that significant adverse economic impacts in the other markets examined in the empirical model could adversely affect any gains in this market.

The model results indicate that the enhanced GSP option could be preferred to the REPA option, under the NPA (if one were concerned only with this portion of the groundnut sector). The examination in section 5.3 shows that if Senegal decides to move to the GSP (enhanced or not) the increase in groundnuts exports to the EU is about six times greater then the largest increase under any of the cases examined under the REPA option. The downside to this decision

is that decreases in producer surplus in the other markets under the enhanced GSP option are greater than any increase in consumer or producer surplus in the groundnuts market. Focusing on the groundnuts market exclusively in the future could prove to be detrimental, since exports of groundnut oil provide needed export revenue and foreign exchange to the Senegalese government.

The question of offsetting any of the adverse economic impacts in the Senegalese groundnuts market via other policy options was addressed in sections 5.4 and 5.5. An increase in development funding had an only a partial offsetting effect in the cases under the enhanced GSP option, the greatest benefit being in boosting groundnuts (in-shell and shelled) exports. For the cases examined under the REPA option, the increase in development funding had the outcome of completely offsetting the impact of the REPA, providing solid support for the REPA option that was not provided under the cases examined in section 5.2. Investments that have the effect of decreasing transportation costs actually dampened some of the gain in exports from entering into a REPA or moving to an enhanced GSP.

The groundnut oil market experienced the direct impact of tariff changes under cases examined in sections 5.2 and 5.3, because groundnuts and groundnut meal enter the EU duty free. Thus, the largest price changes occurred in this market. Examining the model results, these large price changes were a determining factor for the outcomes in the other groundnut markets, due to the inclusion of the price of groundnuts in the supply and demand equations for groundnuts and groundnut meal. The examination of this sector follows more closely with the expected results of the conceptual model developed in Chapter 3, Section 3.2.

The model results provide more support for the REPA option when considering the economic impact on the groundnut oil market. The impact on Senegal's terms of trade in the groundnut oil sector is less under the REPA scenario. The effects of the imposition of the import duty on Senegalese groundnut oil under the GSP is significantly greater than the indirect effect from tariff reductions in other regions of the model. The larger decrease in price under the GSP scenario has the direct effect of decreasing supply, increasing demand, and overall decreasing exports by an amount greater than the decrease in exports under the REPA scenario. The other factor that signifies that the REPA option is better for the Senegalese groundnut sector is the significant decreases in producer surplus experienced for the cases examined under the enhanced GSP scenario. One needs to keep in mind the importance of this market for export revenue and foreign exchange, since Senegal's main agricultural export commodity is groundnut oil.

Investments in the Senegalese groundnut sector have some effect on offsetting the adverse economic impacts of the options under the NPA in the groundnut oil market. The

increase in development funding in the groundnuts sector has a direct impact on the groundnut oil sector by decreasing the costs of groundnuts used to process the oil and meal. The model results indicate that increases in development funding have the ability to offset the overall negative impact of a REPA, but fail to fully offset the impact of moving to an enhanced GSP. The negative impact on producer surplus from the imposition of the import duty on groundnut oil in the enhanced GSP cases is still a significant amount even after the increase in development funding. Producers in the groundnut oil market benefit more from a decrease in transportation costs in this sector than from an increase in development funding, but overall a decrease in transportation costs does not have the ability to offset the negative economic effects of the two options open to Senegal under the NPA.

The results in the groundnut meal market are closely tied with the results in the groundnut oil market. This connection is the result of the production process for groundnut oil, i.e. groundnut meal is a byproduct of the production of groundnut oil (see Chapters 2 and 4). Thus, the results for the groundnut meal market tend to mirror those for the groundnut oil sector, but to a lesser extent (magnitude). Given the relationship between these two markets, it is wiser to consider these two markets in unison. Thus, all of the results and explanations provided above apply in general to this market as well. The only additional remark that needs to be made is that one needs to keep in mind that groundnut meal is also a significant export commodity for Senegal (see Appendix A, Table A.2.6).

To some extent these markets need to be considered individually given the importance of future investments in the Senegalese groundnut sector, but if the results in one market tend to drown out the benefits experienced in another market, the overall results need to be considered. Given the extent of the impact of the results in the groundnut oil market with respect to tariff changes in the import duty on Senegalese groundnut oil going to the EU, the REPA option is the least harmful to the Senegalese groundnut sector overall, taking into consideration other trade regimes that could be formed in the future. The results for an increase in development funding seem to support this result, and a decrease in transportation costs had the least economic impact under this scenario. Market liberalization seems to dampen supply, demand, and exports of all three groundnut product categories, but provides a significant boost for producers, since the majority of the price increases for groundnuts will be passed to private firms and farmers, not the Senegalese government. Again, the economic impact from market liberalization is felt least under the REPA option.

The model results of the simulation of the twenty-six cases examined in this chapter can now be used to examine policy options open to the government of Senegal under the NPA as negotiations continue on the economic arrangements that have to be agreed on by 2004.

Chapter 6: Conclusion

With the expiration of the fourth Lomé Convention in February 2000, the EU and the ACP states renewed their relationship with the signing of a new partnership agreement (the NPA or Cotonou Convention) in June 2000. Under this new agreement, each ACP state has the option of entering into a Regional Economic Partnership Agreement with the EU or moving to an enhanced form of the Generalized System of Preferences. Both these options have been shown to be more detrimental to the ACP states than the status quo, given no changes in the levels of current financial assistance to the ACP states. Furthermore, past studies (conducted for the EU) show that overall the REPA is a better arrangement for the ACP states when compared to the economic impact of an enhanced GSP. This result holds though, only if there exists sufficient infrastructural and institutional capacity in the ACP states entering into such arrangements. Other issues, such as the future of STABEX and structural adjustment policies in the ACP states also play a vital role in determining the success of any alternative economic arrangements with the EU (see Chapter 2).

For Senegal, the decision of which option to choose is significant given the importance of the groundnut sector in the Senegalese economy. The sector provides a source of income for over one million people and provides a substantial portion of export revenue and foreign exchange for the Senegalese government. Senegal's major agricultural export commodity is groundnut oil, and it is a significant exporter of meal as well. The majority of these exports go to the EU. In addition, Senegal is attempting to penetrate the confectionery groundnut market, due to the decline in groundnut oil demand internationally, and has invested a significant share of monies and development funds from the EU into this venture. The government sees the expansion into this market as vital to the future success of the groundnut sector (see Chapter 2, Section 2.2.5). The question of which economic arrangement under the NPA would be more beneficial for Senegal, the REPA or the enhanced GSP, needs to consider the economic impact (of such an arrangement) on the Senegalese groundnut sector. Thus, this study conducted an assessment of the economic impact of a change from non-reciprocal trade preferences on groundnut products under the fourth Lomé Convention to either a REPA or an enhanced form of the GSP, under the NPA.

The remainder of the chapter is organized as followed. The first section provides a brief summary of the results of the study (being complementary to the discussion in Chapter 5, Section 5.7). Section two then provides policy recommendations and guidelines for future negotiations with the EU and for domestic policies dealing with the Senegalese groundnut sector. Section three provides avenues for future research.

6.1 Summary of Results

No matter which option of the NPA Senegal chooses, it will be no better off than in the status quo (i.e. the fourth Lomé Convention), but with the expiration of the fourth Lomé Convention and the desire of the EU to push forward with new trading arrangements under the NPA, keeping the status quo is no longer a viable option. The REPA option, though similar to conditions under the fourth Lomé Convention, will leave Senegal worse off due to alternative economic arrangements created by the NPA, e.g. the enhancement of the GSP at the next ten-year review. It is vital then to examine the REPA and enhanced GSP options in light of the possibility that increased investments and changes in structural adjustment policies can help offset any adverse economic impact on the Senegalese groundnut sector.

Under the REPA option, Senegal would enter into an FTA, as a member of the WAEMU, with the EU. With no other changes, the REPA would provide the same preferential access for groundnut products exported to the EU that the fourth Lomé Convention did. Thus, cases examined by the empirical model focused on external trading regimes and tariff schemes that could impact the decision to enter into a REPA in the future. Some of the tariff schemes are a result of the NPA, e.g. an enhanced GSP (Case 2 under the REPA scenario). The model results in Chapter 5 show that the REPA option, in conjunction with any future trade or tariff regimes that affect Senegal's margin of preference in relation to its competitors, would leave Senegal worse off. Additional cases examined the possibility of offsetting these adverse economic effects by increasing development funding (i.e. through the grant envelope) and by decreasing transportation costs. An increase (of 5% or higher) in development funding in some cases would offset many (and in some cases all of) the adverse economic effects of the REPA and improve Senegal's competitiveness in the international marketplace in all three groundnut markets. Investments that reduce Senegal's transportation costs would decrease exports of groundnuts, while increasing the exports of oil and meal. Investments in transportation (as modeled) would only be minimally effective in offsetting any adverse economic impacts imposed by the formation of a REPA.

Other studies that have examined the overall economic impact of a REPA on the economies of the ACP countries found that the REPA (or FTA) would benefit consumers, but would cause fiscal losses in government revenue that are vital to ACP countries, as well as de-industrialization. Furthermore, it was stressed that a REPA would be beneficial, only if certain feasibility issues were resolved before the implementation of any new arrangement. These feasibility issues included having sufficient institutional capacity, non-conditional and transparent

policies, the placement and development of proper infrastructure, and the will to form and retain regional relationships during the whole phase of the agreement. The formation of a REPA would more likely be harmful if these feasibility options were not addressed in a suitable manner.

If Senegal decides to move to an enhanced form of the GSP instead of a REPA in 2004, the overall economic impact on the Senegalese groundnut sector will be worse than the conditions under the scenario of a REPA. The first noticeable result of moving to the GSP is that the introduction of an import tariff on groundnut oil would directly affect the terms of trade in the groundnut oil and meal markets by decreasing exports in both markets. Furthermore, the tariff would cause producer surplus to decrease in the groundnut oil market by a significant amount, hurting groundnut oil producers and cutting into export revenues that the government relies upon for annual fiscal spending. Yet, there is a benefit to this option that needs to be considered. Given that Senegal is trying to increase its status in the international confectionery groundnut market, the model results showed that moving to the GSP would actually benefit Senegal by increasing exports of groundnuts (in-shell and shelled), which subsumes the confectionery groundnut market. With an increase in development funding the increase in exports was even larger. The Senegalese government must consider if the increase in exports of confectionery groundnut products outweighs the decline in producer surplus in the groundnut oil market and export revenue caused by the imposition of the tariff on groundnut oil exported to the EU.

The enhancement of the GSP was analyzed in the empirical model by decreasing import tariffs by twenty percent on all products subject to the GSP; but there is a second option, differentiation. This option amounts to providing privileged access to the EU market for developing countries by the use of a vulnerability index. The differentiation option could be promising, but the political hurdles it needs to overcome at this time are quite high, making the likelihood of its success highly improbable (see Chapter 2). Thus, this option was not examined as a case under the enhanced GSP scenario.

Overall, the REPA option is the least harmful to the Senegalese groundnut sector given the model results and quantitative analyses in Chapter 5. This conclusion depends whether more emphasis is placed on the future vitality of the groundnut sector as a whole (all three markets) or just the vitality of the groundnuts (in-shell and shelled) market.

6.2 Policy Recommendations

Five distinct policy recommendations for the Senegalese government arise from the summary provided in the previous section. These recommendations are also in light of the qualitative analyses and model results discussed in previous chapters.

The first three policy recommendations arise primarily from the results of the simulations using the empirical model. These recommendations deal with specific aspects of the proposed trading arrangements under the NPA, development funding and market liberalization in the Senegalese groundnut sector.

Recommendation 1: Enter into a Regional Economic Partnership Agreement as a member of the WAEMU with the EU if the concern about the economic impact of such an arrangement is for the whole of the Senegalese groundnut sector. If the focus is strictly on the confectionery groundnut market, then move to an enhanced form of the GSP.

The Senegalese government must make a decision by 2004 of either entering into a REPA or moving to an enhanced GSP, even though the REPA and enhanced GSP options were both found to be more detrimental than the status quo. This recommendation makes light of this fact and provides a recommendation for which option to choose based upon the conclusions in Chapter 5, Section 5.7. Model results show that the REPA option overall is the least harmful economically, but the Senegalese government might be primarily concerned about the economic impact on the confectionery portion of the groundnut sector. In this case, the enhanced GSP option would be the way to proceed in future negotiations with the EU. Such a move would imply that the losses in the groundnut oil market (though significant) are not as important as the gains made in the confectionery market, due to the declining demand for groundnut oil in the EU and worldwide.

Recommendation 2: Make development funding under the Investment Facility and grant envelope a key component of any new trade arrangement with the European Union. Furthermore, continue investments in the groundnuts market and increase investments in other areas of the groundnut sector.

Incorporating development funding as an exogenous variable directly into the groundnuts supply equation for Senegal provided a relatively simple way to examine the ability to see if increased (and continued) development funding in the Senegalese groundnut sector would help offset any of the adverse economic impacts of the REPA and enhanced GSP options (see Chapter 4, Section 4.2.2.1 for a detailed discussion). The model results examining increases in development funding provide evidence that development funding should be an integral component of any future trading arrangement with the European Union. Specifically, model results show that a five percent increase in funding can help to offset the adverse economic impacts on the Senegalese groundnut

sector of entering into such arrangements. Furthermore, analyses of the conceptual model in Chapter 3 provide theoretical support for the ability of these investments to insulate groundnut prices in Senegal from external shocks in the world market, and to promote export diversification by further stimulating the confectionery groundnut sector.

Recommendation 3: Institute market liberalization in the groundnut sector before the implementation of any new trading arrangement with the EU or after the bulk of the tariff reductions under any such arrangement have taken effect. Otherwise, obtain an increase in development funding to help offset the short-term economic impact of market liberalization.

Due to various structural adjustment policies instated by the IMF and World Bank in the past, the complete liberalization of the Senegalese groundnut sector seems inevitable. These policies have altered the composition of the Senegalese groundnut sector by privatizing publicly held firms and significantly reducing government involvement in the sector This restructuring has led to putting SONACOS, the largest publicly held firm in the sector, up for sale. The sale of SONACOS would leave no major producer of groundnut products under primary public control. These privatization efforts could eventually lead to complete market liberalization, meaning CNIA would be disbanded and the producer price for groundnuts would be determined in the marketplace. In Chapter 5, simulations showed that market liberalization had the short-term economic impact of dampening the competitiveness of the Senegalese groundnut sector in the international marketplace. Thus, the policy recommendation here is to push for market liberalization well before 2008 or sometime after the majority of the backloading of policies under the NPA would be implemented. Market liberalization would not be beneficial while any new trading arrangements are being implemented, since this type of policy would be counterproductive (as evidenced by the model results in Chapter 5, Sections 5.2 and 5.3), unless increases in development funding could be used to help offset the short-term economic impacts of such a policy decision. In Chapter 5, Section 5.4.1, the model results for an increase in development funding provide support for this conclusion.

The last two recommendations are broader in scope, and are recommended as guidelines in future negotiations so that Senegal's interests in these negotiations with the EU are maintained and results based upon the recommendations made above are not compromised.

Recommendation 4: Maintain involvement in and support for the integration of Senegal into the West African and Economic Monetary Union. Furthermore, petition for outside funding to help increase infrastructure and institutional capacity in the union for all members.

If Senegal enters into a REPA with the EU, it will do so as a member of the WAEMU. The WAEMU officially became a customs union in January 2000 providing the needed foundation for the formation of a REPA with the EU. Senegal needs to continue to play a key role in the development of the WAEMU as a regional grouping to ensure that the union is not burdened by a lack of infrastructure and institutional capacity, thus hindering the development and success of the REPA. Continued investments need to be made in infrastructure and institutional capacity to accomplish this goal. Due to economic conditions in West Africa, needed development funding likely will only come from external sources, such as the EU. Senegal can play a key role, as a member of the WAEMU, in petitioning the EU and other external sources for further aid to undertake these needed investments.

Recommendation 5: Keep any components of the NPA negotiated in the future transparent and contractual (i.e. non-conditional).

The model results in Chapter 5, implicitly assume that the NPA is transparent and contractual. Given the record of past conventions, this assumption could be violated. Thus, this recommendation plays a vital role. For increases in development funding to be successful in the Senegalese groundnut sector, the IF and grant envelope need to be transparent and contractual. Under past conventions, increases in development funding were based upon the allocation of past STABEX funds. The receipt of past STABEX funds and other aid under past Lomé Conventions has been plagued with large amounts of red tape and bureaucracy due to the addition of conditional stipulations, such as Senegal having to show that certain democratic and human rights guidelines have been met to receive STABEX funds. These additional stipulations have slowed the receipt of aid in the past and have hindered the effectiveness of aid, by failing to deliver the aid when it is most needed (Gueymard, 2000). Furthermore, past agreements have diminished the importance of the principle of contractuality, which was a foundation of the past Lomé Conventions. Contractuality has been side-stepped by the addition of conditional elements to the conventions, such as the addition of the essential elements clause by the EU (see Chapter 2, Section 2.3). These additions have diminished the voice of the ACP states and have made the past Lomé Conventions less effective (see Chapter 2). Future components of the NPA need to avoid

such stipulations and maintain the principle of contractuality, which is a key component of the new partnership agreement.

These policy recommendations are guidelines for the Senegalese government in future negotiations with the EU about the NPA concerning the Senegalese groundnut sector. Future studies could provide a deeper analysis by updating the data utilized in the model and expanding the analysis to integrate dynamics and more encompassing sectoral models.

6.3 Avenues for Future Research

Five future research directions are suggested for this topic. These four directions can be broken down into two categories: (1) updating data collected for the model and (2) expansions of the current modeling framework.

The first category includes the first recommendation for further research, to update, expand and re-estimate the elasticities utilized in the empirical model. Recall that a majority of the elasticities are not specifically for groundnuts, but for oilseeds in general. These elasticities were used because of the lack of availability of estimates for specific groundnuts products. More specific and recent data needs to be collected to obtain estimates for groundnut and other oilseed elasticities for all the regions. These elasticities would include own-price elasticities of supply and demand, as well as corresponding cross-price elasticities (i.e. due to complements, substitutes, technological and production relationships). Once this data is obtained then elasticities could be estimated for all the regions of the empirical model using a simultaneous equations modeling approach. The elasticities themselves would be a significant contribution, and in turn they could be used to update the results of this study.

The second category includes the other four avenues for future research. The first direction is a deeper analysis of the economic impact of investments in the Senegalese groundnut sector. Investments were dealt with in a simple manner in the empirical model and the method used was discussed in Chapter 4, Section 4.2.2.1. Two primary issues were raised that point to two avenues of further research for this study, i.e. (i) dynamics issues and (ii) measurement issues. Both of these issues need to be handled in more detail and could encompass a complete study in their own right, e.g. a researcher could examine the economic impact of past STABEX funding on the Senegalese groundnut sector. The second direction is to completely model the Senegalese groundnut sector in its entirety. This approach would mean modeling all of the intermediate, final, and factor demands as well as supply functions for all levels of production in the groundnut sector, i.e. from the farm level to export. Such a model could follow the diagram in Chapter 2, Figure 2.2.1. Furthermore, the benefit of this type of model is the ability to gauge the

effects of various domestic policies and future trading arrangements in more detail, such as providing subsidies and credit to farmers, that were not addressable in this study. The third direction is to expand the empirical model by building in temporal dynamics that could provide forward projections of the economic impacts of the options under the NPA. Such a model could provide the opportunity to analyze the economic impact of backloading tariff reductions under the REPA option and its effect on the Senegalese groundnut sector. In addition, such a model could provide long-term analyses of the impacts of market liberalization and other issues involving different structural adjustment policies. The final direction for future research could be to expand the number of oilseeds analyzed in the model to build in the effects of groundnut product substitutes and complements, i.e. add these additional markets to the model. Part of the reason there is a decline in groundnut oil worldwide is due to the increase in demand for other oilseed products, such as palm oil (Meilke, Wensley, and Cluff, 2001). This expanded model could gauge the impact of further increases in the demand for palm oil (or other substitutes or complements) in the Senegalese groundnut sector This type of model would move the modeler toward the direction of general equilibrium modeling, which could provide a much more dynamic approach to analyzing this problem. This approach would be in conjunction with the estimation of the elasticities discussed earlier.

This study should provide a reasonable foundation for the extension of the model to these avenues of future research. The study provided a way for the Senegalese government to analyze policies related to the groundnut sector specifically in relation to the Cotonou Convention, but due to the complexity of the international marketplace there are a large number of questions that still need to be addressed. This study could provide a foundation upon which future analyses could be based.

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Appendix A: Data

A.1 Price and Factor Elasticities

Information on demand and supply elasticities for all regions is contained in Tables A.1.1 to A.1.8. These elasticities were acquired from secondary sources.

There is also one factor elasticity of supply with respect to groundnuts for Senegal that is needed for this study. Using the estimates of the cross-price supply elasticities of fertilizer and seeds from another study, which turn out to be 0.07 and –0.26 respectively (Akobundu, 1998), the factor elasticity of development funding (e.g. STABEX funds) with respect to groundnuts was developed. As seen in Chapter 2 and from the data, a large portion of STABEX funds are used for credit, seed programs, and price stabilization. Thus if one looked at the cross-price supply elasticity for seed subsidies with respect to groundnuts, it could reasonably be assumed that it would be positive, since if the subsidy increased, the amount of groundnuts produced would increase (the opposite in sign as the cross-price supply elasticity for groundnut seed). The cross-price supply elasticities for credit and price stabilization funds with respect to groundnuts are expected to be positive. The cross-price supply elasticity for development funding can be treated in the same manner as the subsidy for seed. Due to the relative small own-price elasticities and cross-price elasticities mentioned above, all of these elasticities should be positive but relatively small. Thus it is assumed that the factor elasticity of supply for STABEX-type funds lies between 0.2 and 0.4.

The following tables are matrices of demand and supply elasticities for each of the regions in the model. For ease of construction, the following notation is used:

G = Confectionary Groundnuts/ Groundnuts in-shell and out-of-shell not processed

GO = Groundnut Oil

GM = Groundnut Meal

DF = Development Funding

In some cases where specific groundnut elasticities could not be obtained, the elasticity for general oilseeds was utilized.

Table A.1.1 Own-Price Elasticities and Cross-Price Elasticities of Demand for Argentina

	G	GO	GM
G	-0.25[1]	0.15[1]	0.05[1]
GO		-0.99[1]	
GM			-0.54[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.2 Own-Price Elasticities and Cross-Price Elasticities of Supply for Argentina

	G	GO	GM
G	0.70[1]		
GO	-0.37[1]	0.32[1]	0.10[1]
GM	-0.37[1]	0.32[1]	0.10[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.3 Own-Price Elasticities and Cross-Price Elasticities of Demand for China

	G	GO	GM
G	-0.31[1]	0.15[1]	0.09[1]
GO		-0.50[1]	
GM			-0.46[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.4 Own-Price Elasticities and Cross-Price Elasticities of Supply for China

	G	GO	GM
G	0.10[1]		
GO	-0.35[1]	0.25[1]	0.15[1]
GM	-0.35[1]	0.25[1]	0.15[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.5 Own-Price Elasticities and Cross-Price Elasticities of Demand for EU(15)

	G	GO	GM
G	-0.38[1]	0.25[1]	0.07[1]
GO		-0.56[1]	
GM			-0.81[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories. Elasticities are based on the European Community Region.

Table A.1.6 Own-Price Elasticities and Cross-Price Elasticities of Supply for EU(15)

	G	GO	GM
G	0.75[1]		
GO	-0.16[1]	0.16[1]	0.05[1]
GM	-0.16[1]	0.16[1]	0.05[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories. Elasticities are based on the European Community Region.

Table A.1.7 Own-Price Elasticities and Cross-Price Elasticities of Demand for India

	G	GO	GM
G	-0.34	0.24[1]	0.04[1]
GO		-0.50[1]	
GM			-0.34[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.8 Own-Price Elasticities and Cross-Price Elasticities of Supply for India

	G	GO	GM
G	0.35[1]		
GO	-0.27[1]	0.27[1]	0.05[1]
GM	-0.27[1]	0.27[1]	0.05[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.9 Own-Price Elasticities and Cross-Price Elasticities of Demand for Nigeria

	G	GO	GM
G	-0.22[1]	0.16[1]	0.01[1]
GO		-0.20[1]	
GM			-0.30[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.10 Own-Price Elasticities and Cross-Price Elasticities of Supply for Nigeria

	G	GO	GM
G	0.16[1]		
GO	-0.14[1]	0.18[1]	0.01[1]
GM	-0.14[1]	0.18[1]	0.01[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.11 Own-Price Elasticities and Cross-Price Elasticities of Demand for Senegal

	G	GO	GM
G	-0.18[1]	0.09[1]	0.03[1]
GO		-0.20[1]	
GM			-0.20[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.12 Own-Price Elasticities, Cross-Price Elasticities, and Factor Elasticities of Supply for Senegal

	G	GO	GM	DF
G	0.16[1] (0.4889[2])			0.2-0.4
GO	-0.35[1]	0.30[1]	0.10[1]	
GM	-0.351[1]	0.30[1]	0.10[1]	

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

[2] Lopez and Hathie, 1998. This source provides an own-price elasticity for groundnuts at the aggregate level for total production at the farm-level. This elasticity can be used instead of the other if it is assumed that the farm-level price determines the domestic supply of groundnuts. Another estimate of this is 0.433 (Gaye, 1998).

Table A.1.13 Own-Price Elasticities and Cross-Price Elasticities of Demand for Sudan

	G	GO	GM
G	-0.18[1]	0.07[1]	0.03[1]
GO		-0.20[1]	
GM			-0.30[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.14 Own-Price Elasticities and Cross-Price Elasticities of Supply for Sudan

	G	GO	GM
G	0.16[1] (0.42[2])		
GO	-0.41[1]	0.31[1]	0.15[1]
GM	-0.41[1]	0.31[1]	0.15[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.
[2] Badiane and Kinteh 1994.

Table A.1.15 Own-Price Elasticities and Cross-Price Elasticities of Demand for the United States

	G	GO	GM
G	-0.29[1] (-0.144[2])	0.07[1]	0.14[1]
GO		-0.691[1]	
GM			-0.73[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.
2 Chen and Fletcher 1998.

Table A.1.16 Own-Price Elasticities and Cross-Price Elasticities of Supply for the United States

	G	GO	GM
G	0.55[1]		
GO	-0.82[1]	0.30[1]	0.57[1]
GM	-0.82[1]	0.30[1]	0.57[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.17 Own-Price Elasticities and Cross-Price Elasticities of Demand for the Rest of World

	G	GO	GM
G	-0.17[1]	0.07[1]	0.04[1]
GO		-0.80[1]	
GM			-0.33[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

Table A.1.18 Own-Price Elasticities and Cross-Price Elasticities of Supply for the Rest of World

	G	GO	GM
G	0.25[1]		
GO	-0.34[1]	0.24[1]	0.15[1]
GM	-0.34[1]	0.24[1]	0.15[1]

[1] Sullivan, et al. 1992. – Utilized the Other Oilseeds (OS), Other Meals (OM), and Other Oils (OO) categories.

A.2 Aggregate Supply and Demand Statistics

Tables A.2.1 to A.2.9 provide the aggregate statistics for groundnuts, groundnut oil, and groundnut meal for each region of the model.

(i) "Groundnuts" is defined as in-shell and shelled groundnut crop and includes the confectionery groundnut category of products.

(ii) Total Supply, Domestic Demand, and Total Demand are calculated as follows:

Total Supply = Opening Stocks + Production + Imports,
Domestic Demand = Domestic Disappearance + Crushed + Other Use + Ending Stocks, and
Total Demand = Domestic Demand + Exports.

(iii) Production of groundnuts did not always coincide with the same time periods for the production of groundnut oil and groundnut meal. For this study it is assumed therefore that all of the groundnuts produced in a given crop year are crushed, processed, and/or consumed during the same time period, i.e. the calendar year, for which the data for groundnut oil and groundnut meal was obtained. To keep the data as consistent as possible all statistics for groundnut oil and groundnut meal, except those for India and Senegal, which coincide with their crop year, are from the time period of Jan – Dec for each year indicated in the tables.

Table A.2.1 Aggregate Groundnut Statistics for Argentina

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[2]						
Opening Stocks		18	37	18	13	1000 MT
Production		526	281	627	385	1000 MT
Imports						1000 MT
Total Supply		544	318	645	398	1000 MT
Crushed		181	123	265	170	1000 MT
Other Use		28	30	31	30	1000 MT
Ending Stocks		37	18	13	3	1000 MT
Domestic Demand		246	171	309	203	1000 MT
Export		298	147	336	195	1000 MT
Total Demand		544	318	645	398	1000 MT
Groundnut Oil[3]						
Opening Stocks	7.0	8.0	16.5	1.5	8.3	1000 MT
Production	48.8	60.8	52.3	85.6	72.5	1000 MT
Total Supply	55.8	68.8	68.8	87.1	80.8	1000 MT
Domestic Disappearance	3.5	2.4	2.8	2.3	2.5	1000 MT
Ending Stocks	8.0	16.5	1.5	8.3	1.7	1000 MT
Domestic Demand	11.5	18.9	4.3	10.6	4.2	1000 MT
Export	44.3	49.9	64.5	76.5	76.6	1000 MT
Total Demand	55.8	68.8	68.8	87.1	80.8	1000 MT
Groundnut Meal[3]						
Opening Stocks	11.5	5.2	106.2	9.0	153.5	1000MT
Production	71.5	90.3	92.2	139.8	123.5	1000 MT
Total Supply	83.0	95.5	106.2	148.8	153.5	1000 MT
Domestic Disappearance	20.8	26.9	21.8	35.6	35.4	1000 MT
Ending Stocks	5.2	14.0	9.0	30.0	21.8	1000 MT
Domestic Demand	26.0	40.9	30.8	65.6	57.2	1000 MT
Export	57.0	54.6	75.4	83.2	96.3	1000 MT
Total Demand	83.0	95.5	106.2	148.8	153.5	1000 MT

Source: ISTA Mielke GmbH 2000

[1] MT = Metric Tons

[2] Data is given from April to March, e.g. April 1996 to March 1997 is stated as 1996

[3] Data is given from January to December for the marked calendar year.

Table A.2.2 Aggregate Groundnut Statistics for China

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[2]						
Opening Stocks		380	430	400	265	1000 MT
Production		7165	7097	6754	8320	1000 MT
Imports		0	3	2	3	1000 MT
Total Supply		7545	7530	7154	8588	1000 MT
Crushed		4260	4200	3870	5030	1000 MT
Other Use		2484	2716	2823	2951	1000 MT
Ending Stocks		430	400	265	345	1000 MT
Domestic Demand		7174	7316	6958	8326	1000 MT
Export		371	213	197	263	1000 MT
Total Demand		7545	7529	7155	8589	1000 MT
Groundnut Oil[3]						
Opening Stocks	135	220.0	180.0	190.0	220.0	1000 MT
Production	1543.2	1631.0	1577.1	1682.5	2044.9	1000 MT
Imports	14.4	5.2	10.7	8.7	7.1	1000 MT
Total Supply	1692.6	1856.3	1767.7	1881.2	2272.0	1000 MT
Domestic Disappearance	1461.7	1670.7	1569.1	1651.1	2069.9	1000 MT
Ending Stocks	220.0	180.0	190.0	220.0	190.0	1000 MT
Domestic Demand	1681.7	1850.7	1759.1	1871.1	2259.9	1000 MT
Export	10.9	5.6	8.6	10.1	12.1	1000 MT
Total Demand	1692.6	1856.3	1767.7	1881.2	2272.0	1000 MT
Groundnut Meal[3]						
Production	2385.0	2506.7	2415.6	2565.0	3105.4	1000 MT
Imports	0	1.0	56.6	9.4	8.0	1000 MT
Total Supply	2385.0	2507.7	2472.2	2574.3	3113.4	1000 MT
Domestic Disappearance	2347.1	2504.4	2470.4	2572.7	3111.1	1000 MT
Domestic Demand	2347.1	2504.4	2470.4	2572.7	3111.1	1000 MT
Export	37.9	3.3	1.8	1.6	2.3	1000 MT
Total Demand	2385.0	2507.7	2472.2	2574.3	3113.4	1000 MT

Source: ISTA Mielke GmbH 2000

[1] MT = Metric Tons

[2] Data is given from July to June, e.g. July 1995 to June 1996 is stated as 1996

[3] Data is given from January to December for the marked calendar year.

Table A.2.3 Aggregate Groundnut Statistics for EU(15)

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[2]						
Opening Stocks		53	22	30	37	1000 MT
Production		3	3	3	3	1000 MT
Imports		520	533	551	484	1000 MT
Total Supply		576	558	584	524	1000 MT
Crushed		41	32	54	27	1000 MT
Other Use		453	452	454	446	1000 MT
Ending Stocks		22	30	37	21	1000 MT
Domestic Demand		516	514	545	494	1000 MT
Export		59	43	39	29	1000 MT
Total Demand		575	557	584	523	1000 MT
Groundnut Oil[3]						
Opening Stocks	14	17	15	13	15	1000 MT
Production	16	18	12	24	10	1000 MT
Imports	165	154	164	137	147	1000 MT
Total Supply	195	189	191	174	172	1000 MT
Domestic Disappearance	174	169	173	153	151	1000 MT
Ending Stocks	17	15	13	15	10	1000 MT
Domestic Demand	191	184	186	168	161	1000 MT
Export	4	5	5	7	11	1000 MT
Total Demand	195	189	191	175	172	1000 MT
Groundnut Meal[3]						
Production	22	24	19	31	17	1000 MT
Imports	196	222	221	218	160	1000 MT
Total Supply	218	246	240	249	177	1000 MT
Domestic Disappearance	219	246	240	249	177	1000 MT
Domestic Demand	219	246	240	249	177	1000 MT

Source: ISTA Mielke GmbH 2000

[1] MT = Metric Tons

[2] Data is given from September to October, e.g. September 1995 to October 1996 is stated as 1996

[3] Data is given from January to December for the marked calendar year.

Table A.2.4 Aggregate Groundnut Statistics for India

	1995	1996	1997	1998	1999[2]	Unit of Measure[1]
Groundnuts[3]						
Production	8255	7814	9024	7580	7900	1000 MT
Total Supply	8255	7814	9024	7580	7900	1000 MT
Crushed	6600	6199	7044	5960	6100	1000 MT
Other Use	1605	1525	1760	1470	1620	1000 MT
Domestic Demand	8205	7724	8804	7430	7720	1000 MT
Export	50	90	220	150	180	1000 MT
Total Demand	8255	7814	9024	7580	7900	1000 MT
Groundnut Oil[3]						
Production	1910	1800	2050	1725	1675	1000 MT
Total Supply	1910	1800	2050	1725	1675	1000 MT
Domestic Disappearance	1910	1800	2050	1725	1675	1000 MT
Domestic Demand	1910	1800	2050	1725	1675	1000 MT
Groundnut Meal[3]						
Production	2775	2600	2960	2510	2450	1000 MT
Total Supply	2775	2600	2960	2510	2450	1000 MT
Domestic Disappearance	2460	2340	2640	2290	2420	1000 MT
Domestic Demand	2460	2340	2640	2290	2420	1000 MT
Export	315	260	320	220	30	1000 MT
Total Demand	2775	2600	2960	2510	2450	1000 MT

Source: Pomeroy and Govindan 1996 and 1998; Williams and Govindan 1997; Beeghly and Shunmugam: 1999 and 2000; Food and Agricultural Policy Research Institute 1999.

[1] MT = Metric Tons

[2] "Groundnuts" statistics for 1999 are taken from the *Source:* Food and Agricultural Policy Research Institute. 1999.

[3] Data is given for Marketing Year starting on October of the previous year, i.e. 1996 begins October 1995.

Table A.2.5 Aggregate Groundnut Statistics for Nigeria

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[2]						
Opening Stocks		40	55	80	60	1000 MT
Production		1105	1206	1230	1320	1000 MT
Imports		16	6	4	5	1000 MT
Total Supply		1161	1267	1314	1385	1000 MT
Crushed		570	640	700	760	1000 MT
Other Use		536	547	554	565	1000 MT
Ending Stocks		55	80	60	60	1000 MT
Domestic Demand		1161	1267	1314	1385	1000 MT
Groundnut Oil[3]						
Opening Stocks	10.0	10.0	15.0	11.2	11.0	1000 MT
Production	234.4	258.7	288.3	300.2	334.4	1000 MT
Imports	0	0	0.3	1.1	0	1000 MT
Total Supply	244.4	268.7	303.6	312.5	345.4	1000 MT
Domestic Disappearance	229.4	249.1	273.1	295.6	323.4	1000 MT
Ending Stocks	10.0	15.0	11.2	11.0	17.0	1000 MT
Domestic Demand	239.4	264.1	284.3	306.6	340.4	1000 MT
Export	5.0	4.5	19.3	9.084[4]	5.0	1000 MT
Total Demand	244.4	268.6	303.6	315.684[4]	345.4	1000 MT
Groundnut Meal[3]						
Production	287.7	317.4	353.9	368.4	410.4	1000 MT
Imports	0.1	0.1	0	0	0	1000 MT
Total Supply	287.8	317.5	353.9	368.4	410.4	1000 MT
Domestic Disappearance	287.2	316.5	352.3	368.4	410.4	1000 MT
Domestic Demand	287.2	316.5	352.3	368.4	410.4	1000 MT
Export	0.6	1.0	1.6	0	0	1000 MT
Total Demand	287.8	317.5	353.9	368.4	410.4	1000 MT

Source: ISTA Mielke GmbH 2000; Eurostat 2000

[1] MT = Metric Tons

[2] Data is given from October to September, e.g. October 1996 to September 1997 is stated as 1997

[3] Data is given from January to December for the marked calendar year.

[4] Statistics are adjusted to correspond with statistics provided by the *Source:* Eurostat 2000.

Table A.2.6 Aggregate Groundnut Statistics for Senegal

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[2]						
Opening Stocks	35	35	35	20	20	1000 MT
Production	720	827	646	506	541	1000 MT
Imports	25	18	5	25	25	1000 MT
Total Supply	780	880	686	551	586	1000 MT
Crushed	250	250	150	150	274	1000 MT
Other Use	465	565	500	376	286	1000 MT
Ending Stocks	35	35	20	20	20	1000 MT
Domestic Demand	750	850	670	546	580	1000 MT
Export	30	30	16	5	6	1000 MT
Total Demand	780	880	686	551	586	1000 MT
Groundnut Oil[2]						
Opening Stocks	4	4	2	6	2	1000 MT
Production	88	88	53	53	72	1000 MT
Imports	0	0	0	3	6	1000MT
Total Supply	92	92	55	62	80	1000 MT
Domestic Disappearance	6	6	7	5	10	1000 MT
Ending Stocks	4	10	2	2	3	1000 MT
Domestic Demand	10	16	9	7	13	1000 MT
Export	82	76	46	55	67	1000 MT
Total Demand	92	92	55	62	79	1000 MT
Groundnut Meal[2]						
Opening Stocks	20	20	7	4	16	1000MT
Production	105	105	63	63	86	1000 MT
Total Supply	125	125	70	67	102	1000 MT
Domestic Disappearance	10	15	12	12	20	1000 MT
Ending Stocks	20	15	2	8	9	1000 MT
Domestic Demand	30	30	14	20	29	1000 MT
Export	95	95	56	47	73	1000 MT
Total Demand	125	125	70	67	102	1000 MT

Source: Gressel and Ba 1996 and 1997; Zanin and Ba 1998, 1999, 2000

[1] MT = Metric Tons

[2] Data is given for Marketing Year starting on November of the previous year, i.e. 1996 begins November 1995.

Table A.2.7 Aggregate Groundnut Statistics for Sudan

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[2]						
Opening Stocks		20	23	15	20	1000 MT
Production		400	450	560	460	1000 MT
Total Supply		420	473	575	480	1000 MT
Crushed		300	345	440	345	1000 MT
Other Use		95	100	107	111	1000 MT
Ending Stocks		23	15	20	19	1000 MT
Domestic Demand		418	460	567	475	1000 MT
Export		2	14.8	8	5	1000 MT
Total Demand		420	474.8	575	480	1000 MT
Groundnut Oil[3]						
Opening Stocks	3.1	5.0	14.0	4.0	3.0	1000 MT
Production	104.4	110.6	143.3	172.1	128.4	1000 MT
Total Supply	107.5	115.6	157.3	176.1	131.4	1000 MT
Domestic Disappearance	84.5	87.6	98.5	119.7	101.4	1000 MT
Ending Stocks	5.0	14.0	4.0	3.0	12.0	1000 MT
Domestic Demand	89.5	101.6	102.5	122.7	113.4	1000 MT
Export	18.0	14.0	54.8	53.5	18.6	1000 MT
Total Demand	107.5	115.6	157.3	176.2	132.0	1000 MT
Groundnut Meal[3]						
Production	164.9	174.6	226.2	271.8	202.8	1000 MT
Total Supply	164.9	174.6	226.2	271.8	202.8	1000 MT
Domestic Disappearance	93.9	92.0	139.4	163.8	154.7	1000 MT
Domestic Demand	93.9	92.0	139.4	163.8	154.7	1000 MT
Export	71.0	82.6	86.8	108.0	48.1	1000 MT
Total Demand	164.9	174.6	226.2	271.8	202.8	1000 MT

Source: ISTA Mielke GmbH 2000

[1] MT = Metric Tons

[2] Data is given from November to October, e.g. November 1996 to October 1997 is stated as 1997

[3] Data is given from January to December for the marked calendar year.

Table A.2.8 Aggregate Groundnut Statistics for the United States

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[2]						
Opening Stocks		408	258	270	289	1000 MT
Production		1178	1246	1204	1348	1000 MT
Imports		52	43	48	53	1000 MT
Total Supply		1638	1547	1522	1690	1000 MT
Crushed		358	260	165	194	1000 MT
Other Use		739	779	839	826	1000 MT
Ending Stocks		258	270	289	473	1000 MT
Domestic Demand		1355	1309	1293	1493	1000 MT
Export		282	237	230	196	1000 MT
Total Demand		1637	1546	1523	1689	1000 MT
Groundnut Oil[3]						
Opening Stocks	3.5	10.3	40.1	20.7	23.4	1000 MT
Production	150.7	159.0	76.0	61.0	96.8	1000 MT
Imports	3.2	1.6	6.6	30.3	9.6	1000MT
Total Supply	157.4	170.9	122.7	112.0	129.8	1000 MT
Domestic Disappearance	99.3	93.5	93.2	84.4	114.3	1000 MT
Ending Stocks	10.3	40.1	20.7	23.4	9.7	1000 MT
Domestic Demand	109.6	133.6	113.9	107.8	124.0	1000 MT
Export	47.8	37.3	8.8	4.3	5.8	1000 MT
Total Demand	157.4	170.9	122.7	112.1	198.8	1000 MT
Groundnut Meal[3]						
Opening Stocks	8.7	2.9	4.3	2.0	5.8	1000MT
Production	196.3	212.0	107.6	84.3	122.9	1000 MT
Total Supply	205.0	214.9	111.9	86.3	128.7	1000 MT
Domestic Disappearance	189.5	184.7	106.0	63.2	122.3	1000 MT
Ending Stocks	2.9	4.3	2.0	5.8	1.8	1000 MT
Domestic Demand	192.4	189.0	108.0	69.0	124.1	1000 MT
Export	12.6	25.8	3.9	17.4	4.7	1000 MT
Total Demand	205.0	214.8	111.9	86.4	128.8	1000 MT

Source: ISTA Mielke GmbH 2000

[1] MT = Metric Tons

[2] Data is given from August to July, e.g. August 1996 to July 1997 is stated as 1997

[3] Data is given from January to December for the marked calendar year.

Table A.2.9 Aggregate Groundnut Statistics for the Rest of World

	1995	1996	1997	1998	1999	Unit of Measure[1]
Groundnuts[3]						
Opening Stocks						1000 MT
Production[2]	4080	4237	4302	4201	4287	1000 MT
Imports	728.2	749.4	733.7	574.5	670.6	1000 MT
Total Supply	4808.2	4986.4	5035.7	4775.5	4957.6	1000 MT
Crushed	1189	1270	1296	1270	1296	1000 MT
Other Use	3295.9	3401	3424.4	3203.1	3363.3	1000 MT
Ending Stocks						1000 MT
Domestic Demand	4484.9	4671	4720.4	4473.1	4659.3	1000 MT
Export	323.3	315.4	315.3	302.4	298.3	1000 MT
Total Demand	4808.2	4986.4	5035.7	4775.5	4957.6	1000 MT
Groundnut Oil[3]						
Opening Stocks	47.6	54.7	53.4	55.4	49.7	1000 MT
Production	474.5	505.5	515.6	508.9	548.8	1000 MT
Imports	78.3	86	77.1	77.0	67.7	1000 MT
Total Supply	600.4	646.2	646.1	641.3	666.2	1000 MT
Domestic Disappearance	493.8	555.1	534.3	542.8	548.5	1000 MT
Ending Stocks	54.7	53.4	55.4	49.7	47.2	1000 MT
Domestic Demand	548.5	608.5	589.7	592.5	595.7	1000 MT
Export	51.9	37.3	56.0	54.596[4]	42.3	1000 MT
Total Demand	600.4	645.8	645.7	647.096[4]	638	1000 MT
Groundnut Meal[3]						
Production	634.4	674.6	688.6	681.6	696.7	1000 MT
Imports	447.4	322.3	277.2	220.5	115.3	1000 MT
Total Supply	1081.8	996.9	965.8	902.1	812.0	1000 MT
Domestic Disappearance	1049.1	947.6	942.2	875.4	792.5	1000 MT
Domestic Demand	1049.1	947.6	942.2	875.4	792.5	1000 MT
Export	32.6	49.5	23.5	26.7	19.5	1000 MT
Total Demand	1081.7	997.1	965.7	902.1	812.0	1000 MT

Source: ISTA Mielke GmbH 2000; Eurostat 2000.

Data was calculated by taking world totals and subtracting out the regions already represented above using totals from Oil World Annual 2000.

[1] MT = Metric Tons [2] Data is given for crop years, i.e. 97/98 is stated as 1998

[3] Data is given from January to December for the marked calendar year.

[4] Statistics are adjusted to correspond with statistics provided by the *Source:* Eurostat 2000

A.3 Groundnut Trade Statistics

The following tables show trade flows among the different countries used in the empirical model. The following abbreviations are used to indicate the separate regions:

ARG Argentina
CHN China
EU15 European Union
IND India
NIG Nigeria
SEN Senegal
SUD Sudan
US United States
ROW Rest of World

The ROW column is calculated as the residual of the total exports for each category in Section A.2 minus the exports to each of the eight regions stated above.

Table A.3.1 Trade Matrix for In-Shell/Shelled Groundnuts (Jan – Dec 1999) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	153.5	---	---	---	---	20.5	21
CHN	---	---	122.9	---	---	---	---	3.9	153.2
EU15	---	---	---	---	---	---	---	---	29
IND	---	---	27.3	---	---	---	---	---	152.7
NIG	---	---	---	---	---	---	---	---	---
SEN	---	---	3.5	---	---	---	---	---	2.5
SUD	---	---	2.3	---	---	---	---	---	2.7
US	---	---	85.0	---	---	---	---	---	119.4
ROW									---

Source: ISTA Mielke GmbH 2000

Table A.3.2 Trade Matrix for Groundnut Oil (Jan – Dec 1999) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	69.5	---	---	---	---	2.0	5.1
CHN	---	---	---	---	---	---	---	---	12.1
EU15	---	---	---	---	---	---	---	---	---11
IND	---	---	---	---	---	---	---	---	---
NIG	---	---	---	---	---	---	---	---	5.0
SEN	---	---	69.0	---	---	---	---	---	1.1
SUD	---	---	13.0	---	---	---	---	---	5.6
US	---	---	0.7	---	---	---	---	---	5.1
ROW									---

Source: ISTA Mielke GmbH 2000

Table A.3.3 Trade Matrix for Groundnut Meal (Jan – Dec 1999) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	36.6	---	---	---	---	---	59.7
CHN	---	---	---	---	---	---	---	---	2.3
EU15	---	---	---	---	---	---	---	---	---
IND	---	9.5	---	---	---	---	---	---	20.5
NIG	---	---	---	---	---	---	---	---	---
SEN	---	---	71.5	---	---	---	---	---	5.2
SUD	---	---	48.1	---	---	---	---	---	---
US	---	---	1.1	---	---	---	---	---	3.6
ROW									---

Source: ISTA Mielke GmbH 2000

Table A.3.4 Trade Matrix for In-Shell/Shelled Groundnuts (Jan – Dec 1998) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	223.4	---	---	---	---	15.3	69.5
CHN	---	---	102.694[1]	---	---	---	---	1.8	92.506
EU15	---	---	---	---	---	---	---	---	39
IND	---	2.6	45.832[1]	---	---	---	---	---	101.4
NIG	---	---	0.127[1]	---	---	---	---	---	---
SEN	---	---	4.576[1]	---	---	---	---	---	0.5
SUD	---	---	5.0	---	---	---	---	---	3.0
US	---	---	119.621[1]	---	---	---	---	---	110.379
ROW	---	---	86.429[1]	---	---	---	---	---	215.971

Source: ISTA Mielke GmbH 2000
[1] Eurostat, 2000

Table A.3.5 Trade Matrix for Groundnut Oil (Jan – Dec 1998) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	36.4	---	---	---	---	35.0	5.1
CHN	---	---	0.012[1]	---	---	---	---	---	10.1
EU15	---	---	---	---	---	---	---	---	---
IND	---	---	---	---	---	---	---	---	---
NIG	---	---	7.384[1]	---	---	---	---	---	1.7
SEN	---	---	46.237[1]	---	---	---	---	---	8.763
SUD	---	---	44.6	---	---	---	---	---	8.8
US	---	---	1.0	---	---	---	---	---	3.3
ROW	---	---	54.596[1]	---	---	---	---	---	----

Source: ISTA Mielke GmbH 2000;
[1] Eurostat, 2000

Table A.3.6 Trade Matrix for Groundnut Meal (Jan – Dec 1998) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	44.1	---	---	---	---	---	39.1
CHN	---	---	---	---	---	---	---	---	1.6
EU15	---	---	---	---	---	---	---	---	---
IND	---	7.5	---	---	---	---	---	---	212.5
NIG	---	---	---	---	---	---	---	---	---
SEN	---	---	37.5	---	---	---	---	---	9.5
SUD	---	---	107.8	---	---	---	---	---	0.2
US	---	---	14.7	---	---	---	---	---	2.7
ROW	---	---	---	---	---	---	---	---	26.7

Source: ISTA Mielke GmbH 2000

Table A.3.7 Trade Matrix for In-Shell/Shelled Groundnuts (Jan – Dec 1997) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	103.0	---	---	---	---	23.5	20.5
CHN	---	---	96.041[1]	---	---	---	---	1.5	105.459
EU15	---	---	---	---	---	---	---	---	43
IND	---	0.8	46.889[1]	---	---	---	---	---	172.463
NIG	---	---	0.308[1]	---	---	---	---	---	---
SEN	---	---	3.238[1]	---	---	---	---	---	12.78
SUD	---	---	3.5	---	---	---	---	---	11.3
US	---	---	150.477[1]	---	---	---	---	---	86.523
ROW	---	---	58.753[1]	---	---	---	---	---	256.547

Source: ISTA Mielke GmbH 2000
[1] Eurostat 2000

Table A.3.8 Trade Matrix for Groundnut Oil (Jan – Dec 1997) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	54.0	---	---	---	---	2.0	8.5
CHN	---	---	0.017[1]	---	---	---	---	---	8.6
EU15	---	---	---	---	---	---	---	---	5
IND	---	---	---	---	---	---	---	---	---
NIG	---	---	18.561[1]	---	---	---	---	---	0.739
SEN	--	---	44.085[1]	---	---	---	---	---	1.915
SUD	---	---	45.5	---	---	---	---	---	9.3
US	---	---	1.899[1]	---	---	---	---	---	6.901
ROW	---	---	40.344[1]	---	---	---	---	---	15.656

Source: ISTA Mielke GmbH 2000
[1] Eurostat, 2000

Table A.3.9 Trade Matrix for Groundnut Meal (Jan – Dec 1997) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	72.4	---	---	---	---	---	3.0
CHN	---	---	---	---	---	---	---	---	1.8
EU15	---	---	---	---	---	---	---	---	---
IND	---	55.6	9.0	---	---	---	---	---	256.4
NIG	---	---	1.6	---	---	---	---	---	---
SEN	---	---	35.4	---	---	---	---	---	20.6
SUD	---	---	86.5	---	---	---	---	---	0.3
US	---	---	0.7	---	---	---	---	---	3.2
ROW	---	---	---	---	---	---	---	---	23.5

Source: ISTA Mielke GmbH 2000

Table A.3.10 Trade Matrix for In-Shell/Shelled Groundnuts (Jan – Dec 1996) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	179.3	---	---	---	---	9.9	108.8
CHN	---	---	135.173[1]	---	---	---	---	1.1	234.724
EU15	---	---	---	---	---	---	---	---	59.0
IND	---	---	27.405[1]	---	---	---	---	---	62.595
NIG	---	---	0.186[1]	---	---	---	---	---	---
SEN	---	---	4.345[1]	---	---	---	---	---	25.655
SUD	---	---	1.4	---	---	---	---	---	0.8
US	---	---	146.12[1]	---	---	---	---	---	135.88
ROW	---	---	58.582[1]	---	---	---	---	---	256.818

Source: ISTA Mielke GmbH 2000
[1] Eurostat 2000

Table A.3.11 Trade Matrix for Groundnut Oil (Jan – Dec 1996) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	49.1	---	---	---	---	---	0.8
CHN	---	---	0.076[1]	---	---	---	---	---	5.6
EU15	---	---	---	---	---	---	---	---	5.0
IND	---	---	---	---	---	---	---	---	---
NIG	---	---	3.695[1]	---	---	---	---	---	0.805
SEN	---	---	63.312[1]	---	---	---	---	---	12.688
SUD	---	---	13.4	---	---	---	---	---	0.6
US	---	---	21.908	---	---	---	---	---	15.4
ROW	---	---	16.559	---	---	---	---	---	20.741

Source: ISTA Mielke GmbH 2000
[1] Eurostat 2000

Table A.3.12 Trade Matrix for Groundnut Meal (Jan – Dec 1996) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	50.9	---	---	---	---	---	3.7
CHN	---	---	---	---	---	---	---	---	3.3
EU15	---	---	---	---	---	---	---	---	---
IND	---	0.5	5.2	---	---	---	---	---	254.3
NIG	---	---	1.0	---	---	---	---	---	---
SEN	---	---	75.4	---	---	---	---	---	19.6
SUD	---	---	82.5	---	---	---	---	---	0.1
US	---	---	14.8	---	---	---	---	---	11.0
ROW	---	---	---	---	---	---	---	---	49.5

Source: ISTA Mielke GmbH 2000

Table A.3.13 Trade Matrix for In-Shell/Shelled Groundnuts (Jan – Dec 1995) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	95.593[1]	---	---	---	---	11.6	50.4
CHN	---	---	139.251[1]	1.1	---	---	---	---	225.1
EU15	---	---	---	---	---	---	---	---	---
IND	---	---	17.303[1]	---	---	---	---	---	32.697
NIG	---	---	---	---	---	---	---	---	---
SEN	---	---	4.609[1]	---	---	---	---	---	25.391
SUD	---	---	4.2	---	---	---	---	---	0.4
US	---	---	229.907[1]	---	---	---	---	---	128.2
ROW	---	---	58.482[1]	---	---	---	---	---	264.818

Source: ISTA Mielke GmbH 2000
[1] Eurostat 2000

Table A.3.14 Trade Matrix for Groundnut Oil (Jan – Dec 1995) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	41.2	---	---	---	---	---	3.2
CHN	---	---	0.8	---	---	---	---	---	10.1
EU15	---	---	---	---	---	---	---	---	4
IND	---	---	---	---	---	---	---	---	---
NIG	---	---	4.124[1]	---	---	---	---	---	---
SEN	---	---	77.113[1]	---	---	---	---	---	4.887
SUD	---	---	11.3	---	---	---	---	---	6.7
US	---	---	17.140[1]	---	---	---	---	---	30.66
ROW	---	---	23.832[1]	---	---	---	---	---	28.068

Source: ISTA Mielke GmbH 2000
[1] Eurostat 2000

Table A.3.15 Trade Matrix for Groundnut Meal (Jan – Dec 1995) (1000 MT)

	ARG	CHN	EU15	IND	NIG	SEN	SUD	US	ROW
ARG	---	---	31.0	---	---	---	---	---	26.0
CHN	---	---	---	---	---	---	---	---	37.9
EU15	---	---	---	---	---	---	---	---	---
IND	---	0.3	---	---	---	---	---	---	312.0
NIG	---	---	0.6	---	---	---	---	---	---
SEN	---	---	83.7	---	---	---	---	---	11.3
SUD	---	---	70.5	---	---	---	---	---	0.5
US	---	---	2.8	---	---	---	---	---	9.8
ROW	---	---	---	---	---	---	---	---	32.6

Source: ISTA Mielke GmbH 2000

A.4 Transportation Costs

The transportation costs were collected from the Agriculture and Marketing Service's Grain Transportation Reports at the U.S. Department of Agriculture. These rates are expressed in dollars per ton for a given ship size. Transportation costs were collected by choosing ocean freight routes that were as close to the region as possible, at times this required that the route costs reported were from the EU to that region, instead of the other way around. If more than one cost was found then the transportation costs were averaged across routes for that particular region. In Table A.4.1, transportation costs are reported and explanations of the calculations of the cost are given.

Table A.4.1 Transportation Costs from the Supply Regions of the Empirical Model to the European Union

Region	Transportation Cost to EU	Calculation
Argentina	$15.45/ton	Calculated as an average of 4 shipping routes in 1998 to Denmark[2], Rotterdam[3,8], W. Italy[6], and Spain[6] from Argentina.
China	$14.62/ton	Calculated using three shipping routes in 1998: (i) Rotterdam to S. Korea[5], (ii) France to China[10], and (iii) U.K. to China[10].
India	$16.78/ton	Calculated using three shipping routes in 1998: (i) France to Bangladesh[12], (ii) France to China[10], and (iii) U.K. to China[10].
Nigeria	$10.42/ton	Calculated using three shipping routes in 1998: (i) France to Morocco[2], (ii) Hamburg to Algeria[7], and (iii) France to Tunisia[13].
Senegal	$12.50/ton	Calculated using two shipping routes in 1998: (i) France to the Canary Islands[11], and (ii) Hamburg to Algeria[7].
Sudan	$12.55/ton	Calculated using two shipping routes in 1998: (i) Northern Europe to Saudi Arabia[8] and (ii) U.K. to Saudi Arabia[9].
United States	$10.35/ton	Calculated as an average of 5 shipping routes in 1998 to Europe[1], Ireland[3,4], Holland[5], Rotterdam[12,14], and Amsterdam[6] from the U.S.
Rest of World	$13.23/ton	Calculated as an average of the above transportation costs.

Sources: [1] Dunton, et al 1998; [2] Marathon and Hacker 1998; [3] Hacker and Martin 1998a; [4] Hacker and Martin 1998b; [5] Hacker and Martin 1998c; [6] Hacker and Martin 1998d; [7] Hacker and Martin 1998e; [8] Hacker and Martin 1998f; [9] Hacker and Martin 1998g; [10] Hacker and Martin 1998h; [11] Hacker and Martin 1998i; [12] Hacker and Martin 1998j; [13] Hacker and Martin 1998k; [14] Hacker and Martin 1998l

Section A.5 EU Ad Valorem Import Tariff Rates for Groundnut Products

These tariff rates are dependent on whether a country is under Lomé, the GSP, or MFN. Tariffs for each region in the model are indicated in Table A.5.1. The import tariff on the ROW is a weighted average of these three tariff rates.

Table A.5.1 Ad Valorem Import Tariff Rates on Groundnut Products entering the European Union for 1998-99

Region	Trade Agreement with the EU	Tariff Rate on Groundnuts	Tariff Rate on Groundnut Oil	Tariff Rate on Groundnut Meal
Argentina	GSP	0.00%	5.30%[1]	0.00%
China	GSP	0.00%	5.30%[1]	0.00%
India	GSP	0.00%	5.30%[1]	0.00%
Nigeria	Lomé	0.00%	0.00%	0.00%
Senegal	Lomé	0.00%	0.00%	0.00%
Sudan	Lomé	0.00%	0.00%	0.00%
United States	MFN	0.00%	7.60%[1]	0.00%
Rest of World	N/A	0.00%	4.30%[1]	0.00%

Source: European Union 1999.

[1] Based on the tariff rate on product number 15081090 of the harmonized code. ROW = (5.3 + 7.6)/3.

A.6 Baseline Prices of Groundnuts, Groundnut Oil, and Groundnut Meal.

When possible the producer prices for individual countries were utilized, due to government intervention in some of the regions used in the model. The producer price when used reflects the price in the supply equation for that good. Demand prices are subject to the world prices, which can be seen in the second to last table for Rest of World. Any exceptions to the use of these baseline prices are indicated in Chapter 4 and Appendix C. All prices are CIF Rotterdam without import duties included, so this will also be taken into account, when calculating benchmark parameters. Table A.6.10 has some conversion rates that are needed for the calculation of the benchmark parameters in Appendix C, i.e. exchange rates and measurement ratios.

Table A.6.1 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in Argentina

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[2]	Measurement
1995	856	1005	161	Dollars per MT
1996	989	928	201	Dollars per MT
1997	926	959	235	Dollars per MT
1998	1055	964	134	Dollars per MT
1999	847	801	104	Dollars per MT
2000	835			Dollars per MT

[1]*Source:* ISTA Mielke GmbH 2000. CIF Rotterdam, Import duties excluded, Average prices are for the fiscal year beginning October 1 of the previous year marked, i.e Oct/Sept.
[2] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.2 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in China

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[2]	Measurement
1995	856	1005	161	Dollars per MT
1996	989	928	201	Dollars per MT
1997	926	959	235	Dollars per MT
1998	1055	964	134	Dollars per MT
1999	847	801	104	Dollars per MT
2000	835			Dollars per MT

[1]*Source:* ISTA Mielke GmbH 2000. CIF Rotterdam, Import duties excluded, Average prices are for the fiscal year beginning October 1 of the previous year marked, i.e Oct/Sept.
[2] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.3 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in the European Union

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[2]	Measurement
1995	856	1005	161	Dollars per MT
1996	989	928	201	Dollars per MT
1997	926	959	235	Dollars per MT
1998	1055	964	134	Dollars per MT
1999	847	801	104	Dollars per MT
2000	835			Dollars per MT

[1]*Source:* ISTA Mielke GmbH 2000. CIF Rotterdam, Import duties excluded, Average prices are for the fiscal year beginning October 1 of the previous year marked, i.e Oct/Sept.
[2] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.4 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in India

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[2]	Measurement
1995	1559[1]	4137[1]	161	Rs. per quintal
1996	1515[1]	4074[1]	201	Rs. per quintal
1997	1537[1]	4001[1]	235	Rs. per quintal
1998	1662[1]	4766[1]	134	Rs. per quintal
1999			104	Rs. per quintal
2000				Rs. per quintal

[1] *Source:* India 1999. Wholesale Price. Averages taken for the calendar year. Groundnuts prices are averaged over the regions: Gujarat, Andhra Pradesh, Uttar Pradesh, Andhra Pradesh, Maharashtra, and Tamil Nadu. Groundnut Oil Prices are averaged over the regions: Andhra Pradesh, Gujrat, Maharashtra, Tamil Nadu, West Bengal, and Delhi.
[2] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated. $US/MT

Table A.6.5 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in Nigeria

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[2]	Measurement
1995	856	1005	161	Dollars per MT
1996	989	928	201	Dollars per MT
1997	926	959	235	Dollars per MT
1998	1055	964	134	Dollars per MT
1999	847	801	104	Dollars per MT
2000	835			Dollars per MT

[1]*Source:* ISTA Mielke GmbH 2000. CIF Rotterdam, Import duties excluded, Average prices are for the fiscal year beginning October 1 of the previous year marked, i.e Oct/Sept.
[2] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.6 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in Senegal

Year	Groundnuts[1]	Groundnut Oil[2]	Groundnut Meal[3]	Measurement
1995	120[1]	1005	161	Dollars per MT
1996	125[1]	928	201	Dollars per MT
1997	150[1]	959	235	Dollars per MT
1998	150[1]	964	134	Dollars per MT
1999	161[1]	801	104	Dollars per MT
2000				Dollars per MT

[1] *Source:* Senegal 2000a. Producer prices are a weighted average of the producer price for groundnuts used for groundnut oil and the producer price for groundnuts used for confectionary groundnuts, using the percentage of total production for each as the weight. Unit: CFAF/Kg
[2]*Source:* ISTA Mielke GmbH 2000. CIF Rotterdam, Import duties excluded, Average prices are for the fiscal year beginning October 1 of the previous year marked, i.e Oct/Sept.
[3] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.7 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in Sudan.

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[2]	Measurement
1995	856	1005	161	Dollars per MT
1996	989	928	201	Dollars per MT
1997	926	959	235	Dollars per MT
1998	1055	964	134	Dollars per MT
1999	847	801	104	Dollars per MT
2000	835			Dollars per MT

[1]*Source:* ISTA Mielke GmbH 2000. CIF Rotterdam, Import duties excluded, Average prices are for the fiscal year beginning October 1 of the previous year marked, i.e Oct/Sept.
[2] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.8 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in the United States

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[1]	Measurement
1995	678	977	142	Dollars per MT
1996	610	888	223	Dollars per MT
1997	610	963	256	Dollars per MT
1998	610	1080	231	Dollars per MT
1999	610	876	110	Dollars per MT
2000	610	776	121	Dollars per MT

[1] *Source*: Chen and Fletcher, 1998
[2] *Source*: Foreign Agricultural Service 2001. Prices based on FOB prices at southeast mills and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.9 Prices for Groundnuts, Groundnut Oil, and Groundnut Meal in the Rest of World

Year	Groundnuts[1]	Groundnut Oil[1]	Groundnut Meal[2]	Measurement
1995	856	1005	161	Dollars per MT
1996	989	928	201	Dollars per MT
1997	926	959	235	Dollars per MT
1998	1055	964	134	Dollars per MT
1999	847	801	104	Dollars per MT
2000	835			Dollars per MT

[1]*Source:* ISTA Mielke GmbH 2000. CIF Rotterdam, Import duties excluded, Average prices are for the fiscal year beginning October 1 of the previous year marked, i.e Oct/Sept.
[2] *Source*: Foreign Agricultural Service 2001. Prices are CIF Rotterdam and averaged over the year from October of the previous year to September of the year indicated.

Table A.6.10 Conversions

1 SDR = 1.40803 US$, 1 SDR = 59.8131 Rupee, 59.8131 Rupee = 1.40803 US$, 42.4800 Rupee = 1 US$[1]
595.56 CFAF = 1 US$[2]
1 quintal = 100 kg, 10 quintals = 1 metric ton[3]
1 metric ton = 1.1 short ton (2000 1bs), 1 metric ton = 2240 lbs.[3]

[1] International Monetary Fund 1998
[2] IMF: Senegal Statistical Appendix 1999. Calculated for 1998. Jan. – Oct.
[3] American Heritage Dictionary 1992.

Appendix B: Derivations for the Conceptual Model(s) Specified in Chapter 3

In Chapter 3 the following economic system is presented for the conceptual analysis of the options open to the Senegalese government after the expiration of the fourth Lomé Convention in February 2000. The model presented is a three region, one commodity partial equilibrium model. The three regions are Senegal (S), Argentina (A), and the European Union (EU). The commodity is groundnut oil. The model consisted of the following equations:

Supply Side: $S_S = a + bP_S$ (B.1)

$S_A = e + fP_A$ (B.2)

Demand Side: $D_S = c - dP_S$ (B.3)

$D_A = g - hP_A$ (B.4)

$D_{EU} = j - kP_{EU}$ (B.5)

Market Clearing: $S_S + S_A = D_S + D_A + D_{EU}$ (B.6)

$P_S + \theta_S = P_{EU}(1 - \tau_S)$ (B.7)

$P_A + \theta_A = P_{EU}(1 - \tau_A)$ (B.8)

Variable and Parameter Definitions:

S_S = Quantity supplied of groundnut oil in Senegal

S_A = Quantity supplied of groundnut oil in Argentina

D_S = Quantity demanded domestically of groundnut oil in Senegal

D_A = Quantity demanded domestically of groundnut oil in Argentina

D_{EU} = Quantity demanded domestically of groundnut oil in the European Union

P_S = Price of groundnut oil in Senegal

P_A = Price of groundnut oil in Argentina

P_{EU} = Price of groundnut oil in the European Union

θ = Transportation costs from the supply region to the European Union

τ = Import tariff on groundnut oil entering the European Union

All variables are determined endogenously. Thus, solving for these variables as functions of the exogenous parameters $(\theta_A, \theta_S, \tau_A, \tau_S)$ is needed for comparative static analyses. To complete this task the price variables, (P_S,P_A,P_{EU}), are solved for in terms of the exogenous parameters.

They are then plugged back into the supply and demand functions to solve for the quantity variables, (S_A,S_S,D_A,D_S,D_{EU}). All parameters are assumed to be greater than or equal to zero.

This appendix is laid out in the following manner. The first section solves for the price variables as functions of the exogenous parameters and examines the derivatives of the price variables with respect to the exogenous parameters $(\theta_A, \theta_S, \tau_A, \tau_S)$. The second section examines the derivatives of the quantity variables with respect to the same exogenous parameters after solving for the quantity variables. The third section examines a three market economy with cross-price effects as discussed in Chapter 3, Section 3.7. All of these derivations provide the needed framework for the analysis conducted and explained in Chapter 3.

B.1 Derivation of the Price for Groundnut Oil in each Region as Functions of the Parameters $(\theta_A, \theta_S, \tau_A, \tau_S)$ and the Derivatives of the Price for Groundnut Oil in each Region with Respect to the Parameters $(\theta_A, \theta_S, \tau_A, \tau_S)$

Using equations (B.7) and (B.8) solve for P_S and P_A and then substitute these into (B.1) – (B.4). Then substitute the revised supply and demand functions as functions of P_{EU} and (B.5) into (B.6) to solve for $P_{EU.}$ The result is:

$$P_{EU}(\theta_A, \theta_S, \tau_A, \tau_S) = \frac{\theta_S(b+d) + \theta_A(f+h) - a + c - e + g + j}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k} \tag{B.9}$$

Plugging (B.9) into (B.7) and (B.8), and solving for P_S and P_A gives:

$$P_S(\theta_A, \theta_S, \tau_A, \tau_S) = \frac{(f+h)[\theta_A(1-\tau_S) - \theta_S(1-\tau_A)] + (1-\tau_S)(-a+c-e+g+j) - \theta_S k}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k} \tag{B.10}$$

$$P_A(\theta_A, \theta_S, \tau_A, \tau_S) = \frac{(b+d)[\theta_S(1-\tau_A) - \theta_A(1-\tau_S)] + (1-\tau_A)(-a+c-e+g+j) - \theta_A k}{(1-\tau_S)(b+d) + (1-\tau_A)(f+h) + k} \tag{B.11}$$

All parameters, in the above functional relationships, are greater than or equal to zero. Furthermore, since the supply curves are upward sloping and the demand curves are downward sloping, the intercepts of the demand equations are greater than the intercepts of the supply

equations, i.e. (c + g + j) > (a + e), so (-a +c – e + g + j) > 0. These two points are important to keep in mind, when determining the signs of the following derivatives.

The following functional relationships are the derivatives of (B.9) – (B.11) with respect to the parameters $(\theta_A, \theta_S, \tau_A, \tau_S)$.

$$\frac{\partial P_{EU}}{\partial \theta_S} = \frac{b+d}{(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k} > 0 \tag{B.12}$$

$$\frac{\partial P_{EU}}{\partial \theta_A} = \frac{f+h}{(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k} > 0 \tag{B.13}$$

$$\frac{\partial P_{EU}}{\partial \tau_S} = \frac{(b+d)[\theta_S(b+d)+\theta_A(f+h)-a+c-e+g+j]}{[(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k]^2} > 0 \tag{B.14}$$

$$\frac{\partial P_{EU}}{\partial \tau_A} = \frac{(f+h)[\theta_S(b+d)+\theta_A(f+h)-a+c-e+g+j]}{[(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k]^2} > 0 \tag{B.15}$$

$$\frac{\partial P_S}{\partial \theta_S} = \frac{-(f+h)(1-\tau_A)-k}{(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k} < 0 \tag{B.16}$$

$$\frac{\partial P_S}{\partial \theta_A} = \frac{(f+h)(1-\tau_S)}{(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k} > 0 \tag{B.17}$$

$$\frac{\partial P_S}{\partial \tau_S} = \frac{-[(1-\tau_A)(f+h)+k][\theta_S(b+d)+\theta_A(f+h)-a+c-e+g+j]}{[(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k]^2} < 0 \tag{B.18}$$

$$\frac{\partial P_S}{\partial \tau_A} = \frac{(1-\tau_S)(f+h)[\theta_S(b+d)+\theta_A(f+h)-a+c-e+g+j]}{[(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k]^2} > 0 \tag{B.19}$$

$$\frac{\partial P_A}{\partial \theta_S} = \frac{(b+d)(1-\tau_A)}{(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k} > 0 \tag{B.20}$$

$$\frac{\partial P_A}{\partial \theta_A} = \frac{-(1-\tau_S)(b+d)-k}{(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k} < 0 \tag{B.21}$$

$$\frac{\partial P_A}{\partial \tau_S} = \frac{(1-\tau_A)(b+d)[\theta_S(b+d)+\theta_A(f+h)-a+c-e+g+j]}{[(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k]^2} > 0 \tag{B.22}$$

$$\frac{\partial P_A}{\partial \tau_A} = \frac{-[(1-\tau_S)(b+d)+k][\theta_S(b+d)+\theta_A(f+h)-a+c-e+g+j]}{[(1-\tau_S)(b+d)+(1-\tau_A)(f+h)+k]^2} < 0 \tag{B.23}$$

B.2 The Derivatives of the Quantity Variables with Respect to the Parameters, $(\theta_A, \theta_S, \tau_A, \tau_S)$

Using (B.9) – (B.11) represent the quantity variables, (S_A,S_S,D_A,D_S,D_{EU}), as functions of the exogenous parameters, $(\theta_A, \theta_S, \tau_A, \tau_S)$. Using these functional relationships, the derivatives of these variables with respect to the parameters, $(\theta_A, \theta_S, \tau_A, \tau_S)$, can be determined. The signs of the derivatives are derived from the derivatives determined in Section B.1.

Derivatives of $S_S = a + bP_S$

$$\frac{\partial S_S}{\partial \theta_S} = b\frac{\partial P_S}{\partial \theta_S} < 0 \tag{B.24}$$

$$\frac{\partial S_S}{\partial \theta_A} = b\frac{\partial P_S}{\partial \theta_A} > 0 \tag{B.25}$$

$$\frac{\partial S_S}{\partial \tau_S} = b\frac{\partial P_S}{\partial \tau_S} < 0 \tag{B.26}$$

$$\frac{\partial S_S}{\partial \tau_A} = b\frac{\partial P_S}{\partial \tau_A} > 0 \tag{B.27}$$

Derivatives of $S_A = e + fP_A$

$$\frac{\partial S_A}{\partial \theta_S} = f\frac{\partial P_A}{\partial \theta_S} > 0 \tag{B.28}$$

$$\frac{\partial S_A}{\partial \theta_A} = f\frac{\partial P_A}{\partial \theta_A} < 0 \tag{B.29}$$

$$\frac{\partial S_A}{\partial \tau_S} = f\frac{\partial P_A}{\partial \tau_S} > 0 \tag{B.30}$$

$$\frac{\partial S_A}{\partial \tau_A} = f\frac{\partial P_A}{\partial \tau_A} < 0 \tag{B.31}$$

Derivatives of $D_S = c - dP_S$

$$\frac{\partial D_S}{\partial \theta_S} = -d\frac{\partial P_S}{\partial \theta_S} > 0 \tag{B.32}$$

$$\frac{\partial D_S}{\partial \theta_A} = -d\frac{\partial P_S}{\partial \theta_A} < 0 \tag{B.33}$$

$$\frac{\partial D_S}{\partial \tau_S} = -d\frac{\partial P_S}{\partial \tau_S} > 0 \tag{B.34}$$

$$\frac{\partial D_S}{\partial \tau_A} = -d\frac{\partial P_S}{\partial \tau_A} < 0 \tag{B.35}$$

Derivatives of $D_A = g - hP_A$

$$\frac{\partial D_A}{\partial \theta_S} = -h\frac{\partial P_A}{\partial \theta_S} < 0 \tag{B.36}$$

$$\frac{\partial D_A}{\partial \theta_A} = -h\frac{\partial P_A}{\partial \theta_A} > 0 \tag{B.37}$$

$$\frac{\partial D_A}{\partial \tau_S} = -h\frac{\partial P_A}{\partial \tau_S} < 0 \tag{B.38}$$

$$\frac{\partial D_A}{\partial \tau_A} = -h\frac{\partial P_A}{\partial \tau_A} > 0 \tag{B.39}$$

Derivatives of $D_{EU} = j - kP_{EU}$

$$\frac{\partial D_{EU}}{\partial \theta_S} = -k\frac{\partial P_{EU}}{\partial \theta_S} < 0 \tag{B.40}$$

$$\frac{\partial D_{EU}}{\partial \theta_A} = -k\frac{\partial P_{EU}}{\partial \theta_A} < 0 \tag{B.41}$$

$$\frac{\partial D_{EU}}{\partial \tau_S} = -k\frac{\partial P_{EU}}{\partial \tau_S} < 0 \tag{B.42}$$

$$\frac{\partial D_{EU}}{\partial \tau_A} = -k\frac{\partial P_{EU}}{\partial \tau_A} < 0 \tag{B.43}$$

Appendix C: Derivations and GAMS Code for the Empirical Model

C.1 Model Structure

C.1.1 Indexes/Sets

i supply regions: Argentina, China, India, Nigeria. Senegal, Sudan, United States, ROW.
j demand regions: Argentina, China, EU, India, Nigeria, Senegal, Sudan, United States, ROW.
n commodities: groundnuts, groundnut meal, groundnut oil.
l commodities: all commodities in set of *n* commodities such that *l* is not equal to *n* in the given supply or demand equation, i.e. the *l* set of commodities is a subset of the *n* set of commodities.
t factors: development funding

C.1.2 Supply Side

$$Q_i^n + Q_{i.EU}^n = \alpha_i^n \left(\frac{P_i^n}{\overline{P}_i^n} \right)^{\varepsilon_i^n} \prod_l \left(\frac{P_i^l}{\overline{P}_i^l} \right)^{\sigma_i^l} \prod_t \left(\frac{X_i^t}{\overline{X}_i^t} \right)^{\varsigma_i^t} \quad \forall\, i \text{, where}$$

Q_i^n = Quantity domestically consumed of commodity *n* in market *i=j*,

$Q_{i.EU}^n$ = Quantity exported of commodity *n* from market *i* to the EU,

α_i^n = benchmark quantity supplied of commodity n in market *i*,

P_i^n = the supply price of commodity *n* in market *i*,

P_i^l = the supply price of commodity *l* in market *i*,

$\overline{P}$ = benchmark prices,

X_i^t = factor *t* in market *i*, e.g. development funding,

$\overline{X}_i^t$ = benchmark amount of factor *t* in market *i* in the base year,

ε_i^n = own-price elasticity of supply for commodity *n* in market *i*,

σ_i^l = cross-price elasticity of supply for commodity *l* in market *i*, and

ς_i^t = factor elasticity of supply for factor *t* in market *i*.

To build in the two-stage production process discussed in Chapter 4, the following formulation for the supply equations of groundnut oil and groundnut meal is used.

Let *g* = groundnuts and *m* = groundnut meal, groundnut cake

$$Q_i^m + Q_{i.EU}^m = \frac{\alpha_i^m}{\alpha_i^g} \left(Q_i^g + Q_{i.EU}^g \right) \left(\frac{P_i^m}{\overline{P}_i^m} \right)^{\varepsilon_i^m} \prod_l \left(\frac{P_i^l}{\overline{P}_i^l} \right)^{\sigma_i^l} \prod_t \left(\frac{X_i^t}{\overline{X}_i^t} \right)^{\varsigma_i^t} \quad \forall\, i$$

C.1.3 Demand Side

For regions j:

$$Q_j^n = \beta_j^n \left(\frac{P_j^n}{\overline{P}_j^n} \right)^{\eta_j^n} \prod_l \left(\frac{P_j^l}{\overline{P}_j^l} \right)^{\kappa_j^l}$$

For the EU (specifically):

$$\sum_i Q_{i.EU}^n = \beta_{EU}^n \left(\frac{P_{EU}^n}{\overline{P}_{EU}^n} \right)^{\eta_{EU}^n} \prod_l \left(\frac{P_{EU}^l}{\overline{P}_{EU}^l} \right)^{\kappa_{EU}^l}$$, where

Q_j^n = Quantity domestically consumed of commodity *n* in market *i*,

β_j^n = benchmark quantity demanded of commodity *n* in market *j*,

P_j^n = the price of commodity *n* in market *j*,

P_j^l = the price of commodity *l* in market *j*,

$\overline{P}$ = benchmark prices,

η_j^n = own-price elasticity of demand for commodity *n* in market *j*, and

κ_j^l = cross-price elasticity of demand for commodity *l* in market *j*.

C.1.4 Arbitrage and Pricing Conditions

(i) $P_i^n + W_i^n \geq P_j^n \quad \forall \quad i = j$

(ii) $W_i^n \geq P_j^n - \overline{P}_i^n \quad \forall \quad i = j$

(iii) $P_i^n + W_i^n + \theta_i \geq (1 - \tau_i^n) P_{EU}^n \quad \forall \quad i$

W_i^n = price differential

θ_i = transportation costs from region *i* to the EU

τ_i = the import tariff into the EU on commodity *n* or *l* from region *i*.

See Chapter 4 for the discussion on the inclusion of W_i^n and condition (ii) in the pricing and arbitrage conditions.

C.2 Calculation of Consumer and Producer Surplus for Senegal

For the following let *S* denote the country of Senegal, *g* denote groundnuts, *go* denote groundnut oil and *gm* denote groundnut meal. Furthermore, define $\hat{P}_S^n$ as the prevailing supply price of commodity *n* in Senegal that is determined by the model, $\hat{P}_D^n$ as the prevailing demand price of

commodity *n* in Senegal that is determined by the model, and $\left(\hat{Q}_S^g + \hat{Q}_{S.EU}^g\right)$ as the equilibrium quantity of supply for groundnuts (in-shell and shelled). Now let

$$\overline{QP_g} = \alpha_S^g \prod_l \left(\frac{\hat{P}_S^l}{\overline{P}_S^l}\right)^{\sigma_S^l} \prod_t \left(\frac{X_S^t}{\overline{X}_S^t}\right)^{\varsigma_S^t}$$

$$\overline{QP_m} = \frac{\alpha_S^m}{\alpha_S^g}\left(\hat{Q}_{SEN}^g + \hat{Q}_{SEN.EU}^g\right)\prod_l \left(\frac{\hat{P}_S^l}{\overline{P}_S^l}\right)^{\sigma_S^l} \prod_t \left(\frac{X_S^t}{\overline{X}_S^t}\right)^{\varsigma_S^t}$$, where *m* is defined above, and

$$\overline{QD_n} = \beta_S^n \prod_l \left(\frac{\hat{P}_S^l}{\overline{P}_S^l}\right)^{\kappa_S^l}.$$

C.2.1 Producer Surplus(PS)

Since $Q_S^n + Q_{S.EU}^n = 0$ when $P_S^n = 0$ for the supply functions denoted in Section C.1.2, producer surplus can be calculated as follows:

for groundnuts:

$$PS_g = \int_0^{\hat{P}_S^g} S(P_S^g)dP_S^g = \overline{QP_g}\int_0^{\hat{P}_S^g}\left(\frac{P_S^g}{\overline{P}_S^g}\right)^{\varepsilon_S^g} dP_S^g = \frac{\overline{QP_g}}{\left(\overline{P}_S^g\right)^{\varepsilon_S^g}}\int_0^{\hat{P}_S^g}\left(P_S^g\right)^{\varepsilon_S^g} dP_S^g =$$

$$\frac{\overline{QP_g}}{(1+\varepsilon_S^g)\left(\overline{P}_S^g\right)^{\varepsilon_S^g}}\left[\hat{P}_S^g - 0\right]^{\varepsilon_S^g+1} = \frac{\overline{QP_g}\left(\hat{P}_S^g\right)^{\varepsilon_S^g+1}}{\left(1+\varepsilon_S^g\right)\left(\overline{P}_S^g\right)^{\varepsilon_S^g}},$$

for groundnut oil and groundnut meal:

$$PS_m = \int_0^{\hat{P}_S^m} S(P_S^m)dP_S^m = \overline{QP_m}\int_0^{\hat{P}_S^m}\left(\frac{P_S^m}{\overline{P}_S^m}\right)^{\varepsilon_S^m} dP_S^m = \frac{\overline{QP_m}}{\left(\overline{P}_S^m\right)^{\varepsilon_S^m}}\int_0^{\hat{P}_S^m}\left(P_S^m\right)^{\varepsilon_S^m} dP_S^m =$$

$$\frac{\overline{QP_m}}{(1+\varepsilon_S^m)\left(\overline{P}_S^m\right)^{\varepsilon_S^m}}\left[\hat{P}_S^m - 0\right]^{\varepsilon_S^m+1} = \frac{\overline{QP_m}\left(\hat{P}_S^m\right)^{\varepsilon_S^m+1}}{\left(1+\varepsilon_S^m\right)\left(\overline{P}_S^m\right)^{\varepsilon_S^m}}.$$

The change in producer surplus is defined as: $\Delta_{PS}^n = PS_1 - PS_0$, where 1 denotes a change from baseline and 0 denotes the baseline case.

C.2.2 Consumer Surplus (CS)

The demand curve as given in section C.1.3 is asymptotic to both the P_S^n and Q_S^n axes. Using the definition of an improper integral, it can be shown that the integral from $\hat{P}_D^n$ to infinity for all *n* will always converge to a constant, given no change in the parameters or other variables (e.g. prices of the other commodities) in the demand function. Thus, the calculation of consumer surplus is problematic, since one could not utilize this as a measure to examine the change in consumer surplus given a change in the own-price of the good that is being examined, i.e.

$$\int_{\hat{P}_D^n}^{\infty} D(P_S^n)dP_S^n = \lim_{a\to\infty}\int_{\hat{P}_D^n}^{a} D(P_S^n)dP_S^n = \lim_{a\to\infty}\overline{QD}_n\int_{\hat{P}_D^n}^{a}\left(\frac{P_S^n}{\overline{P}_S^n}\right)^{\eta_S^n} dP_S^n =$$

$$\lim_{a\to\infty}\frac{\overline{QD}_n}{\left(1+\eta_S^n\right)\left(\overline{P}_S^n\right)^{\eta_S^n}}\left[a^{\eta_S^n+1}-\left(\hat{P}_D^n\right)^{\eta_S^n+1}\right], \text{ which converges to } \frac{\overline{QD}_n}{\left(1+\eta_S^n\right)\left(\overline{P}_S^n\right)^{\eta_S^n}} \text{ as } a\to\infty.$$

The above measure is only responsive to exogenous parameter changes and changes in the prices of the other goods in the demand equation. Where does this leave us? One can still compute $\Delta_{CS}^n = CS_1 - CS_0$ though. To do this, instead of using the indefinite integral from $\hat{P}_D^n$ to infinity, one could use the integral from $\hat{P}_D^n$ to *a*, where *a* is some arbitrary number less than infinity. This allows one to get changes in consumer surplus by computing the same integral in the baseline case and in the case where a change to the economic system occurs, e.g. an economic shock. Thus one needs to calculate:

$$\int_{\hat{P}_D^n}^{a} D(P_S^n)dP_S^n = \overline{QD}_n\int_{\hat{P}_D^n}^{a}\left(\frac{P_S^n}{\overline{P}_S^n}\right)^{\eta_S^n} dP_S^n = \frac{\overline{QD}_n}{\left(1+\eta_S^n\right)\left(\overline{P}_S^n\right)^{\eta_S^n}}\left[a^{\eta_S^n+1}-\left(\hat{P}_D^n\right)^{\eta_S^n+1}\right],$$

where $a < \infty$,

for CS_1 and CS_0, and then take their difference to get Δ_{CS}^n. This calculation should give an approximate idea of the change in direction of consumer surplus given a particular economic shock, i.e. the sign of the change. To infer any more from this calculation could be misleading, since any such conclusions would not fully take into account the complete shift in the demand curves caused by a change in an exogenous parameter or price of another groundnut commodity, i.e. changes in $\overline{QD}_n$.

C.3 Benchmark Parameters

Table C.3.1 Benchmark Parameters Used for the Baseline Simulation of the Model for 1998

Region	Supply Price[1] ($/MT)	Demand Price[2] ($/MT)	Domestic Supply[3] (1000 MT)	Domestic Demand[4] (1000 MT)
	Groundnuts			
Argentina	1039.55	1039.55	560.2	309
China	1040.38	1040.38	7057.7	6956
European Union	N/A	1055	0	587.679
India	391.242	1038.22	7476	7430
Nigeria	1044.58	1044.58	1310	1310
Senegal	215.864	1042.5	525.5	521
Sudan	1042.45	1042.45	572	567
Unites States	610	1044.65	1363.6	1245
ROW[1]	1041.77	1041.77	3985	3898.6
	Groundnut Oil			
Argentina	897.458	897.458	47	10.6
China	898.288	898.288	1862.4	1862.4
European Union	N/A	964	0	190.229
India	1121.94	1121.94	1725	1725
Nigeria	953.58	953.58	309.7	305.5
Senegal	951.5	951.5	50.2	4
Sudan	951.45	951.45	167.3	122.7
Unites States	1080	1080	78.4	77.5
ROW[1]	909.318	909.318	564.3	515.5
	Groundnut Meal			
Argentina	118.55	118.55	109.7	65.6
China	119.38	119.38	2563.3	2563.3
European Union	N/A	134	0	204.1
India	117.22	117.22	2290	2290
Nigeria	123.58	123.58	368.4	368.4
Senegal	121.5	121.5	57.5	20
Sudan	121.45	121.45	271.6	163.8
Unites States	123.65	123.65	83.6	69
ROW[5]	120.77	120.77	654.9	654.9

Sources: See Appendix 1

[1] Supply Prices are calculated using data from Appendix A, Sections A.4 thru A.6 as follows: (EU Price)*(1 – tariff) – (transportation costs), except when the price is determined domestically.

[2] Demand Prices are calculated using data from Appendix A, Sections A.4 thru A.6 as follows: (EU Price)*(1 – tariff) – (transportation costs), except when the price is determined domestically.

[3] Supply is calculated using data from Appendix A, Sections A.2 and A.3 as follows: (Production) + (Opening Stocks) – (Exports to regions other than the EU)

[4] Domestic Consumption (Demand) is calculated using data from Appendix A, Section A.2 as follows: (Domestic Demand) – (Imports). In the EU it is equal to imports due to the assumption that the EU does not produce any of its own domestic demand. This calculation is done using data from Appendix A, Section A.3

[5] ROW = Rest of World

There are some additional points that need to be made about the above data points. First, the demand and supply prices are calculated in such a way as to reflect that some countries price-set or have other market mechanisms that determine the domestic price (see Chapter 4, Section 4.3). Second, all price calculations take into account that the prices reported in Appendix A, Section A.6 are CIF Rotterdam. Third, exports to the EU from each region are not included explicitly, but can be calculated by subtracting domestic consumption from supply. Fourth, to ensure that exports are included in certain markets, i.e. the U.S., the international price is used instead of the domestic price in some instances. For example, if the groundnut meal price in the U.S. where set at $231 per metric ton then the model would not produce any exports for the US, when in fact they exported over 14,000 metric tons in 1998. Thus, the international price is used to determine the groundnut meal supply and demand for the United States.

Transportation costs and import tariffs are used as presented in Appendix A, Sections A.4 and A.5 for baseline data. The only country that has development funding in the model is Senegal, equal to $7,768,320. This amount refers to the amount of STABEX funds Senegal received in 1998 (see chapter 2, Section 2.2.5).

All the elasticities for the supply and demand equations are used as presented in Appendix 1, Section A1.1 except the US cross-price supply elasticity for groundnut meal with respect to groundnut oil and the US cross-price supply elasticity for groundnut oil with respect to groundnut meal. These two latter elasticities are replaced with 0.30 and 0.30. It does not seem to follow, why these elasticities would be much greater in the United States when compared to the eight other regions, so they are adjusted to bring into accordance with the other regions of the model.

C.4 GAMS Code

```
$title Partial Equilibrium Model analyzing the impact of the NPA on the
Senegalese groundnut sector

set     k       Regions
        /ARG    Argentina,
         CHI    China,
         EU     European Union,
         IND    India,
         NIG    Nigeria,
         SEN    Senegal,
         SUD    Sudan,
         US     United States,
```

```
         ROW    Rest of World/
        i(k)    Supply Regions /ARG, CHI, IND, NIG, SEN, SUD, US, ROW/
        j(k)    Demand Regions /ARG, CHI, EU, IND, NIG, SEN, SUD, US,
                ROW/
        n       Commodities    / g      groundnuts,
                                 go     groundnut oil,
                                 gm     grounndut meal/
alias(n,nn,nnn);

table seg(n,nn,i)   "Supply elasticities for the groundnut supply
equation"
        ARG     CHI     IND     NIG     SEN     SUD     US      ROW
g.g     0.70    0.10    0.35    0.16    0.4889  0.42    0.55    0.25
g.go    0       0       0       0       0       0       0       0
g.gm    0       0       0       0       0       0       0       0
go.g    0.37    0.35    0.27    0.14    0.35    0.41    0.82    0.34
go.go   0.32    0.25    0.27    0.18    0.30    0.31    0.30    0.24
go.gm   0.10    0.15    0.05    0.01    0.10    0.15    0.30    0.15
gm.g    0.37    0.35    0.27    0.14    0.35    0.41    0.82    0.34
gm.go   0.32    0.25    0.27    0.18    0.30    0.31    0.30    0.24
gm.gm   0.10    0.15    0.05    0.01    0.10    0.15    0.30    0.15;

* Note: the signs for the rows (go.g, gm.g) of the above table are
negative, which will be indicated in the equations defined below.
Changed (go.gm) and (gm.go) to 0.30 to bring in line. It doesn't seem
to follow why these elasticities would be far greater in the US than in
other countries.

table deg(n,nn,k)   "Demand Elasticities for the groundnut demand
equation"
        ARG   CHI     EU     IND     NIG    SEN     SUD    US    ROW
g.g     0.25  0.31    0.38   0.34    0.22   0.18    0.18   0.144 0.17
g.go    0.15  0.15    0.25   0.24    0.16   0.09    0.07   0.07  0.07
g.gm    0.05  0.09    0.07   0.04    0.01   0.03    0.03   0.14  0.04
go.g    0     0       0      0       0      0       0      0     0
go.go   0.99  0.50    0.56   0.50    0.20   0.20    0.20   0.69  0.80
go.gm   0     0       0      0       0      0       0      0     0
gm.g    0     0       0      0       0      0       0      0     0
gm.go   0     0       0      0       0      0       0      0     0
gm.gm   0.54  0.46    0.81   0.34    0.30   0.20    0.30   0.73  0.33;

*Note: The demand elasticities in the above table for (g.g, go.go,
gm.gm) are all negative, but this will be dealt with in the demand
equations.

table alpha(n,i)    "Supply function share coefficient for commodity n\
                    (1998 base year)"

        ARG    CHI     IND     NIG     SEN     SUD     US      ROW
g       560.2  7057.7  7476    1310    525.5   572     1363.6  3985
go      47     1862.4  1725    309.7   50.2    167.3   78.4    564.3
gm      109.7  2563.3  2290    368.4   57.5    271.6   83.6    654.9;

* Each alpha is calculated as follows: Production plus Opening Stocks
* minus Exports to regions other than the EU

table beta(n,k)     "Demand function share coefficient for commodity n
```

(1998 base year)"

	ARG	CHI	EU	IND	NIG	SEN	SUD	US	ROW
g	309	6956	587.679	7430	1310	521	567	1245	3898.6
go	10.6	1862.4	190.229	1725	305.5	4	122.7	77.5	515.5
gm	65.6	2563.3	204.1	2290	368.4	20	163.8	69	654.9;

* Each beta is equal to total domestic demand minus imports, except in the EU where it is just equal to imports from Appendix A Section A.3 (due to the assumption that the EU does not produce any groundnut products in the model.

table pbs(n,k) "Reference prices for the supply equations for commodity n in region k ($/MT)"

	ARG	CHI	EU	IND	NIG	SEN	SUD	US	ROW
g	1039.55	1040.38	1055	391.242	1044.58	251.864	1042.45	610.00	1041.77
go	897.458	898.288	964	1121.94	953.58	951.5	951.45	1080.0	909.318
gm	118.55	119.38	134	117.22	123.58	121.5	121.45	123.65	120.77;

* All prices in Appendix A are taken as CIF Rotterdam. For GSP/MFN countries and the ROW, the price is equal to (1 - tariff)*(Price in the EU) - transportation cost. For Lome countries the price is equal to EU price - transportation cost.

table pbd(n,k) "Reference prices for the demand equations for commodity n in region k ($/MT)"

	ARG	CHI	EU	IND	NIG	SEN	SUD	US	ROW
g	1039.55	1040.38	1055	1038.22	1044.58	1042.5	1042.45	1044.65	1041.77
go	897.458	898.288	964	1121.94	953.58	951.5	951.45	1080.00	909.318
gm	118.55	119.38	134	117.22	123.58	121.5	121.45	123.65	120.77;

* All prices in Appendix A are taken as CIF Rotterdam. For GSP/MFN countries and the ROW, the price is equal to (1 - tariff)*(Price in the EU) - transportation cost. For Lome countries the price is equal to EU price - transportation cost.

parameter theta(i) "Transportation Cost in $1000/1000MT"
/ARG 15.45,
CHI 14.62,
IND 16.78,
NIG 10.42,
SEN 12.50,
SUD 12.55,
US 10.35,
ROW 13.23/;

table tau(n,i) "Ad Valorem Import Tariff Rate on imports into the EU"

	ARG	CHI	IND	NIG	SEN	SUD	US	ROW
g	0	0	0	0	0	0	0	0
go	0.053	0.053	0.053	0	0	0	0.076	0.043
gm	0	0	0	0	0	0	0	0;

parameter fbst(i) "Amount of STABEX funds received in 1998 (Only examining Senegal),($1000) – baseline amount"
/ARG 0.001,

```
         CHI    0.001,
         IND    0.001,
         NIG    0.001,
         SEN    7768.319,
         SUD    0.001,
         US     0.001,
         ROW    0.001/;
*Note: Other values set to 0.001 to avoid division by zero error!

parameter FST(i)  "Amount of STABEX funds received in future periods
                  (Only examining Senegal),($1000) – exogenously
                   determined variable"
        /ARG    0.001,
         CHI    0.001,
         IND    0.001,
         NIG    0.001,
         SEN    7768.319,
         SUD    0.001,
         US     0.001,
         ROW    0.001/;

*Note: This variable is always determined exogenously.

parameter fes(i)   "Factor elasticities of supply for groundnuts for
                    the variable FST"
        /ARG    0,
         CHI    0,
         IND    0,
         NIG    0,
         SEN    0.2,
         SUD    0,
         US     0,
         ROW    0/;

Positive Variables
        PSG(i)     "Supply Price of groundnuts in market i"
        PSGO(i)    "Supply Price of groundnut oil in market i"
        PSGM(i)    "Supply Price of groundnut meal in market i"
        PDG(i)     "Demand Price of groundnuts in market i"
        PDGO(i)    "Demand Price of groundnut oil im market i"
        PDGM(i)    "Demand Price of groundnut meal in market i"
        PEUG       "Price of groundnuts in the EU"
        PEUGO      "Price of groundnut oil in the EU"
        PEUGM      "Price of groundnut meal in the EU"
        WG(i)      "Surplus/Profit/Rent received by government or firms
                    in market i"
        WGO(i)     "Surplus/Profit/Rent received by government or firms
                    in market i"
        XDG(i)     "Domestic Consumption of groundnuts in market i"
        XTG(i)     "Amount exported of groundnuts to the EU from market
                    i"
        XDGO(i)    "Domestic Consumption of groundnut oil in market i"
        XTGO(i)    "Amount exported of groundnut oil to the EU from
                    market i"
        XDGM(i)    "Domestic Consumption of groundnut meal in market i"
        XTGM(i)    "Amount exported of groundnut oil to the EU from
                    market i"
```

```
Equations
        SupplyG(i)      "Supply equations for groundnuts in region i"
        SupplyGO(i)     "Supply equations for groundnuts in reiogn i"
        SupplyGM(i)     "Supply equations for groundnuts in region i"
        DemandG(i)      "Domestic demand equations for groundnuts in
                         region i"
        DemandGO(i)     "Domestic demand equations for groundnut oil in
                         region i"
        DemandGM(i)     "Domestic demand equations for groundnut meal
                         in region i"
        DemandEUG       "Domestic demand equation for groundnuts in the
                         EU"
        DemandEUGO      "Domestic demand equation for groundnut oil in
                         the EU"
        DemandEUGM      "Domestic demand equation for groundnut meal in
                         the EU"
        DomPriceG(i)    "Domestic Arbitrage Conditions for groundnuts
                         prices"
        DomPriceG2(i)   "Same as above - to ensure DomPriceG is met"
        DomPriceGO(i)   "Domestic Arbitrage Conditions for groundnut
                         oil prices"
        DomPGO2(i)      "Same as above - to ensure DomPriceGO is met"
        DomPriceGM(i)   "Domestic Arbitrage Conditions for groundnut
                         meal prices"
        PriceG(i)       "Zero profit conditions/Arbitrage Conditions
                         for groundnuts"
        PriceGO(i)      "Zero profit conditions/Arbitrage Conditions
                         for groundnut oil"
        PriceGM(i)      "Zero profit conditions/Arbitrage Conditions
                         for groundnut meal";

SupplyG(i)..      alpha("g",i)*[(PSG(i)/pbs("g",i))**seg("g","g",i)]*
                  [(PSGO(i)/pbs("go",i))**(seg("g","go",i))]*
                  [(PSGM(i)/pbs("gm",i))**(seg("g","gm",i))]*
                  [(FST(i)/fbst(i))**(fes(i))]
                  =G= (XDG(i) + XTG(i));
SupplyGO(i)..     [alpha("go",i)/alpha("g",i)]*[XDG(i)+XTG(i)]*
                  [(PSG(i)/pbs("g",i))**(-seg("go","g",i))]*
                  [(PSGO(i)/pbs("go",i))**seg("go","go",i)]*
                  [(PSGM(i)/pbs("gm",i))**seg("go","gm",i)]
                  =G= (XDGO(i) + XTGO(i));
SupplyGM(i)..     [alpha("gm",i)/alpha("g",i)]*[XDG(i)+XTG(i)]*
                  [(PSG(i)/pbs("g",i))**(-seg("gm","g",i))]*
                  [(PSGO(i)/pbs("go",i))**seg("gm","go",i)]*
                  [(PSGM(i)/pbs("gm",i))**seg("gm","gm",i)]
                  =G= (XDGM(i) + XTGM(i));
DemandG(i)..      XDG(i) =G= Beta("g",i)*
                  [(PDG(i)/pbd("g",i))**(deg("g","g",i))]*
                  [(PDGO(i)/pbd("go",i))**deg("g","go",i)]*
                  [(PDGM(i)/pbd("gm",i))**deg("g","gm",i)];
DemandGO(i)..     XDGO(i) =G= Beta("go",i)*
                  [(PDG(i)/pbd("g",i))**deg("go","g",i)]*
                  [(PDGO(i)/pbd("go",i))**(-deg("go","go",i))]*
                  [(PDGM(i)/pbd("gm",i))**(-deg("go","gm",i))];
DemandGM(i)..       XDGM(i) =G= Beta("gm",i)*
                  [(PDG(i)/pbd("g",i))**deg("gm","g",i)]*
```

```
                    [(PDGO(i)/pbd("go",i))**(-deg("gm","go",i))]*
                    [(PDGM(i)/pbd("gm",i))**(-deg("gm","gm",i))];
DemandEUG..         sum(i, XTG(i)) =G= Beta("g","EU")*
                    [(PEUG/pbd("g","EU"))**(-deg("g","g","EU"))]*
                    [(PEUGO/pbd("go","EU"))**deg("g","go","EU")]*
                    [(PEUGM/pbd("gm","EU"))**deg("g","gm","EU")];
DemandEUGO..        sum(i, XTGO(i)) =G= Beta("go","EU")*
                    [(PEUG/pbd("g","EU"))**deg("go","g","EU")]*
                    [(PEUGO/pbd("go","EU"))**(-deg("go","go","EU"))]*
                    [(PEUGM/pbd("gm","EU"))**(-deg("go","gm","EU"))];
DemandEUGM..        sum(i, XTGM(i)) =G= Beta("gm","EU")*
                    [(PEUG/pbd("g","EU"))**deg("gm","g","EU")]*
                    [(PEUGO/pbd("go","EU"))**(-deg("gm","go","EU"))]*
                    [(PEUGM/pbd("gm","EU"))**(-deg("gm","gm","EU"))];
DomPriceG(i)..      PSG(i) + WG(i) =G= PDG(i);
DomPriceG2(i)..     WG(i) =G= PDG(i) - pbs("g",i);
DomPriceGO(i)..     PSGO(i) + WGO(i) =G= PDGO(i);
DomPGO2(i)..        WGO(i) =G= PDGO(i) - pbs("go",i);
DomPriceGM(i)..     PSGM(i) =G= PDGM(i);
PriceG(i)..         PSG(i) + WG(i) + theta(i) =G= (1 - tau("g",i))*PEUG;
PriceGO(i)..        PSGO(i) + WGO(i) + theta(i) =G=
                    (1 tau("go",i))*PEUGO;
PriceGM(i)..        PSGM(i) + theta(i) =G= (1 - tau("gm",i))*PEUGM;

Model peanut /SupplyG.PSG, SupplyGO.PSGO, SupplyGM.PSGM, DemandG.PDG,
DemandGO.PDGO, DemandGM.PDGM,DemandEUG.PEUG, DemandEUGO.PEUGO,
DemandEUGM.PEUGM, DomPriceG.XDG, DomPriceG2.WG, DomPGO2.WGO,
DomPriceGO.XDGO, DomPriceGM.XDGM, PriceG.XTG, PriceGO.XTGO,
PriceGM.XTGM/;


PSG.LO(i) = 0.001;
PSGO.LO(i)= 0.001;
PSGM.LO(i)= 0.001;
PDG.LO(i) = 0.001;
PDGO.LO(i)= 0.001;
PDGM.LO(i)= 0.001;
PEUG.LO   = 0.001;
PEUGO.LO  = 0.001;
PEUGM.LO  = 0.001;

WG.UP("ARG") = 0;
WG.UP("CHI") = 0;
WG.UP("NIG") = 0;
WG.UP("SUD") = 0;
WG.UP("ROW") = 0;
WGO.UP("ARG") = 0;
WGO.UP("CHI") = 0;
WGO.UP("NIG") = 0;
WGO.UP("SEN") = 0;
WGO.UP("SUD") = 0;
WGO.UP("ROW") = 0;

peanut.iterlim = 1000;

Solve peanut using MCP;
```

```
set     rep     /PSG, PDG, XSG, XDG, XTG, PSGO, PDGO, XSGO, XDGO, XTGO,
                 PSGM,PDGM,XSGM, XDGM, XTGM/;

set     sur     / CS_G   Consumer surplus groudnuts,
                  CS_GO  Consumer surplus groundnut oil,
                  CS_GM  Consumer surplus groundnut meal,
                  PS_G   Producer surplus groundnuts,
                  PS_GO  Producer surplus grounndut oil,
                  PS_GM  Producer surplus groundnut meal/;

parameter report2(k,rep);

         Report2(i,"PSG") = PSG.L(i);
         Report2("EU","PSG") = 0;
         Report2(i,"PDG") = PDG.L(i);
         Report2("EU","PDG") = PEUG.L;
         Report2(i,"XSG") = XDG.L(i) + XTG.L(i);
         Report2("EU","XSG") = 0;
         Report2(i,"XDG") = XDG.L(i);
         Report2("EU","XDG") = sum(i, XTG.L(i));
         Report2(i,"XTG") = XTG.L(i);
         Report2("EU","XTG") = 0;

         Report2(i,"PSGO") = PSGO.L(i);
         Report2("EU","PSGO") = 0;
         Report2(i,"PDGO") = PDGO.L(i);
         Report2("EU","PDGO") = PEUGO.L;
         Report2(i,"XSGO") = XDGO.L(i) + XTGO.L(i);
         Report2("EU","XSGO") = 0;
         Report2(i,"XDGO") = XDGO.L(i);
         Report2("EU","XDGO") = sum(i, XTGO.L(i));
         Report2(i,"XTGO") = XTGO.L(i);
         Report2("EU","XTGO") = 0;

         Report2(i,"PSGM") = PSGM.L(i);
         Report2("EU","PSGM") = 0;
         Report2(i,"PDGM") = PDGM.L(i);
         Report2("EU","PDGM") = PEUGM.L;
         Report2(i,"XSGM") = XDGM.L(i) + XTGM.L(i);
         Report2("EU","XSGM") = 0;
         Report2(i,"XDGM") = XDGM.L(i);
         Report2("EU","XDGM") = sum(i, XTGM.L(i));
         Report2(i,"XTGM") = XTGM.L(i);
         Report2("EU","XTGM") = 0;

parameter       QD(n)           intermediate term for surplus
                                calculations;

QD("g") = beta("g","SEN")*
          [(PDGO.L("SEN")/pbd("go","SEN"))**deg("g","go","SEN")]*
          [(PDGM.L("SEN")/pbd("gm","SEN"))**deg("g","gm","SEN")];
QD("go") = beta("go","SEN")*
          [(PDG.L("SEN")/pbd("g","SEN"))**deg("go","g","SEN")]*
          [(PDGM.L("SEN")/pbd("gm","SEN"))**(-deg("go","gm","SEN"))];
QD("gm") = beta("gm","SEN")*
          [(PDG.L("SEN")/pbd("g","SEN"))**deg("gm","g","SEN")]*
          [(PDGO.L("SEN")/pbd("go","SEN"))**(-deg("gm","go","SEN"))];
```

```
parameter       QP(n)           intermediate term for surplus
                                calculations;

QP("g") = alpha("g","SEN")*
          [(PSGO.L("SEN")/pbs("go","SEN"))**(seg("g","go","SEN"))]*
          [(PSGM.L("SEN")/pbs("gm","SEN"))**(seg("g","gm","SEN"))]*
          [(FST("SEN")/fbst("SEN"))**(fes("SEN"))];
QP("go") = [alpha("go","SEN")/alpha("g","SEN")]*
           [XDG.L("SEN")+XTG.L("SEN")]*
           [(PSG.L("SEN")/pbs("g","SEN"))**(-seg("go","g","SEN"))]*
           [(PSGM.L("SEN")/pbs("gm","SEN"))**seg("go","gm","SEN")];
QP("gm") = [alpha("gm","SEN")/alpha("g","SEN")]*
           [XDG.L("SEN")+XTG.L("SEN")]*
           [(PSG.L("SEN")/pbs("g","SEN"))**(-seg("gm","g","SEN"))]*
           [(PSGO.L("SEN")/pbs("go","SEN"))**(seg("gm","go","SEN"))];

parameter       CD(n)           itermediate term for surplus
                                calculations;

CD("g") = QD("g")/[(1 - deg("g","g","SEN"))*
         (pbd("g","SEN")**(deg("g","g","SEN")))];
CD("go") = QD("go")/[(1 - deg("go","go","SEN"))*
         (pbd("go","SEN")**(-deg("go","go","SEN")))];
CD("gm") = QD("gm")/[(1 - deg("gm","gm","SEN"))*
         (pbd("gm","SEN")**(-deg("gm","gm","SEN")))];

parameter       PS(n)           intermediate term for surplus
                                calculations;

PS("g") = QP("g")/[(1 + seg("g","g","SEN"))*
         (pbs("g","SEN")**seg("g","g","SEN"))];
PS("go") = QP("go")/[(1 + seg("go","go","SEN"))*
         (pbs("go","SEN")**seg("go","go","SEN"))];
PS("gm") = QP("gm")/[(1 + seg("gm","gm","SEN"))*
         (pbs("gm","SEN")**seg("gm","gm","SEN"))];

scalar       a       /1500/;

parameter       surplus(sur)    Consumer and Producer Surplus values;

* Note: a = 2000 in the below calculations, see Appendix A for further
details.

surplus("CS_G") = CD("g")*[a**(1 - deg("g","g","SEN")) –
                  PDG.L("SEN")**(1 - deg("g","g","SEN"))];
surplus("CS_GO") = CD("go")*[a**(1 - deg("go","go","SEN")) –
                  PDGO.L("SEN")**(1 - deg("go","go","SEN"))];
surplus("CS_GM") = CD("go")*[a**(1 - deg("gm","gm","SEN")) –
                  PDGM.L("SEN")**(1 - deg("gm","gm","SEN"))];
surplus("PS_G") = PS("g")*[PSG.L("SEN")**(seg("g","g","SEN") + 1)];
surplus("PS_GO") = PS("go")*[PSGO.L("SEN")**(seg("go","go","SEN")+ 1)];
surplus("PS_GM") = PS("gm")*[PSGM.L("SEN")**(seg("gm","gm","SEN")+ 1)];

Display Report2, surplus;

$stitle Examination of GSP options
```

```
$stitle Case Analysis


set   t1    /1*25/;

parameter   report(k,rep,t1);
parameter       reportCSPS(t1,sur)   Change in surplus value from
baselined;
* See Appendix C for further details and definitions.

parameter   taud(t1)    /"1"    0.00212,
                          "2"    0.00424,
                          "3"    0.00636,
                          "4"    0.00848,
                          "5"    0.0106 ,
                          "6"    0.01272,
                          "7"    0.01484,
                          "8"    0.01696,
                          "9"    0.01908,
                          "10"   0.0212 ,
                          "11"   0.02332,
                          "12"   0.02544,
                          "13"   0.02756,
                          "14"   0.02968,
                          "15"   0.0318 ,
                          "16"   0.03392,
                          "17"   0.03604,
                          "18"   0.03816,
                          "19"   0.04028,
                          "20"   0.0424 ,
                          "21"   0.04452,
                          "22"   0.04664,
                          "23"   0.04876,
                          "24"   0.05088,
                          "25"   0.053/;

parameter   sti(t1)     /"1"    0.01,
                          "2"    0.02,
                          "3"    0.03,
                          "4"    0.04,
                          "5"    0.05 ,
                          "6"    0.06,
                          "7"    0.07,
                          "8"    0.08,
                          "9"    0.09,
                          "10"   0.1 ,
                          "11"   0.11,
                          "12"   0.12,
                          "13"   0.13,
                          "14"   0.14,
                          "15"   0.15 ,
                          "16"   0.16,
                          "17"   0.17,
                          "18"   0.18,
                          "19"   0.19,
                          "20"   0.20 ,
```

```
                                    "21"   0.21,
                                    "22"   0.22,
                                    "23"   0.23,
                                    "24"   0.24,
                                    "25"   0.25/;

parameter       surplus2(sur)   Consumer and Producer Surplus values;

Model peanut2 /SupplyG.PSG, SupplyGO.PSGO, SupplyGM.PSGM, DemandG.PDG,
DemandGO.PDGO, DemandGM.PDGM, DemandEUG.PEUG, DemandEUGO.PEUGO,
DemandEUGM.PEUGM, DomPriceG.XDG, DomPriceG2.WG, DomPGO2.WGO,
DomPriceGO.XDGO, DomPriceGM.XDGM, PriceG.XTG, PriceGO.XTGO,
PriceGM.XTGM/;

$offlisting;

PSG.LO(i) = 0.001;
PSGO.LO(i)= 0.001;
PSGM.LO(i)= 0.001;
PDG.LO(i) = 0.001;
PDGO.LO(i)= 0.001;
PDGM.LO(i)= 0.001;
PEUG.LO   = 0.001;
PEUGO.LO  = 0.001;
PEUGM.LO  = 0.001;

WG.UP("ARG") = 0;
WG.UP("CHI") = 0;
WG.UP("NIG") = 0;
WG.UP("SUD") = 0;
WG.UP("ROW") = 0;
WGO.UP("ARG") = 0;
WGO.UP("CHI") = 0;
WGO.UP("NIG") = 0;
WGO.UP("SEN") = 0;
WGO.UP("SUD") = 0;
WGO.UP("ROW") = 0;

loop(t1,
* Choose a combination of any of the below items for analysis by
* unselecting the asterisk in front of the argument
*        tau("go","SEN") = 0.053;
*        tau("go","SEN") = 0.053*0.80;
*        tau("go","NIG") = 0.053*0.80;
*        tau("go","SUD") = 0.053*0.80;
*        tau("go","ARG") = 0;
*        theta("SEN") = 12.50*(1.05);
*        theta("SEN") = 12.50*(1.1);
*        FST("SEN") = 7768.319*(1.05);
*        FST("SEN") = 7768.319*(1.1);
*        tau("go","ARG") = 0.053 - taud(t1);
*        tau("go","CHI") = 0.053 - 0.053*0.20;
*        tau("go","IND") = 0.053 - 0.053*0.20;
*        tau("go","ARG") = 0.053 - 0.053*0.20;
*        tau("go","ROW") = (0.076 - 0.053*0.80)/3;
*        tau("go","ROW") = (0.076 - 0.053*0.80)/2;
*        pbs("g","SEN") = 1042.5;
```

```
*        fes("SEN") = 0.4;

      Option      iterlim = 1000
                  limcol = 0
                  limrow = 0;
                  peanut2.solprint = 0;

      Solve peanut2 using MCP;

QD("g") = beta("g","SEN")*
            [(PDGO.L("SEN")/pbd("go","SEN"))**deg("g","go","SEN")]*
            [(PDGM.L("SEN")/pbd("gm","SEN"))**deg("g","gm","SEN")];
QD("go") = beta("go","SEN")*
            [(PDG.L("SEN")/pbd("g","SEN"))**deg("go","g","SEN")]*
            [(PDGM.L("SEN")/pbd("gm","SEN"))**(-deg("go","gm","SEN"))];
QD("gm") = beta("gm","SEN")*
            [(PDG.L("SEN")/pbd("g","SEN"))**deg("gm","g","SEN")]*
            [(PDGO.L("SEN")/pbd("go","SEN"))**(-deg("gm","go","SEN"))];

QP("g") = alpha("g","SEN")*
            [(PSGO.L("SEN")/pbs("go","SEN"))**(seg("g","go","SEN"))]*
            [(PSGM.L("SEN")/pbs("gm","SEN"))**(seg("g","gm","SEN"))]*
            [(FST("SEN")/fbst("SEN"))**(fes("SEN"))];
QP("go") =  [alpha("go","SEN")/alpha("g","SEN")]*
            [XDG.L("SEN")+XTG.L("SEN")]*
            [(PSG.L("SEN")/pbs("g","SEN"))**(-seg("go","g","SEN"))]*
            [(PSGM.L("SEN")/pbs("gm","SEN"))**seg("go","gm","SEN")];
QP("gm") =  [alpha("gm","SEN")/alpha("g","SEN")]*
            [XDG.L("SEN")+XTG.L("SEN")]*
            [(PSG.L("SEN")/pbs("g","SEN"))**(-seg("gm","g","SEN"))]*
            [(PSGO.L("SEN")/pbs("go","SEN"))**(seg("gm","go","SEN"))];

CD("g") = QD("g")/[(1 - deg("g","g","SEN"))*
         (pbd("g","SEN")**(-deg("g","g","SEN")))];
CD("go") = QD("go")/[(1 - deg("go","go","SEN"))*
         (pbd("go","SEN")**(-deg("go","go","SEN")))];
CD("gm") = QD("gm")/[(1 - deg("gm","gm","SEN"))*
         (pbd("gm","SEN")**(-deg("gm","gm","SEN")))];

PS("g") = QP("g")/[(1 + seg("g","g","SEN"))*
         (pbs("g","SEN")**seg("g","g","SEN"))];
PS("go") = QP("go")/[(1 + seg("go","go","SEN"))*
         (pbs("go","SEN")**seg("go","go","SEN"))];
PS("gm") = QP("gm")/[(1 + seg("gm","gm","SEN"))*
         (pbs("gm","SEN")**seg("gm","gm","SEN"))];

* Note: a = 2000 in the below calculations, see Appendix A for further
details.

surplus2("CS_G") = CD("g")*[a**(1 - deg("g","g","SEN")) –
                    PDG.L("SEN")**(1 - deg("g","g","SEN"))];
surplus2("CS_GO") = CD("go")*[a**(1 - deg("go","go","SEN")) –
                     PDGO.L("SEN")**(1 - deg("go","go","SEN"))];
surplus2("CS_GM") = CD("go")*[a**(1 - deg("gm","gm","SEN")) –
                     PDGM.L("SEN")**(1 - deg("gm","gm","SEN"))];
surplus2("PS_G") = PS("g")*[PSG.L("SEN")**(seg("g","g","SEN") + 1)];
```

```
surplus2("PS_GO") = PS("go")*[PSGO.L("SEN")**(seg("go","go","SEN")+
1)];
surplus2("PS_GM") = PS("gm")*[PSGM.L("SEN")**(seg("gm","gm","SEN")+
1)];

        reportCSPS(t1,"CS_G") = surplus2("CS_G") - surplus("CS_G");
        reportCSPS(t1,"CS_GO") = surplus2("CS_GO") - surplus("CS_GO");
        reportCSPS(t1,"CS_GM") = surplus2("CS_GM") - surplus("CS_GM");
        reportCSPS(t1,"PS_G") = surplus2("PS_G") - surplus("PS_G");
        reportCSPS(t1,"PS_GO") = surplus2("PS_GO") - surplus("PS_GO");
        reportCSPS(t1,"PS_GM") = surplus2("PS_GM") - surplus("PS_GM");

        Report(i,"PSG",t1) = PSG.L(i);
        Report("EU","PSG",t1) = 0;
        Report(i,"PDG",t1) = PDG.L(i);
        Report("EU","PDG",t1) = PEUG.L;
        Report(i,"XSG",t1) = XDG.L(i) + XTG.L(i);
        Report("EU","XSG",t1) = 0;
        Report(i,"XDG",t1) = XDG.L(i);
        Report("EU","XDG",t1) = sum(i, XTG.L(i));
        Report(i,"XTG",t1) = XTG.L(i);
        Report("EU","XTG",t1) = 0;

        Report(i,"PSGO",t1) = PSGO.L(i);
        Report("EU","PSGO",t1) = 0;
        Report(i,"PDGO",t1) = PDGO.L(i);
        Report("EU","PDGO",t1) = PEUGO.L;
        Report(i,"XSGO",t1) = XDGO.L(i) + XTGO.L(i);
        Report("EU","XSGO",t1) = 0;
        Report(i,"XDGO",t1) = XDGO.L(i);
        Report("EU","XDGO",t1) = sum(i, XTGO.L(i));
        Report(i,"XTGO",t1) = XTGO.L(i);
        Report("EU","XTGO",t1) = 0;

        Report(i,"PSGM",t1) = PSGM.L(i);
        Report("EU","PSGM",t1) = 0;
        Report(i,"PDGM",t1) = PDGM.L(i);
        Report("EU","PDGM",t1) = PEUGM.L;
        Report(i,"XSGM",t1) = XDGM.L(i) + XTGM.L(i);
        Report("EU","XSGM",t1) = 0;
        Report(i,"XDGM",t1) = XDGM.L(i);
        Report("EU","XDGM",t1) = sum(i, XTGM.L(i));
        Report(i,"XTGM",t1) = XTGM.L(i);
        Report("EU","XTGM",t1) = 0;
);

parameter report2(k,rep);

        Report2(i,"PSG") = PSG.L(i);
        Report2("EU","PSG") = 0;
        Report2(i,"PDG") = PDG.L(i);
        Report2("EU","PDG") = PEUG.L;
        Report2(i,"XSG") = XDG.L(i) + XTG.L(i);
        Report2("EU","XSG") = 0;
        Report2(i,"XDG") = XDG.L(i);
        Report2("EU","XDG") = sum(i, XTG.L(i));
        Report2(i,"XTG") = XTG.L(i);
```

```
        Report2("EU","XTG") = 0;

        Report2(i,"PSGO") = PSGO.L(i);
        Report2("EU","PSGO") = 0;
        Report2(i,"PDGO") = PDGO.L(i);
        Report2("EU","PDGO") = PEUGO.L;
        Report2(i,"XSGO") = XDGO.L(i) + XTGO.L(i);
        Report2("EU","XSGO") = 0;
        Report2(i,"XDGO") = XDGO.L(i);
        Report2("EU","XDGO") = sum(i, XTGO.L(i));
        Report2(i,"XTGO") = XTGO.L(i);
        Report2("EU","XTGO") = 0;

        Report2(i,"PSGM") = PSGM.L(i);
        Report2("EU","PSGM") = 0;
        Report2(i,"PDGM") = PDGM.L(i);
        Report2("EU","PDGM") = PEUGM.L;
        Report2(i,"XSGM") = XDGM.L(i) + XTGM.L(i);
        Report2("EU","XSGM") = 0;
        Report2(i,"XDGM") = XDGM.L(i);
        Report2("EU","XDGM") = sum(i, XTGM.L(i));
        Report2(i,"XTGM") = XTGM.L(i);
        Report2("EU","XTGM") = 0;

Display report,report2,reportCSPS;
```

Note: See Chapter 4 for a discussion of Mixed Complementarity Programming.

Appendix D: Model Results

D.1 Results from Baseline Replication

Table D.1.1 Model Results for Baseline Replication

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.763	1036.763	559.148	309.366	249.782
China	1037.593	1037.593	7055.807	6964.698	91.109
European Union	N/A	1052.213	0	588.794	0
India	391.242	1035.433	7476	7436.795	39.205
Nigeria	1046.367	1046.367	1310.358	1310.358	0
Senegal	251.864	1039.713	525.5	521.412	4.088
Sudan	1039.663	1039.663	571.357	567.401	3.957
Unites States	610	1041.863	1363.6	1244.120	119.480
Rest of World	1038.983	1038.983	3982.332	3901.158	81.174
	Groundnut Oil				
Argentina	901.262	901.262	47.011	10.556	36.455
China	902.092	902.092	1864.948	1858.469	6.48
European Union	N/A	968.017	0	189.786	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.597	957.957	309.938	305.243	4.695
Senegal	955.517	955.517	50.252	3.997	46.255
Sudan	955.467	955.467	167.455	122.597	44.858
Unites States	1068.227	1068.227	78.088	78.088	0
Rest of World	913.163	913.163	564.807	513.763	51.044
	Groundnut Meal				
Argentina	118.264	118.264	109.725	65.686	44.039
China	119.094	119.094	2566.807	2566.131	0.676
European Union	N/A	133.714	0	204.454	0
India	117.22	117.22	2290	2290	0
Nigeria	123.294	123.294	368.683	368.656	0.027
Senegal	121.214	121.214	57.559	20.009	37.550
Sudan	121.164	121.164	271.852	163.916	107.936
Unites States	123.364	123.364	83.268	69.117	14.151
Rest of World	120.484	120.484	655.488	655.413	0.075

[1] $/MT

[2] 1000 MT

Table D.1.2 Percentage Difference Between Baseline Replication Results and the Benchmark Parameters Presented in Appendix C, Section C.3

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]
	Groundnuts			
Argentina	0.27%	0.27%	0.19%	0.12%
China	0.27%	0.27%	0.27%	0.13%
European Union	0%	0.27%	0%	0.19%
India	0%	0.27%	0%	0.09%
Nigeria	0.17%	0.17%	0.03%	0.03%
Senegal	0%	0.28%	0%	0.08%
Sudan	0.27%	0.27%	0.12%	0.07%
Unites States	0%	0.26%	0%	0.07%
Rest of World	0.27%	0.27%	0.07%	0.07%
	Groundnut Oil			
Argentina	0.42%	0.42%	0.02%	0.41%
China	0.42%	0.42%	0.14%	0.21%
European Union	0%	0.42%	0%	0.23%
India	0%	0%	0%	0%
Nigeria	0.42%	0.42%	0.08%	0.08%
Senegal	0.42%	0.42%	0.10%	0.08%
Sudan	0.42%	0.42%	0.09%	0.08%
Unites States	1.09%	1.09%	0.41%	0.53%
Rest of World	0.42%	0.42%	0.09%	.34%
	Groundnut Meal			
Argentina	0.24%	0.24%	0.02%	0.13%
China	0.25%	0.25%	0.14%	0.11%
European Union	0%	0.21%	0%	0.17%
India	0%	0%	0%	0%
Nigeria	0.23%	0.23%	0.08%	0.07%
Senegal	0.24%	0.24%	0.10%	0.05%
Sudan	0.24%	0.24%	0.09%	0.07%
Unites States	0.23%	0.23%	0.40%	0.17%
Rest of World	0.24%	0.24%	0.09%	0.08%

Note: “Exports to the EU” is not included because it is calculated as domestic supply minus domestic demand.

D.2 Model Results for Cases Under the REPA Scenario

D.2.1 Case 1: Argentina moves to a FTA between MERCOSUR and the EU. This amounts to the import tariff on groundnut oil going to the EU changing from 5.3% to 0% for Argentina.

Table D.2.1 Model Results for Case 1 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.879	1036.879	559.192	311.864	247.328
China	1037.709	1037.709	7055.886	6963.801	92.084
European Union	N/A	1052.329	0	588.579	0
India	391.242	1035.549	7476	7436.511	39.489
Nigeria	1046.139	1046.139	1310.313	1310.313	0
Senegal	251.864	1039.829	525.5	521.329	4.171
Sudan	1039.779	1039.779	571.384	567.316	4.068
Unites States	610	1041.979	1363.6	1243.656	119.944
Rest of World	1039.099	1039.099	3982.443	3900.948	81.495
	Groundnut Oil				
Argentina	952.068	952.068	47.83	9.998	37.832
China	901.62	901.62	1864.604	1858.956	5.648
European Union	N/A	967.518	0	189.841	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.098	957.098	309.908	305.275	4.633
Senegal	955.018	955.018	50.228	3.997	46.231
Sudan	954.968	954.968	167.351	122.609	44.742
Unites States	1069.201	1069.201	78.039	78.039	0
Rest of World	912.685	912.685	564.734	513.978	50.756
	Groundnut Meal				
Argentina	117.894	117.894	111.636	65.797	45.839
China	119.073	119.073	2566.333	2566.333	0
European Union	N/A	133.344	0	204.913	0
India	117.22	117.22	2290	2290	0
Nigeria	123.304	123.304	368.647	368.647	0
Senegal	120.844	120.844	57.533	20.022	37.511
Sudan	120.794	120.794	271.683	164.067	107.616
Unites States	122.994	122.994	83.215	69.269	13.947
Rest of World	120.489	120.489	655.404	655.404	0

[1] $/MT
[2] 1000 MT

D.2.2 Case 2: Senegal chooses to move to a REPA and import duties are Decreased by 20% for all countries subject to the GSP.

Table D.2.2 Model Results for Case 2 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.817	1036.817	559.169	309.51	249.659
China	1037.647	1037.647	7055.844	6967.699	88.145
European Union	N/A	1052.267	0	587.613	0
India	391.242	1035.487	7476	7436.661	39.339
Nigeria	1043.034	1043.034	1309.69	1309.69	0
Senegal	251.864	1039.767	525.5	521.027	4.473
Sudan	1039.717	1039.717	571.37	567.07	4.299
Unites States	610	1041.917	1363.6	1244.009	119.591
Rest of World	1039.037	1039.037	3982.384	3900.278	82.106
	Groundnut Oil				
Argentina	904.344	904.344	47.059	10.52	36.539
China	905.174	905.174	1866.314	1855.302	11.012
European Union	N/A	960.52	0	190.615	0
India	1121.94	1121.94	1725	1725	0
Nigeria	950.1	950.1	309.494	305.723	3.771
Senegal	948.02	948.02	50.13	4.003	46.127
Sudan	947.97	947.97	167.029	122.79	44.239
Unites States	1068.451	1068.451	78.077	78.077	0
Rest of World	909.382	909.382	564.398	515.471	48.927
	Groundnut Meal				
Argentina	118.179	118.179	109.839	65.711	44.127
China	119.009	119.009	2568.687	2566.976	1.711
European Union	N/A	133.629	0	204.559	0
India	117.22	117.22	2290	2290	0
Nigeria	123.854	123.854	368.155	368.155	0
Senegal	121.129	121.129	57.419	20.012	37.407
Sudan	121.079	121.079	271.16	163.951	107.209
Unites States	123.279	123.279	83.256	69.152	14.104
Rest of World	120.706	120.706	655.014	655.014	0

[1] $/MT

[2] 1000 MT

D.2.3 Case 3: A 5% increase in development funding to Senegal.

Table D.2.3 Model Results for Case 3 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.02	1036.02	588.68	309.402	249.466
China	1036.85	1036.85	7055.302	6965.7	89.602
European Union	N/A	1051.47	0	588.893	0
India	391.242	1034.69	7476	7438.608	37.392
Nigeria	1046.226	1046.226	1310.33	1310.33	0
Senegal	251.864	1038.97	530.653	521.459	9.194
Sudan	1038.92	1038.92	571.186	567.455	3.731
Unites States	610	1041.12	1363.6	1244.2	119.4
Rest of World	1038.24	1038.24	3981.62	3901.512	80.109
	Groundnut Oil				
Argentina	900.975	900.975	46.993	10.559	36.434
China	901.805	901.805	1865.04	1858.764	6.275
European Union	N/A	967.714	0	189.820	0
India	1121.94	1121.940	1725	1725	0
Nigeria	957.294	957.294	309.919	305.263	4.657
Senegal	955.214	955.214	50.738	3.997	46.741
Sudan	955.164	955.164	167.429	122.604	44.825
Unites States	1068.332	1068.332	78.083	78.083	0
Rest of World	912.873	912.873	564.782	513.894	50.888
	Groundnut Meal				
Argentina	118.224	118.224	109.684	65.698	43.986
China	119.054	119.054	2566.933	2566.527	0.405
European Union	N/A	133.674	0	204.503	0
India	117.22	117.22	2290	2290	0
Nigeria	123.289	123.289	368.661	368.661	0
Senegal	121.174	121.174	58.116	20.011	38.105
Sudan	121.124	121.124	271.809	163.932	107.877
Unites States	123.324	123.324	83.262	69.133	14.129
Rest of World	120.458	120.458	655.459	655.459	0

[1] $/MT

[2] 1000 MT

D.2.4 Case 4: A 10% increase in development funding to Senegal.

Table D.2.4 Model Results for Case 4 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1035.305	1035.305	558.598	309.435	249.163
China	1036.135	1036.135	7054.815	6966.633	88.182
European Union	N/A	1050.755	0	588.987	0
India	391.242	1033.975	7476	7440.357	35.643
Nigeria	1046.096	1046.096	1310.304	1310.304	0
Senegal	251.864	1038.255	535.613	521.503	14.11
Sudan	1038.205	1038.205	571.021	567.507	3.513
Unites States	610	1040.405	1363.6	1244.27	119.33
Rest of World	1037.525	1037.525	3980.934	3901.888	79.046
	Groundnut Oil				
Argentina	900.697	900.697	46.976	10.562	36.414
China	901.527	901.527	1865.113	1859.051	6.062
European Union	N/A	967.42	0	189.852	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957	957	309.902	305.281	4.621
Senegal	954.92	954.92	51.206	3.997	47.208
Sudan	954.87	954.87	167.403	122.612	44.791
Unites States	1068.449	1068.449	78.077	78.077	0
Rest of World	912.591	912.591	564.777	514.02	50.757
	Groundnut Meal				
Argentina	118.179	118.179	109.644	65.711	43.933
China	119.009	119.009	2567.034	2566.969	0.065
European Union	N/A	133.629	0	204.558	0
India	117.22	117.22	2290	2290	0
Nigeria	123.312	123.312	368.64	368.64	0
Senegal	121.129	121.129	58.652	20.012	38.64
Sudan	121.079	121.079	271.767	163.95	107.816
Unites States	123.279	123.279	83.256	69.151	14.104
Rest of World	120.461	120.461	655.454	655.454	0

[1] $/MT

[2] 1000 MT

D.2.5 Case 5: A combination of Case 1 and Case 3

Table D.2.5 Model Results for Case 5 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.122	1036.122	558.096	311.884	247.023
China	1036.952	1036.952	7055.371	6964.923	90.448
European Union	N/A	1051.572	0	588.641	0
India	391.242	1034.792	7476	7438.359	37.641
Nigeria	1045.998	1045.998	1310.284	1310.284	0
Senegal	251.864	1039.072	530.653	521.361	9.292
Sudan	1039.022	1039.022	571.209	567.354	3.855
Unites States	610	1041.222	1363.6	1243.592	120.008
Rest of World	1038.342	1038.342	3981.718	3901.344	80.374
	Groundnut Oil				
Argentina	951.748	951.748	47.806	10.001	37.805
China	901.316	901.316	1864.742	1859.269	5.473
European Union	N/A	967.198	0	189.877	0
India	1121.94	1121.94	1725	1725	0
Nigeria	956.778	956.778	309.889	305.269	4.593
Senegal	954.698	954.698	50.709	3.997	46.712
Sudan	954.648	954.648	167.299	122.618	44.681
Unites States	1069.628	1069.628	78.018	78.018	0
Rest of World	912.378	912.378	564.728	514.116	50.612
	Groundnut Meal				
Argentina	117.732	117.732	111.582	65.846	45.736
China	119.054	119.054	2566.523	2566.523	0
European Union	N/A	133.182	0	205.115	0
India	117.22	117.22	2290	2290	0
Nigeria	123.329	123.329	368.625	368.625	0
Senegal	120.682	120.682	58.083	20.027	38.056
Sudan	120.632	120.632	271.598	164.133	107.466
Unites States	122.832	122.832	83.192	69.335	13.857
Rest of World	120.493	120.493	655.397	655.397	0

[1] $/MT

[2] 1000 MT

D.2.6 Case 6: A combination of Case 2 and Case 3

Table D.2.6 Model Results for Case 6 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.074	1036.074	558.888	309.544	249.344
China	1036.904	1036.904	7055.338	6968.67	86.669
European Union	N/A	1051.524	0	587.71	0
India	391.242	1034.744	7476	7438.477	37.523
Nigeria	1042.9	1042.9	1309.663	1309.663	0
Senegal	251.864	1039.024	530.653	521.073	9.58
Sudan	1038.974	1038.974	571.198	567.124	4.074
Unites States	610	1041.174	1363.6	1244.081	119.519
Rest of World	1038.294	1038.294	3981.672	3900.669	81.002
	Groundnut Oil				
Argentina	904.055	904.055	47.042	10.523	36.518
China	904.885	904.885	1866.391	1855.599	10.791
European Union	N/A	960.218	0	190.648	0
India	1121.94	1121.94	1725	1725	0
Nigeria	949.798	949.798	309.476	305.743	3.733
Senegal	947.718	947.718	50.614	4.003	46.611
Sudan	947.668	947.668	167.002	122.798	44.204
Unites States	1068.572	1068.572	78.071	78.071	0
Rest of World	909.091	909.091	564.393	515.603	48.791
	Groundnut Meal				
Argentina	118.133	118.133	109.797	65.725	44.072
China	118.963	118.963	2568.792	2567.434	1.359
European Union	N/A	133.583	0	204.616	0
India	117.22	117.22	2290	2290	0
Nigeria	123.878	123.878	368.134	368.134	0
Senegal	121.083	121.083	57.975	20.014	37.961
Sudan	121.033	121.033	271.116	163.969	107.146
Unites States	123.233	123.233	83.249	69.171	14.079
Rest of World	120.709	120.709	655.008	655.008	0

[1] $/MT

[2] 1000 MT

D.2.7 Case 7: A decrease in Senegal's transportation costs by 5%.

Table D.2.7 Model Results for Case 7 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.764	1036.764	559.149	309.365	249.783
China	1037.594	1037.594	7055.808	6964.669	91.139
European Union	N/A	1052.214	0	588.791	0
India	391.242	1035.434	7476	7436.79	39.21
Nigeria	1046.361	1046.361	1310.357	1310.357	0
Senegal	251.864	1040.339	525.5	521.466	4.034
Sudan	1039.664	1039.664	571.358	567.4	3.958
Unites States	610	1041.864	1363.6	1244.117	119.483
Rest of World	1038.984	1038.984	3982.333	3901.15	81.183
	Groundnut Oil				
Argentina	901.252	901.252	47.010	10.556	36.455
China	902.085	902.082	1864.936	1858.48	6.457
European Union	N/A	968.006	0	189.788	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.586	957.586	309.937	305.244	4.693
Senegal	956.131	956.131	50.287	3.996	46.291
Sudan	955.456	955.456	167.454	122.597	44.857
Unites States	1068.234	1068.234	78.088	78.088	0
Rest of World	913.152	913.152	564.804	513.768	51.036
	Groundnut Meal				
Argentina	118.261	118.261	109.724	65.686	44.038
China	119.091	119.091	2566.791	2566.155	0.635
European Union	N/A	133.711	0	204.457	0
India	117.22	117.22	2290	2290	0
Nigeria	123.291	123.291	368.682	368.658	0.024
Senegal	121.836	121.836	57.6	19.989	37.611
Sudan	121.161	121.161	271.85	163.917	107.933
Unites States	123.361	123.361	83.267	69.118	14.15
Rest of World	120.481	120.481	655.484	655.417	0.067

[1] $/MT

[2] 1000 MT

D.2.8 Case 8: A decrease in Senegal's transportation costs by 10%.

Table D.2.8 Model Results for Case 8 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.766	1036.766	559.150	309.364	249.785
China	1037.596	1037.596	7055.809	6964.64	91.170
European Union	N/A	1052.216	0	588.788	0
India	391.242	1035.436	7476	7436.786	39.214
Nigeria	1046.355	1046.355	1310.356	1310.356	0
Senegal	251.864	1040.966	525.5	521.519	3.981
Sudan	1039.666	1039.666	571.358	567.399	3.959
Unites States	610	1041.866	1363.6	1244.114	119.486
Rest of World	1038.986	1038.986	3982.335	3901.143	81.192
	Groundnut Oil				
Argentina	901.241	901.241	47.01	10.556	36.454
China	902.071	902.071	1864.924	1858.491	6.433
European Union	N/A	967.995	0	189.789	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.575	957.575	309.936	305.245	4.692
Senegal	956.745	956.745	50.322	3.996	46.327
Sudan	955.445	955.445	167.453	122.597	44.855
Unites States	1068.24	1068.24	78.088	78.088	0
Rest of World	913.141	913.141	564.8	513.773	51.027
	Groundnut Meal				
Argentina	118.259	118.259	109.724	65.687	44.037
China	119.089	119.089	2566.774	2566.18	0.594
European Union	N/A	133.709	0	204.46	0
India	117.22	117.22	2290	2290	0
Nigeria	123.289	123.289	368.681	368.661	0.02
Senegal	122.459	122.459	57.64	19.969	37.672
Sudan	121.159	121.159	271.848	163.918	107.93
Unites States	123.359	123.359	83.267	69.119	14.148
Rest of World	120.479	120.479	655.48	655.422	0.059

[1] $/MT

[2] 1000 MT

D.2.9 Case 9: A combination of Case 1 and Case 7.

Table D.2.9 Model Results for Case 9 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.879	1036.879	559.192	311.861	247.331
China	1037.709	1037.709	7055.886	6963.79	92.095
European Union	N/A	1052.329	0	588.571	0
India	391.242	1035.549	7476	7436.511	39.489
Nigeria	1046.133	1046.133	1310.312	1310.312	0
Senegal	251.864	1040.454	525.5	521.381	4.119
Sudan	1039.799	1039.779	571.384	567.313	4.071
Unites States	610	1041.979	1363.6	1243.632	119.968
Rest of World	1039.099	1039.099	3982.443	3900.945	81.498
	Groundnut Oil				
Argentina	952.054	952.054	47.829	9.998	37.831
China	901.607	901.607	1864.599	1858.969	5.63
European Union	N/A	967.504	0	189.843	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.084	957.084	309.907	305.276	4.631
Senegal	955.629	955.629	50.263	3.997	46.267
Sudan	954.954	954.954	167.346	122.61	44.736
Unites States	1069.253	1069.253	78.037	78.037	0
Rest of World	912.672	912.672	564.733	513.984	50.749
	Groundnut Meal				
Argentina	117.874	117.874	111.634	65.803	45.831
China	119.074	119.074	2566.326	2566.326	0
European Union	N/A	133.324	0	204.938	0
India	117.22	117.22	2290	2290	0
Nigeria	123.305	123.305	368.646	368.646	0
Senegal	121.449	121.449	57.572	20.002	37.571
Sudan	120.774	120.774	271.675	164.075	107.601
Unites States	122.974	122.974	83.213	69.277	13.936
Rest of World	120.49	120.49	655.402	655.402	0

[1] $/MT

[2] 1000 MT

D.2.10 Case 10: A combination of Case 2 and case 7.

Table D.2.10 Model Results for Case 10 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.819	1036.819	559.169	309.508	249.661
China	1037.649	1037.649	7055.845	6967.666	88.179
European Union	N/A	1052.269	0	587.61	0
India	391.242	1035.489	7476	7436.657	39.343
Nigeria	1043.029	1043.029	1309.689	1309.689	0
Senegal	251.864	1040.394	525.5	521.08	4.42
Sudan	1039.719	1039.719	571.37	567.069	4.301
Unites States	610	1041.919	1363.6	1244.005	119.595
Rest of World	1039.039	1039.039	3982.386	3900.275	82.111
	Groundnut Oil				
Argentina	904.333	904.333	47.059	10.52	36.539
China	905.163	905.163	1866.3	1855.313	10.987
European Union	N/A	960.509	0	190.616	0
India	1121.94	1121.94	1725	1725	0
Nigeria	950.089	950.089	309.493	305.724	3.769
Senegal	948.634	948.634	50.165	4.002	46.163
Sudan	947.959	947.959	167.028	122.79	44.237
Unites States	1068.459	1068.459	78.077	78.077	0
Rest of World	909.371	909.371	564.397	515.476	48.921
	Groundnut Meal				
Argentina	118.176	118.176	109.838	65.712	44.126
China	119.006	119.006	2568.668	2567.007	1.661
European Union	N/A	133.626	0	204.563	0
India	117.22	117.22	2290	2290	0
Nigeria	123.855	123.855	368.154	368.154	0
Senegal	121.751	121.751	57.46	19.992	37.468
Sudan	121.076	121.076	271.158	163.952	107.206
Unites States	123.276	123.276	83.255	69.153	14.102
Rest of World	120.707	120.707	655.013	655.013	0

[1] $/MT

[2] 1000 MT

D.2.11 Case 11: Senegal lets the producer price for groundnuts to be set by the market.

Table D.2.11 Model Results for Case 11 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.853	1036.853	559.182	309.361	249.821
China	1037.683	1037.683	7055.868	6964.549	91.319
European Union	N/A	1052.303	0	588.779	0
India	391.242	1035.523	7476	7436.575	39.425
Nigeria	1046.377	1046.377	1310.36	1310.36	0
Senegal	1039.803	1039.803	524.835	521.405	3.43
Sudan	1039.753	1039.753	571.378	567.393	3.985
Unites States	610	1041.953	1363.6	1244.108	119.492
Rest of World	1039.073	1039.073	3982.418	3901.11	81.308
	Groundnut Oil				
Argentina	901.283	901.283	47.012	10.555	36.457
China	902.113	902.113	1864.925	1858.447	6.478
European Union	N/A	968.039	0	189.784	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.619	957.619	309.939	305.242	4.697
Senegal	955.539	955.539	50.234	3.997	46.237
Sudan	955.489	955.489	167.457	122.596	44.861
Unites States	1068.22	1068.22	78.089	78.089	0
Rest of World	913.183	913.183	564.808	513.754	51.054
	Groundnut Meal				
Argentina	118.267	118.267	109.729	65.685	44.044
China	119.097	119.097	2566.775	2566.103	0.672
European Union	N/A	133.717	0	204.45	0
India	117.22	117.22	2290	2290	0
Nigeria	123.297	123.297	368.685	368.654	0.031
Senegal	121.217	121.217	57.539	20.009	37.53
Sudan	121.167	121.167	271.855	163.915	107.94
Unites States	123.367	123.367	83.268	69.116	14.152
Rest of World	120.487	120.487	655.489	655.408	0.081

[1] $/MT

[2] 1000 MT

D.2.12 Case 12: A combination of Case 1 and Case 11.

Table D.2.12 Model Results for Case 12 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.965	1036.965	559.225	311.859	247.365
China	1037.795	1037.795	7055.945	6963.6	92.285
European Union	N/A	1052.415	0	588.565	0
India	391.242	1035.635	7476	7436.299	39.701
Nigeria	1046.149	1046.149	1310.315	1310.315	0
Senegal	1039.915	1039.915	524.863	521.323	3.54
Sudan	1039.865	1039.865	571.404	567.309	4.095
Unites States	610	1042.065	1363.6	1243.647	119.953
Rest of World	1039.185	1039.185	3982.526	3900.899	81.627
	Groundnut Oil				
Argentina	952.089	952.089	47.831	9.998	37.834
China	901.64	901.64	1864.582	1858.935	5.647
European Union	N/A	967.539	0	189.839	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.119	957.119	309.909	305.274	4.635
Senegal	955.039	955.039	50.212	3.997	46.215
Sudan	954.989	954.989	167.353	122.609	44.744
Unites States	1069.189	1039.189	78.04	78.04	0
Rest of World	912.705	912.705	564.733	513.969	50.764
	Groundnut Meal				
Argentina	117.898	117.898	111.641	65.796	45.845
China	119.076	119.76	2566.303	2566.303	0
European Union	N/A	133.348	0	204.908	0
India	117.22	117.22	2290	2290	0
Nigeria	123.303	123.303	368.649	368.649	0
Senegal	120.848	120.848	57.513	20.022	37.492
Sudan	120.798	120.798	271.687	164.065	107.622
Unites States	122.998	122.998	83.216	69.267	13.949
Rest of World	120.49	120.49	655.403	655.403	0

[1] $/MT

[2] 1000 MT

D.2.13 Case 13: A combination of Case 2 and Case 11.

Table D.2.13 Model Results for Case 13 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.906	1036.906	559.202	309.504	249.698
China	1037.736	1037.736	7055.904	6967.556	88.348
European Union	N/A	1052.356	0	587.598	0
India	391.242	1035.576	7476	7436.445	39.555
Nigeria	1043.044	1043.044	1309.692	1309.692	0
Senegal	1039.856	1039.856	524.848	521.02	3.828
Sudan	1039.806	1039.806	571.39	567.063	4.327
Unites States	610	1042.006	1363.6	1243.998	119.602
Rest of World	1039.126	1039.126	3982.469	3900.228	82.24
	Groundnut Oil				
Argentina	904.365	904.365	47.061	10.52	36.541
China	905.195	905.195	1866.293	1855.281	11.011
European Union	N/A	960.542	0	190.612	0
India	1121.94	1121.94	1725	1725	0
Nigeria	950.122	950.122	309.495	305.722	3.773
Senegal	948.042	948.042	50.112	4.003	46.109
Sudan	947.992	947.992	167.031	122.789	44.242
Unites States	1068.442	1068.442	78.078	78.078	0
Rest of World	909.402	909.402	564.397	515.462	48.936
	Groundnut Meal				
Argentina	118.182	118.182	109.843	65.71	44.133
China	119.012	119.012	2568.658	2566.943	1.715
European Union	N/A	133.632	0	204.555	0
India	117.22	117.22	2290	2290	0
Nigeria	123.853	123.853	368.156	368.156	0
Senegal	121.132	121.132	57.4	20.012	37.387
Sudan	121.082	121.082	271.163	163.949	107.214
Unites States	123.282	123.282	83.256	69.15	14.106
Rest of World	120.707	120.707	655.013	655.013	0

[1] $/MT

[2] 1000 MT

D.2.14 Case 14: An increase in development funding by 5% and the cross-price factor elasticity in the Senegalese groundnut supply equation increases to 0.4 .

Table D.2.14 Model Results for Case 14 Under the REPA Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1035.27	1035.27	558.585	309.437	249.148
China	1036.1	1036.1	7054.791	6966.679	88.112
European Union	N/A	1050.72	0	588.992	0
India	391.242	1033.94	7476	7440.443	35.557
Nigeria	1046.09	1046.09	1310.303	1310.303	0
Senegal	251.864	1038.22	535.856	521.506	14.351
Sudan	1038.17	1038.17	571.012	567.51	3.503
Unites States	610	1040.37	1363.6	1244.273	119.327
Rest of World	1037.49	1037.49	3980.901	3901.907	78.994
	Groundnut Oil				
Argentina	900.863	900.683	46.975	10.562	36.413
China	901.513	901.513	1865.116	1859.065	6.051
European Union	N/A	967.406	0	189.854	0
India	1121.94	1121.94	1725	1725	0
Nigeria	956.986	956.986	309.901	305.282	4.619
Senegal	954.906	954.906	51.228	3.997	47.231
Sudan	954.856	954.856	167.401	122.612	44.789
Unites States	1068.455	1068.455	78.077	78.077	0
Rest of World	912.578	912.578	564.777	514.026	50.751
	Groundnut Meal				
Argentina	118.177	118.177	109.462	65.712	43.93
China	119.007	119.007	2567.039	2566.99	0.048
European Union	N/A	133.627	0	204.561	0
India	117.22	117.22	2290	2290	0
Nigeria	123.313	123.313	368.639	368.639	0
Senegal	121.127	121.127	58.678	20.012	38.666
Sudan	121.077	121.077	271.765	163.591	107.813
Unites States	123.277	123.277	83.255	69.152	14.103
Rest of World	120.461	120.461	655.454	655.454	0

[1] $/MT

[2] 1000 MT

D.3 Model Results for Cases Under the Enhanced GSP Scenario

D.3.1 Case 1: Senegal's import tariff on groundnut oil entering the EU increases to the GSP level (5.3%)

Table D.3.1 Model Results for Case 1 under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.527	1036.527	559.059	309.401	249.658
China	1037.357	1037.357	7055.646	6965.629	90.017
European Union	N/A	1051.977	0	588.894	0
India	391.242	1035.197	7476	7437.371	38.629
Nigeria	1046.501	1046.501	1310.385	1310.385	0
Senegal	251.864	1039.477	525.5	518.867	6.633
Sudan	1039.427	1039.427	571.303	567.439	3.864
Unites States	610	1041.627	1363.6	1244.191	119.409
Rest of World	1038.747	1038.747	3982.106	3901.422	80.684
	Groundnut Oil				
Argentina	901.528	901.528	47.013	10.553	36.46
China	902.358	902.358	1865.251	1858.196	7.055
European Union	N/A	968.297	0	189.756	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.877	957.877	309.956	305.225	4.73
Senegal	904.478	904.478	49.432	4.041	45.391
Sudan	955.747	955.747	167.475	122.589	44.886
Unites States	1068.161	1068.161	78.092	78.092	0
Rest of World	913.431	913.431	564.876	513.642	51.234
	Groundnut Meal				
Argentina	118.289	118.289	109.729	65.678	44.051
China	119.119	119.119	2567.224	2565.879	1.344
European Union	N/A	133.739	0	204.422	0
India	117.22	117.22	2290	2290	0
Nigeria	123.319	123.319	368.704	368.634	0.071
Senegal	121.239	121.239	56.62	20.009	36.612
Sudan	121.189	121.189	271.884	163.906	107.978
Unites States	123.389	123.389	83.271	69.106	14.165
Rest of World	120.509	120.509	655.569	655.367	0.201

[1] $/MT

[2] 1000 MT

D.3.2Case 2: Senegal's import tariff on groundnut oil entering the EU increases to the GSP level of 5.3% and Argentina moves to an FTA.

Table D.3.2 Model Results for Case 2 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.675	1036.675	559.115	311.935	247.18
China	1037.505	1037.505	7055.747	6964.439	91.308
European Union	N/A	1052.125	0	588.764	0
India	391.242	1035.345	7476	7437.009	38.991
Nigeria	1046.28	1046.28	1310.341	1310.341	0
Senegal	251.864	1039.625	525.5	518.819	6.681
Sudan	1039.575	1039.575	571.337	567.392	3.945
Unites States	610	1041.775	1363.6	1244.052	119.548
Rest of World	1038.895	1038.895	3982.248	3901.137	81.11
	Groundnut Oil				
Argentina	952.387	952.387	47.844	9.995	37.849
China	901.921	901.921	1864.79	1858.645	6.145
European Union	N/A	967.837	0	189.806	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.417	957.417	309.926	305.255	4.672
Senegal	904.041	904.041	49.421	4.041	45.38
Sudan	955.287	955.287	167.431	122.601	44.829
Unites States	1068.409	1068.409	78.079	78.079	0
Rest of World	912.99	912.99	564.772	513.841	50.931
	Groundnut Meal				
Argentina	118.195	118.195	111.67	65.706	45.963
China	119.048	119.048	2566.59	2566.59	0
European Union	N/A	133.645	0	204.54	0
India	117.22	117.22	2290	2290	0
Nigeria	123.279	123.279	368.669	368.669	0
Senegal	121.145	121.145	56.608	20.012	36.596
Sudan	121.095	121.095	271.812	163.944	107.868
Unites States	123.295	123.295	83.258	69.145	14.113
Rest of World	120.464	120.464	655.448	655.448	0

[1] $/MT

[2] 1000 MT

D.3.3 Case 3: Senegal's import tariff on groundnut oil entering the EU increases to a level for some enhanced form of the GSP. In this case, all GSP countries are affected. GSP duties are decreased by 20% for all groundnut products.

Table D.3.3 Model Results for Case 3 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.631	1036.631	559.099	309.538	249.56
China	1037.461	1037.461	7055.718	6968.483	87.234
European Union	N/A	1052.081	0	587.695	0
India	391.242	1035.301	7476	7437.115	38.885
Nigeria	1043.134	1043.134	1309.71	1309.71	0
Senegal	251.864	1039.581	525.5	519.003	6.497
Sudan	1039.531	1039.531	571.327	567.102	4.225
Unites States	610	1041.731	1363.6	1244.075	119.525
Rest of World	1038.851	1038.851	3982.206	3900.438	81.768
	Groundnut Oil				
Argentina	904.559	904.559	47.061	10.518	36.544
China	905.389	905.389	1866.575	1855.083	11.492
European Union	N/A	960.744	0	190.59	0
India	1121.94	1121.94	1725	1725	0
Nigeria	950.324	950.324	309.507	305.709	3.798
Senegal	907.509	907.509	49.478	4.038	45.44
Sudan	948.194	948.194	167.047	122.784	44.263
Unites States	1068.376	1068.376	78.081	78.081	0
Rest of World	909.597	909.597	564.427	515.374	49.053
	Groundnut Meal				
Argentina	118.207	118.207	109.843	65.703	44.14
China	119.037	119.037	2569.046	2566.694	2.352
European Union	N/A	133.657	0	204.524	0
India	117.22	117.22	2290	2290	0
Nigeria	123.837	123.837	368.171	368.171	0
Senegal	121.157	121.157	56.673	20.011	36.662
Sudan	121.107	121.107	271.189	163.939	107.25
Unites States	123.307	123.307	83.26	69.14	14.12
Rest of World	120.688	120.688	655.047	655.047	0

[1] $/MT

[2] 1000 MT

D.3.4 Case 4: Case 3 with the Sudan and Nigeria moving to the enhanced form of the GSP instead of a REPA.

Table D.3.4 Model Results for Case 4 under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.629	1036.629	559.098	309.915	249.182
China	1037.459	1037.459	7055.716	6976.528	79.188
European Union	N/A	1052.079	0	588.888	0
India	391.242	1035.299	7476	7437.121	38.879
Nigeria	1041.659	1041.659	1309.413	1303.484	5.929
Senegal	251.864	1039.579	525.5	519.382	6.118
Sudan	1039.529	1039.529	571.326	565.677	5.65
Unites States	610	1041.729	1363.6	1243.849	119.751
Rest of World	1038.849	1038.849	3982.204	3898.015	84.189
	Groundnut Oil				
Argentina	912.415	912.415	47.184	10.428	36.756
China	913.245	913.245	1870.166	1847.086	23.08
European Union	N/A	968.948	0	189.684	0
India	1121.94	1121.94	1725	1725	0
Nigeria	919.544	919.544	307.729	307.729	0
Senegal	915.365	915.365	49.599	4.031	45.567
Sudan	915.315	915.315	165.19	123.654	41.537
Unites States	1068.873	1068.873	78.056	78.056	0
Rest of World	898.356	898.356	563.27	520.526	42.744
	Groundnut Meal				
Argentina	118.018	118.018	110.13	65.759	44.37
China	118.848	118.848	2573.989	2568.57	5.419
European Union	N/A	133.468	0	204.758	0
India	117.22	117.22	2290	2290	0
Nigeria	126.239	126.239	366.055	366.055	0
Senegal	120.968	120.968	56.811	20.018	36.794
Sudan	120.918	120.918	268.175	164.016	104.16
Unites States	123.118	123.118	83.233	69.217	14.016
Rest of World	121.441	121.441	653.704	653.704	0

[1] $/MT

[2] 1000 MT

D.3.5 Case 5: An increase in development funding of 5% in combination with Case 1

Table D.3.5 Model Results for Case 5 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1035.787	1035.787	558.78	309.437	249.343
China	1036.617	1036.617	7055.143	6966.65	88.493
European Union	N/A	1051.237	0	588.995	0
India	391.242	1034.457	7476	7439.178	36.822
Nigeria	1046.355	1046.355	1310.356	1310.356	0
Senegal	251.864	1038.737	530.653	518.914	11.739
Sudan	1038.687	1038.687	571.132	567.494	3.638
Unites States	610	1040.887	1363.6	1244.275	119.325
Rest of World	1038.007	1038.007	3981.397	3901.761	79.635
	Groundnut Oil				
Argentina	901.243	901.243	46.995	10.556	36.439
China	902.073	902.073	1865.352	1858.489	6.863
European Union	N/A	967.997	0	189.789	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.557	957.577	309.936	305.245	4.692
Senegal	904.193	904.193	49.91	4.041	45.869
Sudan	955.447	955.447	167.45	122.597	44.853
Unites States	1068.255	1068.255	78.087	78.087	0
Rest of World	913.143	913.143	564.844	513.772	51.072
	Groundnut Meal				
Argentina	118.253	118.253	109.689	65.689	44
China	119.083	119.083	2567.362	2566.237	1.125
European Union	N/A	133.703	0	204.467	0
India	117.22	117.22	2290	2290	0
Nigeria	123.283	123.83	368.681	368.666	0.015
Senegal	121.203	121.203	57.168	20.010	37.159
Sudan	121.153	121.153	271.844	163.92	107.923
Unites States	123.353	123.353	83.266	69.121	14.145
Rest of World	120.473	120.473	655.532	655.432	0.1

[1] $/MT

[2] 1000 MT

D.3.6 Case 6: An increase in development funding of 5% in combination with Case 2

Table D.3.6 Model Results for Case 6 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1035.92	1035.92	558.83	311.955	246.875
China	1036.75	1036.75	7055.233	6965.561	89.672
European Union	N/A	1051.37	0	588.827	0
India	391.242	1034.59	7476	7438.854	37.146
Nigeria	1046.14	1046.14	1310.313	1310.313	0
Senegal	251.864	1038.87	530.653	518.850	11.802
Sudan	1038.82	1038.82	571.163	567.43	3.732
Unites States	610	1041.02	1363.6	1243.991	119.609
Rest of World	1038.14	1038.14	3981.524	3901.533	79.990
	Groundnut Oil				
Argentina	952.069	952.069	47.821	9.998	37.823
China	901.621	901.621	1864.929	1858.955	5.975
European Union	N/A	967.519	0	189.841	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.099	957.099	309.908	305.275	4.633
Senegal	903.741	903.741	49.894	4.041	45.853
Sudan	954.969	954.969	167.379	122.609	44.77
Unites States	1068.829	1068.829	78.058	78.058	0
Rest of World	912.686	912.686	564.766	513.978	50.789
	Groundnut Meal				
Argentina	118.035	118.035	111.616	65.754	45.861
China	119.028	119.028	2566.781	2566.781	0
European Union	N/A	133.485	0	204.738	0
India	117.22	117.22	2290	2290	0
Nigeria	123.304	123.304	368.347	368.647	0
Senegal	120.985	120.985	57.149	20.017	37.132
Sudan	120.935	120.935	271.728	164.009	107.719
Unites States	123.135	123.135	83.235	69.211	14.025
Rest of World	120.468	120.468	655.441	655.441	0

[1] $/MT

[2] 1000 MT

D.3.7 Case 7: An increase in development funding of 5% in combination with Case 3

Table D.3.7 Model Results for Case 7 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1035.889	1035.889	558.818	309.573	249.245
China	1036.719	1036.719	7055.212	6969.457	85.756
European Union	N/A	1051.339	0	587.793	0
India	391.242	1034.559	7476	7438.929	37.071
Nigeria	1043	1043	1309.683	1309.683	0
Senegal	251.864	1038.839	530.653	519.049	11.604
Sudan	1038.789	1038.789	571.155	567.156	3.999
Unites States	610	1040.989	1363.6	1244.148	119.452
Rest of World	1038.109	1038.109	3981.484	3900.829	80.665
	Groundnut Oil				
Argentina	904.271	904.271	47.044	10.521	36.523
China	905.101	905.101	1866.653	1855.377	11.276
European Union	N/A	960.444	0	190.623	0
India	1121.94	1121.94	1725	1725	0
Nigeria	950.024	950.024	309.489	305.728	3.761
Senegal	907.221	907.221	49.957	4.038	45.918
Sudan	947.894	947.894	167.02	122.792	44.228
Unites States	1068.497	1068.497	78.075	78.075	0
Rest of World	909.308	909.308	564.422	515.504	48.918
	Groundnut Meal				
Argentina	118.161	118.161	109.802	65.716	44.085
China	118.991	118.991	2569.154	2567.148	2.005
European Union	N/A	133.611	0	204.581	0
India	117.22	117.22	2290	2290	0
Nigeria	123.86	123.86	368.15	368.15	0
Senegal	121.111	121.111	57.221	20.013	37.208
Sudan	121.061	121.061	271.145	163.958	107.187
Unites States	123.261	123.261	83.253	69.159	14.094
Rest of World	120.691	120.691	655.042	655.042	0

[1] $/MT

[2] 1000 MT

D.3.8 Case 8: A decrease in Senegal's transportation costs by 5% in combination with Case 1.

Table D.3.8 Model Results for Case 8 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.529	1036.529	559.06	309.4	249.66
China	1037.359	1037.359	7055.648	6965.6	90.048
European Union	N/A	1051.979	0	588.892	0
India	391.242	1035.199	7476	7437.366	38.634
Nigeria	1046.496	1046.496	1310.384	1310.384	0
Senegal	251.864	1040.104	525.5	518.922	6.578
Sudan	1039.429	1039.429	571.303	567.438	3.865
Unites States	610	1041.629	1363.6	1244.188	119.412
Rest of World	1038.749	1038.749	3982.108	3901.414	80.694
	Groundnut Oil				
Argentina	901.517	901.517	47.012	10.553	36.46
China	902.347	902.347	1865.239	1858.207	7.032
European Union	N/A	968.286	0	189.757	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.866	957.866	309.955	305.226	4.729
Senegal	905.092	905.092	49.467	4.04	45.427
Sudan	955.736	955.736	167.474	122.59	44.884
Unites States	1068.167	1068.167	78.091	78.091	0
Rest of World	913.42	913.42	564.873	513.647	51.225
	Groundnut Meal				
Argentina	118.287	118.287	109.729	65.679	44.05
China	119.117	119.117	2567.207	2565.904	1.303
European Union	N/A	133.737	0	204.425	0
India	117.22	117.22	2290	2290	0
Nigeria	123.317	123.317	368.703	368.636	0.067
Senegal	121.862	121.862	56.661	19.988	36.673
Sudan	121.187	121.187	271.882	163.907	107.976
Unites States	123.387	123.387	83.271	69.107	14.163
Rest of World	120.507	120.507	655.565	655.372	0.193

[1] $/MT

[2] 1000 MT

D.3.9 Case 9: A decrease in Senegal's transportation costs by 5% in combination with Case 2

Table D.3.9 Model Results for Case 9 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.675	1036.675	559.115	311.932	247.183
China	1037.505	1037.505	7055.747	6964.427	91.32
European Union	N/A	1052.125	0	588.756	0
India	391.242	1035.345	7476	7437.009	38.991
Nigeria	1046.274	1046.274	1310.34	1310.34	0
Senegal	251.864	1040.25	525.5	518.872	6.628
Sudan	1039.575	1039.575	571.337	567.389	3.948
Unites States	610	1041.775	1363.6	1244.029	119.571
Rest of World	1038.895	1038.895	3982.248	3901.134	81.113
	Groundnut Oil				
Argentina	952.373	952.373	47.843	9.995	37.848
China	901.908	901.908	1864.785	1858.658	6.127
European Union	N/A	967.823	0	189.808	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.403	957.403	309.926	305.256	4.67
Senegal	904.653	904.653	49.456	4.041	45.415
Sudan	955.273	955.273	167.426	122.602	44.824
Unites States	1068.461	1068.461	78.077	78.077	0
Rest of World	912.976	912.976	564.771	513.847	50.924
	Groundnut Meal				
Argentina	118.175	118.175	111.667	65.712	45.955
China	119.048	119.048	2566.583	2566.583	0
European Union	N/A	133.625	0	204.564	0
India	117.22	117.22	2290	2290	0
Nigeria	123.28	123.28	368.668	368.668	0
Senegal	121.75	121.75	56.647	19.992	36.655
Sudan	121.075	121.075	271.804	163.952	107.852
Unites States	123.275	123.075	83.255	69.153	14.102
Rest of World	120.465	120.465	655.446	655.446	0

[1] $/MT

[2] 1000 MT

D.3.10 Case 10: A decrease in Senegal's transportation costs by 5% in combination with Case 3.

Table D.3.10 Model Results for Case 10 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.633	1036.633	559.099	309.537	249.562
China	1037.463	1037.463	7055.719	6968.45	87.269
European Union	N/A	1052.083	0	587.692	0
India	391.242	1035.303	7476	7437.11	38.89
Nigeria	1043.129	1043.129	1309.709	1309.709	0
Senegal	251.864	1040.208	525.5	519.058	6.442
Sudan	1039.533	1039.533	571.327	567.101	4.226
Unites States	610	1041.733	1363.6	1244.071	119.529
Rest of World	1038.853	1038.853	3982.208	3900.434	81.774
	Groundnut Oil				
Argentina	904.548	904.548	47.061	10.518	36.543
China	905.378	905.378	1866.561	1855.094	11.467
European Union	N/A	960.733	0	190.591	0
India	1121.94	1121.94	1725	1725	0
Nigeria	950.313	950.313	309.507	305.71	3.797
Senegal	908.123	908.123	49.514	4.038	45.476
Sudan	948.183	948.183	167.045	122.784	44.261
Unites States	1068.385	1068.385	78.08	78.08	0
Rest of World	909.586	909.586	564.425	515.379	49.047
	Groundnut Meal				
Argentina	118.204	118.204	109.843	65.704	44.139
China	119.034	119.034	2569.027	2566.725	2.302
European Union	N/A	133.654	0	204.528	0
India	117.22	117.22	2290	2290	0
Nigeria	123.838	123.838	368.17	368.17	0
Senegal	121.779	121.779	56.714	19.991	36.723
Sudan	121.104	121.104	271.187	163.94	107.247
Unites States	123.304	123.304	83.259	69.141	14.118
Rest of World	120.689	120.689	655.045	655.045	0

[1] $/MT

[2] 1000 MT

D.3.11 Case 11: Senegal lets the producer price for groundnuts to be set by the market in combination with Case 1

Table D.3.11 Model Results for Case 11 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.624	1036.624	559.096	309.395	249.701
China	1037.454	1037.454	7055.713	6965.468	90.245
European Union	N/A	1052.074	0	588.878	0
India	391.242	1035.294	7476	7437.132	38.868
Nigeria	1046.513	1046.513	1310.388	1310.388	0
Senegal	1039.574	1039.574	524.778	518.859	5.919
Sudan	1039.524	1039.524	571.325	567.431	3.895
Unites States	610	1041.724	1363.6	1244.178	119.422
Rest of World	1038.844	1038.844	3982.199	3901.37	80.829
	Groundnut Oil				
Argentina	901.55	901.55	47.014	10.552	36.462
China	902.38	902.38	1865.226	1858.173	7.053
European Union	N/A	968.321	0	189.753	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.901	957.901	309.957	305.224	4.733
Senegal	904.5	904.5	49.413	4.041	45.372
Sudan	955.771	955.771	167.477	122.589	44.888
Unites States	1068.153	1068.153	78.092	78.092	0
Rest of World	913.453	913.453	564.877	513.632	51.244
	Groundnut Meal				
Argentina	118.292	118.292	109.734	65.677	44.057
China	119.122	119.122	2567.189	2565.849	1.34
European Union	N/A	133.742	0	204.419	0
India	117.22	117.22	2290	2290	0
Nigeria	123.322	123.322	368.706	368.631	0.075
Senegal	121.242	121.242	56.599	20.008	36.59
Sudan	121.192	121.192	271.887	163.904	107.983
Unites States	123.392	123.392	83.272	69.105	14.167
Rest of World	120.512	120.512	655.569	655.362	0.208

[1] $/MT

[2] 1000 MT

D.3.12 Case 12: Senegal lets the producer price for groundnuts to be set by the market in combination with Case 2

Table D.3.12 Model Results for Case 12 Under the Enhanced GSP scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.768	1036.768	559.15	311.93	247.221
China	1037.598	1037.598	7055.81	6964.286	91.524
European Union	N/A	1052.218	0	588.749	0
India	391.242	1035.438	7476	7436.782	39.218
Nigeria	1046.29	1046.29	1310.343	1310.343	0
Senegal	1039.718	1039.718	524.814	518.812	6.002
Sudan	1039.668	1039.668	571.358	567.384	3.974
Unites States	610	1041.868	1363.6	1244.042	119.558
Rest of World	1038.988	1038.998	3982.337	3901.085	81.252
	Groundnut Oil				
Argentina	952.409	952..409	47.846	9.994	37.851
China	901.942	901.942	1864.767	1858.623	6.144
European Union	N/A	967.859	0	189.804	0
India	1121.94	1121.94	1725	1725	0
Nigeria	957.439	957.439	309.928	305.253	4.674
Senegal	904.062	904.062	49.403	4.041	45.362
Sudan	955.309	955.309	167.433	122.601	44.832
Unites States	1068.397	1068.397	78.08	78.08	0
Rest of World	913.011	913.011	564.771	513.831	50.94
	Groundnut Meal				
Argentina	118.119	118.119	111.674	65.705	45.969
China	119.051	119.051	2566.558	2566.558	0
European Union	N/A	133.649	0	204.534	0
India	117.22	117.22	2290	2290	0
Nigeria	123.278	123.278	368.671	368.671	0
Senegal	121.149	121.149	56.587	20.012	36.576
Sudan	121.099	121.099	271.816	163.942	107.874
Unites States	123.299	123.299	83.259	69.143	14.115
Rest of World	120.465	120.465	655.447	655.447	0

[1] $/MT

[2] 1000 MT

D.3.13 Case 13: Senegal lets the producer price for groundnuts to be set by the market in combination with Case 3

Table D.3.13 Model Results for Case 13 Under the Enhanced GSP Scenario

Region	Supply Price[1]	Demand Price[1]	Domestic Supply[2]	Domestic Demand[2]	Exports to the EU[2]
	Groundnuts				
Argentina	1036.726	1036.726	559.134	309.533	249.602
China	1037.556	1037.556	7055.782	6968.33	87.451
European Union	N/A	1052.176	0	587.68	0
India	391.242	1035.396	7476	7436.884	39.116
Nigeria	1043.144	1043.144	1309.712	1309.712	0
Senegal	1039.676	1039.676	524.804	518.996	5.807
Sudan	1039.626	1039.626	571.349	567.094	4.254
Unites States	610	1041.826	1363.6	1244.063	119.537
Rest of World	1038.946	1038.946	3982.296	3900.385	81.912
	Groundnut Oil				
Argentina	904.58	904.58	47.063	10.517	36.546
China	905.41	905.41	1866.552	1855.061	11.491
European Union	N/A	960.767	0	190.587	0
India	1121.94	1121.94	1725	1725	0
Nigeria	950.347	950.347	309.509	305.078	3.801
Senegal	907.53	907.53	49.46	4.038	45.422
Sudan	948.217	948.217	167.049	122.784	44.265
Unites States	1068.367	1068.367	78.081	78.081	0
Rest of World	909.618	909.618	564.426	515.364	49.062
	Groundnut Meal				
Argentina	118.211	118.211	109.848	65.702	44.146
China	119.041	119.041	2569.015	2566.659	2.356
European Union	N/A	133.661	0	204.52	0
India	117.22	117.22	2290	2290	0
Nigeria	123.835	123.835	368.172	368.172	0
Senegal	121.161	121.161	56.652	20.011	36.641
Sudan	121.111	121.111	271.192	163.938	107.255
Unites States	123.311	123.311	83.26	69.139	14.122
Rest of World	120.689	120.689	655.046	655.046	0

[1] $/MT

[2] 1000 MT

D.4 Model Results for Changes in Consumer and Producer Surplus, for All Three Groundnut Markets in Senegal Under the REPA Scenario

Table D.4.1 Changes in Consumer and Producer Surplus for Senegal Under the REPA Scenario

Case	Change in Consumer Surplus			Change in Producer Surplus		
	Groundnuts	Groundnut Oil	Groundnut Meal	Groundnuts	Groundnut Oil	Groundnut Meal
1	-92.731	1.995	2.237	0	-36.375	-22.302
2	-197.633	29.987	0.515	0	-378.865	-19.862
3	378.084	1.212	0.241	871.678	345.568	59.262
4	742.050	2.386	0.510	1710.757	677.624	115.898
5	285.328	3.276	3.216	871.678	304.213	29.630
6	180.428	31.198	0.793	871.678	-37.120	38.852
7	-277.885	-2.453	-3.758	0	49.784	37.071
8	-556.035	-4.905	-7.513	0	99.521	74.174
9	-370.473	-0.448	-1.419	0	12.786	13.748
10	-475.165	27.531	-3.24	0	-329.365	17.087
11	-46.314	-0.087	-0.017	277634.551	-12.113	-2.077
12	-137.168	1.911	2.21	277693.716	-47.905	-24.182
13	-243.071	29.902	0.494	277662.421	-390.597	-21.857
14	759.892	2.444	0.523	1751.904	693.899	118.674

Unit of Measurement: Thousands of Dollars

D.5 Model Results for Changes in Consumer and Producer Surplus, for All Three Groundnut Markets in Senegal Under the Enhanced GSP Scenario

Table D.5.1 Changes in Consumer and Producer Surplus for Senegal Under the Enhanced GSP Scenario

Case	Change in Consumer Surplus			Change in Producer Surplus		
	Groundnuts	Groundnut Oil	Groundnut Meal	Groundnuts	Groundnut Oil	Groundnut Meal
1	-1018.525	205.101	-0.153	0	-2543.303	-102.163
2	-1110.75	206.864	0.419	0	-2567.558	-108.428
3	-1008.037	192.858	0.343	0	-2395.745	-100.553
4	-838.565	161.161	1.484	0	-2011.977	-95.123
5	-643.351	206.251	0.065	871.678	-2221.296	-43.627
6	-735.001	208.078	1.383	871.678	-2250.115	-57.048
7	-631.857	194.019	0.62	871.678	-2072.738	-42.564
8	-1294.37	202.619	-3.911	0	-2495.297	-65.627
9	-1386.546	204.391	-3.235	0	-2520.162	-72.887
10	-1283.948	190.378	-3.411	0	-2347.656	-64.028
11	-1068.48	205.011	-0.172	277514.752	-2555.542	-104.381
12	-1158.329	206.778	0.390	277590.099	-2579.126	-110.43
13	-1056.358	192.771	0.321	277568.008	-2407.588	-102.658

Unit of Measurement: Thousands of Dollars

Vita

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