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Impacts Analysis of the Liberalization of Groundnut Production in Senegal : A Multiple Household Computable General Equilibrium Model

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IMPACTS ANALYSIS OF THE LIBERALIZATION OF GROUNDNUT PRODUCTION IN SENEGAL: A MULTIPLE HOUSEHOLD COMPUTABLE GENERAL EQUILIBIUM MODEL[1]

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Abstract

In Senegal, the poverty reduction strategy will take place in a context characterized by international trade liberalization in the agricultural sector, in general and the groundnut sector, in particular. This is the backdrop against which we have developed a micro-simulated multiple household computable general equilibrium such as proposed by Decaluwé *et al.* (1999b). Four simulations have been made and their impacts assessed at the macroeconomic, sectoral and household levels. The first two simulations concerned tariff reforms, and the last two, the external shocks resulting from a change in export prices on the world market (groundnuts and groundnut oils). These simulations have been used to assess the impacts that the liberalization of the groundnut industry and the privatization of *Société Nationale de Commercialisation des Oléagineux du Sénégal (SONACOS)* provided for in the Framework Agreement, may have on households and to establish a link between these economic reforms, poverty and income distribution. This model is very flexible because it allows, in particular, a change in the distribution of the target groups who had not been retained prior to the simulation exercise so that an *ex post* analysis of poverty and inequality to the modeling exercise could be carried out.

Keyword: computable general equilibrium model, micro-simulation, poverty analysis, income distribution, privatization.

JEL: D58, D31, I32, L33

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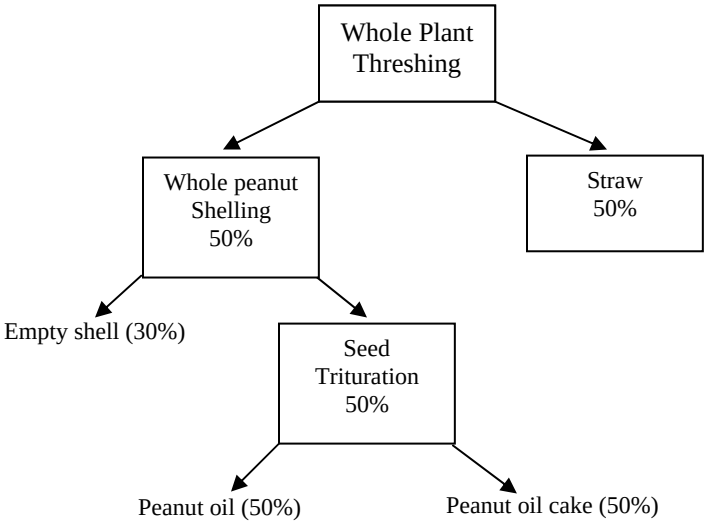
I- INTRODUCTION: THE GROUNDNUT SECTOR IN SENEGAL

Historically, groundnut appeared in the Amazonian Basin where it was domesticated about 3,500 years ago (Peru, Bolivia and Brazil). It was introduced in Africa by the Portuguese through the Brazil – West African Coast route while Spaniards exported it to the Far-East from Peru to the Philippines, Indonesia and China. In the 19th Century, the French imported it to Senegal where it became a dominant crop in the country's economy. Ideally, groundnut grows in regions where temperature wavers between 25 and 35 degrees and rainfall reaches an average of 600 and 1,200 mm annually[4]. Groundnut is consumed in different forms; seeds, oil or processed items (paste, candies,…). Some by-products such as oilcake or combustibles are also derived from groundnut. Figure 1 describes the main operations and their respective parts in the processing of this leguminous plant.

Figure 1 : Sequence of main groundnut processing operations



The percentages indicated represent averages. Average percentage of industrial extraction in weight of refined oil from pod: one-third.
Source : Schilling (2003)

[4] About 70% of the world groundnut productions come from semi-arid regions.

One of the major advantages of this seed lies in the caloric and protein content of groundnut and the oil extracted from it which has become, in the course of time, a staple food for the Senegalese households. It contributes up to 28 percent of daily calories intake of Senegalese Evers (1997). Moreover, groundnut oil is a staple which absorbs an important share of the budgets Senegalese households. Apart from becoming a staple food over time, groundnut production[5], traditional processing and marketing have turned out to be the main sources of income for many rural[6] households. Groundnut dominates their agricultural activity behind millet/sorghum. The two crops occupy about 80% of cultivated lands in Senegal. While about 91% of rural agricultural households cultivate millet/sorghum, over 73% of them are involved with groundnut production. However, unlike millet or sorghum which are food crops, groundnut is associated with speculative behaviors. From this point of view, groundnut is both as a food and cash crop. Most of the rural agricultural households involved with groundnut production are concentrated in the groundnut basin formed by the regions of Kaolack, Fatick, Diourbel, Louga and Thiès. Groundnut production in Senegal is thus concentrated in this area which represents about one-third of Senegal's cultivable lands and employs almost two-thirds of the working population in the agricultural sector (Akobundu, 1998). The groundnut basin extends from north to south over 220 km and from East to West over 200km. Moreover, 61% of the urban population outside the Dakar region is concentrated in this area. Any action tending to influence the strategy regulating the groundnut sector may therefore prove to be politically sensitive.

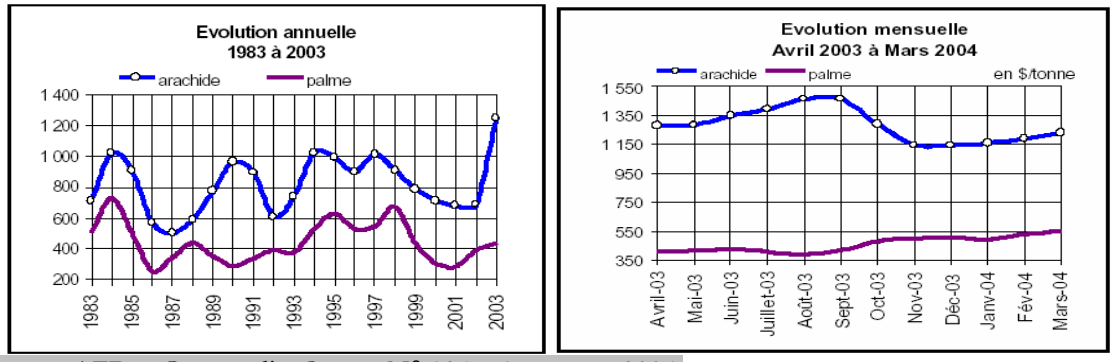
The reforms and external shocks affecting the groundnut sector in Senegal will clearly have deep and diffuse effects on the economy and a significant on rural household welfare. Given its size

[5] Senegal was one of the five largest world producers in the mid-1990s and remained so until 2000.

[6] 70% of the population is involved with agriculture which contributes 20% to GDP. Of the 2.3 million hectares cultivated in Senegal, one million hectare is earmarked for industrial production (of which 98% for groundnut and 2% for cotton) and groundnut production provides a source of income for about one-third of the population.

the groundnut is strongly linked to other sectors of the economy such as food-industry and transport. Moreover, it is the source of a strong intermediate demand for inputs produced by the rest of the economy. On average, groundnut is the most profitable crop compared to cereals, which is the main alternative crop for farmers of the groundnut basin. As for trade, groundnut exports accounted for more than 80% of Senegal's overall exports in the 1960s, they fell to 40% in the 1970s and finally stabilized at around 10% in the 1990s (Freud *et al.* 1997). Initially, Senegal's exports financed the country's food imports, and more particularly, cereals (rice and wheat). Since the 1970s, the falling prices of groundnut and groundnut by-products on the world market, bad weather conditions, successive national or international economic shocks as well as the appearance of substitute commodities are among the factors explaining the drop in Senegal's groundnut exports. The Figure 2 below shows the strong volatility of groundnut oil prices.

Figure 2: Trends in Groundnut (and Palm) Oil Prices on the World Market



Source: AFD – Commodity Survey N° 124 – 1st quarter 2004.

The recent surge in price can be explained in part by the slump in production in recent years due to the drought that hit some of the producing regions of the USA and Senegal (261,000 tons in 2002-2003 compared to 900,000 tons in 2001-2002). It is also important to mention that in early 2004, Senegal stocks of groundnut fell to their lowest level since 1997 (32.65 million tons). The dominance of groundnut in Senegal can be traced back to the pre-independence era. From 1890, the colonial administration introduced groundnut as the primary crop in the current northern

groundnut basin. In 1920, large French trading companies such as Buhan & Teisseire, Deves & Chaumet and Maurel & Prom, participated to groundnut production and marketing in Senegal. Since the establishment of the first Senegalese cooperatives in the late 1940s, cooperatives kept expanding to facilitate seed distribution, groundnut marketing as well as the creation of improved varieties. By the mid-1960s, the Government obtained a monopoly over groundnut sale and protected the sector by instituting customs duties and other non-tariff barriers. In 1975, the *Société Nationale de Commercialisation des Oléagineux du Sénégal (SONACOS)* was established to reduce foreigners' control of the oil manufactory sector. By 1978 all production and marketing of edible oil was nationalized. SONACOS weak performance put enormous pressure on public budgets in the mid-eighties. The structural adjustment program (SAP) introduced competition with private seedsman. The NAP opened the door to Private Stocking Companies (PSC) which put and end to the buyer's monopoly held by cooperatives (Gaye 1998a).

The drop in production of groundnut in the early nineties forced *SONACOS* to import crude vegetal oil to meet domestic consumption. In order to maintain a relatively stable volume of crude ground nut oil exports, Senegal had to import about 100,000 tons of vegetal oil annually. Senegal value of groundnut oil exports is very rarely sufficient to cover its vegetal oil import needs while the income generated by its oilcake exports is not sufficient to compensate the deficit. In the early 2000 despite an increase in production, the falling world prices coupled with the mismanagement of *SONACOS* have led to the signing of the Framework Agreement. This Agreement compels the Government to liberalize the groundnut industry, improving the financial situation of *SONACOS* and privatize it. *SONAGRAINES*[7], a subsidiary of *SONACOS* had to disengage from groundnut collection and was finally dissolved in 2001. This was done to make

[7] The mandate of the SONAGRAINES company was to organize seed production and marketing.

individual actors more accountable; they could no longer hide behind *SONAGRAINES* to "conceal" deficits. The dissolution of the *SONAGRAINES* was strongly criticized given the low efficiency of the alternative solutions and it increased producers' income volatility (Hirsch (2002) and Union Européenne – Afrique de l'Ouest, (2002)).

Many reforms have been introduced in this sector with mitigated results. The various actors involved in groundnut production still clash over the privatization of *SONACOS* following the failure of two previous attempts in 1995 and 1997[8]. Despite all these difficulties, the government aims to reform the sector to contribute, *inter alia*, to an increase in the productivity of this industry by stabilizing, in particular, the economic and financial environment of the industry and the organizational difficulties of its actors.

Analyzing the impact of the liberalization of the groundnut sector on macro and sectoral variables as well as on poverty and income distribution can contribute to enlighten actors involved in the process and help modulate and/or implement the reform. Many actors of the sector are resisting changes based on impressions and not rigorous analysis the reforms. The rest of the paper is structure as follow, we present a literature review of macro-micro models used to analyze impact of policy reform on poverty and income distribution, followed by a description of the model and poverty and distributional indices and we move to the presentation of simulations and analysis of the results. We conclude with final comments on our results.

II- LITERATURE REVIEW OF MACRO-MICRO MODELING

One of the first contribution linking a CGE model and micro data in a developing country is Adelman and Robinson (1977) for South Korea. This application was followed by that of Taylor and Lysy (1979) for Brazil, Dervis *et al* (1982), and Bourguignon *et al* (1983) for Venezuela.

[8] For additional information on the history of the industry and its operational mode, see Gaye (1998a and 1998b).

These papers we pioneer for income distribution analysis with CGE models. Later in the early ninetees OCDE sponsered work by Thorbecke (1991), de Janvry, *et al* (1991), Bourguignon, de Melo and Suwa (1991) and Morrisson (1991) which analysed the impact of structural adjustment programs on income distribution. The first article survey using poverty indices is de Janvry *et al* (1991) with an application to Ecuador. They used the Foster Greer and Thorbecke (FGT), (1984) to measure poverty changes. Chia *et al* (1994) also used the same indices in a CGE application to Ivory Coast.

More recently, a new wave of researchers tried to go further by making poverty analysis a central objective of research. As a result, it was possible, in particular, to highlight the relation existing between economic policies, poverty levels and income distribution. These researchers include Decaluwé *et al.* (1999a), Decaluwé *et al.* (1999b) and Cogneau and Robilliard (2000). These papers have been followed by a large number of applications[9].

Three main approaches have been used to link macro reforms to changes in income distribution and poverty. The first one being is the most commonly used is the representative household approach RH, the second one is usually referred to as CGE integrated multi-household (IMH) approach and the third is generally referred to as the Top-down or micro-simulation sequential approach MMS. The RH approach consists of using representative household subgroups in a CGE model and inferring changes in the income of all household within each groups based on the change of income of the representative household of the CGE model. With this approach the within-group redistribution of income is not taken into account and can lead to misleading conclusions as demonstrated in Savard (2005). The second approach first proposed by Decaluwé

[9] For an interesting review, the reader can consult Hertel and Reimer (2004).

et al (1999b), is the CGE integrated multi-household approach (IMH)[10]. This approach is theoretically sound since the macro and micro components are coherent and fully respect the standard CGE framework. CGE-IMH consists of including a large number of household from household survey or all households of the survey into a CGE model. However, it can raise some difficulties at implementations and resolution stage. First, according to Rutherford *et al.* (2005) data reconciliation can be very problematic; the numerical resolution can also be challenging (Chen and Ravallion (2004)).

The third approach is referred to as the CGE micro-simulation sequential method (MSS) which could be subdivided in different variants. The first variant is the macro-accounting formally presented by in Chen and Ravallion (2004) and extensively applied in recent years. The second variant proposed by Bourguignon, Robilliard and Robinson (2005) consist of integrating rich micro behavior at the household level such as labor supply at the individual level, consumption behavior etc. The general idea of the MSS approach is that a CGE module feeds market price changes into a micro-simulation household model. The main drawback of this approach is that the micro-feedback effect is not fully taken into account. This critique of the MMS approach has been raised in two literature review of macro-micro modeling for poverty analysis (Hertel and Reimer (2004) as well as Bourguignon and Spadaro (2005).

In this paper we have selected the CGE-IMH as we were able to resolve the problems raised by Rutherford *et al* (2005) and Chen and Ravallion (2004). The paper also complements the findings of Boccanfuso *et al* (2005) in which they analyze the privatization of the SONACOS. It also used the Boccanfuso *et al* (2005) model as a starting point by modifying some hypothesis to capture the effects of the liberalization of the sector. In this paper we focus on the impact of price reforms

[10] Some authors refer to this approach as a CGE micro-simulation application.

(import duties, fixed prices etc) on vulnerable groups of Senegal. The simulations performed in this paper we designed followed a national consultation process with all actors of the sector included the World Bank.

III- MODEL DESCRIPTION

Economic policies or external shocks are transmitted to household welfare through variation in the prices of goods (cost of consumption basket) and the prices factor (wages and rental rate of capital)[11]. On the other hand, initial factor endowment (labor and capital) changes and transfers between agents can also play a significant. In this version of the model, factor endowments are exogenous by inter-household transfers are endogenous. In Senegal an important portion of the population (above 20 percent) is heavily dependent on these transfers highlighting the importance of endogenizing these transfers.

As stated, we build upon Boccanfuso et *al.* (2005) model in which the behaviors of actors involved in the groundnut industry are modeled to reflect as accurately as possible the market mechanisms of the sector. We posit that Senegal is a small open economy and therefore world prices of imports and exports are exogenous to the model. However, since Senegal is one of the major groundnut and groundnut oil exporters, we assume that world demand for these two commodities is not infinite. If they want to expand their share of world market, Senegalese exporters must reduce their price on the international market for the two goods. We therefore introduced a demand for groundnut and groundnut oil with limited elasticity[12]. We postulate in standard fashion the Armington's hypothesis (1969) for import demand. As stated we include the entire households of the Senegalese Households Survey (ESAM-I, 94-95). From Boccanfuso *et al*

[11] McCullouch, Winters and Cirera (2002) provide an interesting discussion on transmission mechanism between liberalization and poverty.

[12] This hypothesis is different from the one postulated in the model used within the framework of pre-psia analysis in which we had assumed that demand for Senegal's exports was infinitely elastic for all export commodities.

(2005) we have introduced the following hypothesis. The main objective of the changes is to highlight the importance of inter-actions between the groundnut sector and other branches of the economy. In addition we wanted to improve the links between macroeconomic variables and the poverty and inequality indices.

Production is determined in the by a three tier system: total production of the branch (*XS*) is composed of value-added shares (*VA*) and intermediate consumptions (*CI*) linked with a fixed share assumption (Leontief). The relationship determining the level of *VA* is a Cobb-Douglas function between composite labor (*LD*) and capital (*KD*). Labor is decomposed into two elements viz., qualified labor and unqualified labor, and the relationship between two types of labor is a constant elasticity of substitution (CES) function. Intermediate consumptions are modeled in a standard Leontief fashion.

The main hypotheses that we have introduced in the model are fixed producer price, fixed seed price paid by *SONACOS*. We modeled the marketing margin of the Private Stocking Companies (PSC) who are responsible of buying groundnuts for *SONACOS* as well as a dual sale market for producers (parallel/informal market and *PSC*). Moreover, *SONACOS* are non-profit maximizer as they have fixed factors and excess production capacity. Specifically we had to modify the following items in the model to capture these stylized facts of the sector. Starting with *SONACOS*, its production will be determined in large part by the quantity of seeds that it can purchase through the Private Stocking Companies (*PSC*).

Moreover, the number of *SONACOS'* employees is assumed to be exogenous with its existing physical capital[13]. In light of this *SONACOS* is faced with important fixed cost. As such, if it is unable to purchase enough seeds, it will have a deficit. To avoid deficit situations, it may "act" on

[13] Trade unions and labour market regulation makes it extremely difficult to layoff workers in Senegal. Some privatized firms have been confronted with long strikes when they attempted to layoff workers.

the price it offers producers for their seeds. The groundnut producer price offered by *SONACOS* will determine the quantity that producers will make available to purchasers (*PSC*) since they also have the option of selling on the parallel market. The choice by the producer is made by maximizing income under the constraint of a constant elasticity of transformation (CET) function. This function captures the trade-off made by producer in relation to the relative price he can receive on both markets but also the elasticity of transformation he faces[14].

Agent income equations are consistent with the structure presented in SAM. Household income is composed of the factor payments and dividends. The other sources of income are transfers from the other agents (Government, other households and the rest of the world). The firms' income is the capital payment not distributed to households to which must be added government subsidies and transfers from the rest of the world. As stated earlier herein, we have added an agent "PSC" who receives the marketing margin from buying the seeds from the producer and we assume that the incomes from this activity are saved by PCS. Government revenue is made up of production taxes, customs duties, household and company taxes as well as transfers from the rest of the world (budgetary assistance). The Government spends its income by producing public services, transfers to households and transfers to the rest of the world. We further assumed that *SONACOS'* surpluses are paid to the Government and that its deficits are financed by the latter.

Our price index is a GDP deflator, and as we have stated earlier herein, international prices (imports and exports) are exogenous; accordingly the country has no control over world prices. The model equilibrium conditions are also standard for non-groundnut commodity markets. The markets are balanced by an adjustment of the market prices of each commodity. However, in the case of groundnut, there are two distinct markets. The parallel market behaves like a standard

[14] The main technical constraint is access to these markets. PSC have established an extensive system of seed collection across the country.

commodity market with the market price balancing supply and demand. Yet, producers' supply is determined by a fixed price on the official market. And as we further assumed that demand for groundnut and groundnut oil exports is not infinite, we specify an export demand function which implies that a gain in world market share comes through a reduction in export price[15]. The labor market is perfectly segmented (qualified and unqualified) and both market clear with the respective nominal wages that adjust. It is therefore possible for workers to go from one sector to the other but not from one market to another. One should also note that labor supply on each of the markets is exogenous and that there is no unemployment[16]. Capital is fixed by sector. The current account balance is exogenous and the nominal exchange rate is adjusts the constraint. For savings/investment equilibrium, total investment is determined by to the sum of agents' savings.

The model has nine commodity market prices seven capital payment as well as two wages (qualified and unqualified). These prices will by the link between the simulations and the households' welfare changes. The consumption structure and factor endowments of households are drawn directly from the household survey (ESAM-I)[17].

The Social Accounting Matrix (SAM) used in the study is a modified version of Boccanfuso *et al*. (2003a) SAM in which the 3278 household of the ESAM I are included. The main changes are the disaggregation of the groundnut sector within the agricultural branch the addition of the PSC and the segmentation of the groundnut market.

We used the poverty and inequality indices commonly used in the context of CGE modeling. We have grouped households into subgroups with the objective to reflect the vulnerable groups in the groundnut industry, allowing for comparative analysis with other groups of the Senegalese

[15] For specification of the export demand the reader can consult the EXTER II model of Decaluwé *et al* (2001).

[16] This does not mean that we assume that there is zero unemployment in the Senegalese economy but simply that unemployment is exogenous to the model. We are planning to introduce unemployment in a new version of the model under preparation.

[17] A complete list of equations, variables and parameters can be provided upon request to the authors.

economy. It should be noted that the household classification is independent of the CGE modeling exercise. We compute our poverty and inequality at the reference period and after simulations. We used the Foster, Greer and Thorbecke (F-G-T, 1984) P_α for poverty analysis and Gini index for inequality changes. FGT poverty indices are additively decomposable; as such they are interesting within the CGE framework[18]. We also adopt an endogenous poverty line as proposed by Decaluwé *et al.* (2005). The endogenous poverty line consist of specifying a basket of basic needs such as described in Ravallion (1994) in volume which are exogenous and the market price of these goods are endogenously determined by the model. Hence a price increase of the goods included in the basic needs basket will increase poverty *ceteris paribus*. The Gini (G) index[19] is used to measure the gap between the Lorenz Curve and the perfect equality line. G is a scalar measure indicating the degree inequality and it is comprised between 0 (perfect equality) and 1 (extreme inequality).

IV- SIMULATIONS AND MACROECONOMIC RESULTS

In the following section, four simulations have been carried out in order to assess their impacts at the macro and micro levels. The first two concern tariff reforms and the other two, the external shocks resulting from a change in export prices (groundnut and groundnut oil) on the world market. The purpose of the first simulation is to analyze the impact of adoption of a common regional policy (WAEMU) implemented in the member countries in January 2000. The objective of this reform was to reduce and standardize customs duties in the region in combination with a uniform valued-added tax rate (VAT) to compensate for the Government's forgone revenues

[18] For a detailed presentation of the FGT index the reader can consult Foster et al (1984) or Ravallion (1994). We used the DAD software for poverty computation by Duclos et al (1999).

[19] It is defined with: $G = \frac{2}{n\bar{y}}\left[- \frac{Y(n+1)}{2} + \sum_{i=1}^{n} y_i r_i \right]$ where Y represents the total income of households; n, the size of the global population; r_i, household ranking i; and y_i, household income i.

resulting from lower customs duties. To simulate this policy therefore, we applied a reduction on the effective tax rate corresponding to the decrease in the official rates. The weighted average official rate prior to the reform was about 65% and the effective rate was around 19%. Therefore, a decrease in import duties from 65% to 20% implies a reduction of the effective tax from 19% of 6% applied to all sectors. For the VAT the effective average rate 6.1% for an 18% official rate[20]. When implementing this reform, the edible oil sector was exempted from the tariff reduction and this is what we simulate. The Government of Senegal engaged to implement on April 1st, 2004 but has yet implemented the reduction of the specific tax. In the second simulation, we perform the same reform as in simulation one but implement the reduction of the edible oil special tax.

The purpose of the second group of simulations (3 and 4) is to analyze the effects of a decrease in the world prices of groundnut and groundnut oil. This fall in prices could be induced by an increase in world supply or a decrease in world demand. In the first case, the increase in supply may be attributable to a good production year or even to the adoption of production incentives such as production subsidies in competing countries. Lower demand may be the result of a substitution groundnut oil by other vegetal oils or even of an increase in the production of importing countries. The stylized facts (see Figure 2) revealed a downward trend between 1997 and 2002 and an upward trend as from 2002. Let us move to the analysis of the four simulations with the results presented in Table 1 and Table 2 for the macro and sectoral changes[21].

SIMULATION 1: The common external tariff, harmonizing VAT and maintaining the specific tax on oil imports

The first observation that we can make regarding the effect of this simulation is that the final impact on government revenue is relatively weak (an increase of 1.74%). In fact, the increase is

[20] The difference between effective and official rates is due in large part to evasion and exemptions.

[21] We do not present complete sectoral results of the model but the key variables of interest in this analysis.

generated by higher revenues from the VAT than the foregone revenues resulting from lower import duties. This allows the Government to increase its savings by 13%. Total investment benefit from this with an increase of 2.5%. We also note that this reform tends to favor more capital-intensive activity and as a result, the final impact on both wages is negative. Since factors are fixed in the model, this reform has practically no impact on GDP. It is also positive for *SONACOS* as it increases its earnings by 12.05% as a result of lower labor cost.

Table 1: Macroeconomic Results of CGE Model

Variables	Reference	Sim 1	Sim 2	Gap 2/1	Sim 3	Sim 4
s	1.00	-2.79	-2.77	*-0.76*	0.08	0.48
sn	0.50	-1.17	-1.22	*4.12*	-0.01	-0.04
yg	59.41	1.74	1.22	*-29.59*	-0.33	-1.97
sg	7.95	13.00	9.15	*-29.59*	-2.46	-14.72
ye	36.03	0.47	0.50	*6.50*	0.18	1,08
yops	0.87	-4.65	-4.62	*-0.75*	-0.29	-1.76
it	32.99	2.50	2.23	*-10.83*	0.03	0.17
PIB	210.56	-0.01	-0.01	*-1.75*	0.00	0.01
e	1.00	6.44	6.52	*1.28*	0.44	2.58
Ysonacos	3.75	12.05	11.82	*-1.93*	-6.72	-39.96

Source : Figures computed by the authors on the basis of SAM 96 and GAMS *ide*.

The two sectors most favored by this reform in terms of output are “other industries” and “mining industries” sectors, with an increase of 2.16% and 0.81% respectively. These two sectors see their capital payment increase significantly by 8.86% and 9.19% respectively. The other services and the groundnut sector are negatively affected in terms of output, with decreases of 3.98% and 2.40% respectively. The sectors that have recorded the most significant decrease in their capital payment are the “groundnut” and “fishing industries” sectors (8.19 and 1.43% respectively).

SIMULATION 2[22]: simulation 1 with the elimination of the specific tax on edible oil imports

It is interesting to investigate the impact of eliminating the specific tax protecting *SONACOS* from foreign competition as this policy reform has been at the centre of discussion between the World Bank and the government of Senegal. The expected effect is that *SONACOS* will be less

[22] This second simulation is similar to the first one with the difference that the specific tax on oil imports has been suppressed.

competitive on the domestic market and that imports will provide substitutes to their output on the local market. As this simulation is a combination of the first simulation we added a column indicating the difference between the results of the two simulations to isolate the impact of the specific tax elimination. As SONACOS has been importing larger amounts of vegetable oils to supply the local market, they will be affected in terms of cost of inputs in addition to competition by foreign producers. By comparing SONACOS' revenue with the previous simulation, it decreases only marginally by 1.93%. Its production is very slightly affected (-0.76%) despite a substantial increase in household consumptions from a negative 3.37% in the first simulation to an increase of 2.32% in the current simulation. The reduction in vegetal oil prices is at the source of this increase in household consumption. While *SONACOS* is loses market shares domestically, higher import volume accounts for almost all of the increase in consumption. It, indeed, loses market shares but maintains a relative stability of its value on the domestic market. On the other hand, an interesting effect is that the export demand for Senegalese groundnut oil has increased in relation to the previous simulation. *SONACOS* therefore loses shares of the domestic market but is able to compensate by increase its exports. This is generated by a reduction in production cost through a drop of price of its inputs and wages.

It is also important to note that this policy generates lower consumer prices than in the previous simulation. This is interesting insofar that this effect contributes to reducing the cost of the food basket. The effect on salaries is very similar to the effects to the previous simulation while decreases in capital payment are generally stronger except for the "other services and other industries".

Table 2: Main Sectoral Results of CGE Model (percentage)

Variables	Sectors	Base	Sim1	Sim2	Gap 2 - 1	Sim3	Sim4
pq	**Agriculture**	1.03	0.45	0.42	-7.39%	0.13	0.75
	Industrial Fishing.	1.00	6.35	6.30	-0.90%	0.11	0.63

Variables	Sectors	Base	Sim1	Sim2	Gap 2 - 1	Sim3	Sim4
	Groundnut	1.00	3.72	3.57	-3.92%	0.17	1.01
	SONACOS	1.16	2.99	-2.76	-192.29%	-0.45	-3.21
	Other Food Items	1.10	-4.20	-4.26	1.34%	0.18	1.05
	Mining Industries	1.01	14.38	14.44	0.46%	0.41	2.44
	Other Industries	1.13	-2.11	-2.09	-0.73%	0.31	1.81
	Other Services.	1.01	3.91	3.88	-0.69%	0.15	0.90
	Non-Commercial Services.	1.00	4.14	4.15	0.06%	0.12	0.74
exd	**Agriculture**	3.30	2.95	3.00	1.88%	0.19	1.09
	Industrial Fishing	3.08	3.76	3.81	1.30%	0.31	1.80
	Groundnut	1.16	-0.05	-0.05	-16.01%	-1.54	-10.15
	SONACOS	5.05	-3.15	-1.79	-43.18%	-1.72	-12.26
	Other Food Items	13.51	5.31	5.46	2.86%	0.25	1.47
	Mining Industries	3.62	0.76	0.80	5.54%	0.08	0.47
	Other Industries	24.90	6.77	6.88	1.60%	0.28	1.64
	Other Services	19.38	4.95	5.03	1.58%	0.21	1.23
Va	**Agriculture**	34.93	-0.03	-0.04	47.61%	0.00	0.00
	Industrial Fishing	4.98	0.13	0.08	-34.32%	0.07	0.44
	Groundnut	7.35	-2.40	-2.44	1.61%	-0.31	-1.86
	SONACOS	0.95	0.00	0.00		0.00	0.00
	Other Food Items	14.29	0.52	0.56	8.94%	0.06	0.36
	Mining Industries	3.19	0.81	0.82	0.97%	0.04	0.24
	Other Industries	29.78	2.16	2.16	-0.02%	0.06	0.37
	Other Services	97.06	0.12	0.13	2.52%	0.01	0.08
	Non-Commercial Services	21.11	-3.98	-3.98	0.06%	-0.12	-0.73
r	**Agriculture**	1.00	-1.36	-1.45	6.57%	0.00	-0.02
	Industrial Fishing	1.00	-1.43	-1.54	7.67%	0.16	0.95
	Groundnut	1.00	-8.19	-8.34	1.79%	-0.92	-5.42
	SONACOS	1.00	0.00	0.00		0.00	0.00
	Other Food items	1.00	1.03	1.29	24.58%	0.39	2.32
	Mining Industries	1.00	9.19	9.31	1.27%	0.61	3.61
	Other Industries	1.00	8.86	8.85	-0.12%	0.35	2.10
	Other Services	1.00	-1.29	-1.27	-1.51%	0.15	0.89

Sources : Figures calculated by the authors on the basis of SAM 96 and GAMS *ide*.

SIMULATION 3: A 5% decrease in the world export prices of groundnut and oil

The first observation on this external shock is that it has very little effect on most of the macroeconomic and sectoral variables. As anticipated, the most sensitive variables are government revenue (*yg*), *SONACOS*' earnings and the productions of the two sectors concerned. Government revenue and *SONACOS*' earnings have decreased by 0.33% and 6.72% respectively. The outputs of the "groundnut" sector and *SONACOS* have decreased by 0.31% and 0.26% respectively. The fall in world prices generated a rather slight increase of 0.50% in household

consumption. The price of edible oil has dropped by 0.45%. On the other hand, the capital payment of the "groundnut" branch is the only one to have diminished (-0.95%).

SIMULATION 4: A 30% fall in the world export prices of groundnut and oil

This last simulation is similar to the previous one with stronger quantitative effects. The market prices of edible oils appeared to have decreased quite significantly together with groundnut and groundnut oil exports. Demand was driven up by the fall in oil prices; as a result, national groundnut oil production increased proportionately at a higher rate than the drop in world prices.

V- MICROECONOMIC RESULTS

In order to capture intra-group redistribution of income we included the 3,278 households of the ESAM-I. For the poverty and income distribution analysis we aggregated the households into seven sub-groups[23] analysis: 1) households residing in the groundnut basin and headed by a farmer (**GB - Agr**); 2) households residing in the agricultural basin and headed by a non-farmer (**GB – Non-agr**); 3) households residing in Casamance and headed by a farmer (**Casam – Agr**); 4) households residing in Casamance and headed by a non-farmer (**Casam – Non-agr**); 5) households residing in the other regions of Senegal and headed by a farmer (**Other Regions – Agr**); 6) households residing in the other regions of Senegal and headed by a non-farmer (**Other Regions – Non-agr**); 7) households residing in Dakar (**Dakar**). Poverty indices at reference period are presented in Table 3.

Table 3: Poverty Index for Senegal and Group Base Situation

Reference	(1)	(2)	(3)	(4)	(5)	(6)	(7)	SEN
FGT0	83.19%	53.75%	83.97%	58.87%	78.23%	59.50%	20.12%	57.85%
FGT1	32.58%	18.63%	37.73%	23.56%	31.50%	20.41%	4.54%	21.60%
FGT2	16.15%	8.49%	20.29%	11.91%	15.94%	9.86%	1.46%	10.51%

Sources : Figures computed by the authors on the basis of ESAM 1995 with DAD 4.3. software

[23] In the present case, they have been established on the basis of groundnut- producing regions: Groundnut Basin (Diourbel, Kaolack, Thiès, Louga and Fatick), Casamance (Ziguinchor and Kolda) and other regions (Saint-Louis and Tambacounda).

At reference period, a majority of farmers residing in groundnut producing regions are poor. In fact, 83% of rural households residing in the groundnut basin and Casamance are poor. The proportion is less than 80% in the other groundnut-producing regions (78.23%). The households headed by non-farmers are also but with poverty rates below or around the national rate. As for Dakar, 20.12% of households are poor. Regarding poverty depth and severity, trends appear to be similar since the poorest households are farmers residing in the three groundnut-producing regions. As for inequality analysis based on Gini index presented in Table 4, it appears that the most egalitarian groups are the groups with the highest poverty rates viz. the agricultural households residing in the groundnut basin and those residing in Casamance.

Table 4: Gini Index Senegal and Groups

(1)	(2)	(3)	(4)	(5)	(6)	(7)	SEN
0.272	0.439	0.309	0.504	0.360	0.354	0.477	0.481

Source : ESAM 1995, computed with DAD 4.2. software

On the hand, the household groups with lower poverty rates exhibit higher Gini index. Such is the case of the non-agricultural households residing in Casamance and those residing in the groundnut basin. The agricultural households residing in the third groundnut-producing regions exhibit an inequality rate very close to those of the non-agricultural households found in the same region i.e. 0.360 compared to 0.354. The analysis also revealed that the Gini Index is 0.481 for the country and slightly lower in Dakar. Now let us analyze the impact of the two policies and two external shocks simulated on each group and at the national level. Let us start by analyzing policy effect on the poverty line (see Table5).

Table5: Pre and Post Simulations Poverty Lines

Poverty Line (CFAF/year)					
Base	Sim1	Sim2	Gap 1/2	Sim3	Sim4
143080.01	145776.31	145020.35		143208.21	143774.04

Variation	1.88%	1.36%	-0.52 %	0.09%	0.49%

Source : Figures computed by the authors

It appears from the four simulations that the poverty line is more sensitive for the first groups of policies. As shown in Table 2, the fall in the world export prices of oil and groundnut generates an increase in all prices excluding the prices of vegetal oil. This results in a marginal increase in the poverty line (0.09% and 0.49%). It is also important to note that the stronger the fall in the world prices the higher the variation of the poverty line. The increases in the poverty line will generate a negative effect on the poverty indices. If we isolate the elimination of the special import tax on edible oils (difference between simulation 1 and simulation 2), the poverty line decreases by 0.52%. The price effect of this policy will generate favorable on the poverty indices. We first present the poverty indices changes for the first two policy reforms in Table 6 and Figure 3.

Table 6: Poverty Indexes for the First Two Simulations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	SEN
Sim 1	FGT0	2.58%	1.72%	1.55%	1.47%	2.28%	6.25%	4.52%	2.66%
	FGT1	5.83%	3.51%	4.57%	3.58%	5.26%	3.50%	6.19%	4.84%
	FGT2	7.77%	5.10%	6.42%	5.02%	7.11%	3.44%	7.82%	6.48%
Sim 2	FGT0	2.44%	1.24%	1.55%	1.47%	1.93%	6.25%	3.64%	2.39%
	FGT1	5.13%	2.54%	4.02%	2.84%	4.58%	2.45%	4.37%	4.03%
	FGT2	6.82%	3.88%	5.62%	4.04%	6.19%	2.31%	5.57%	5.46%
Smulation 2 vs 1	FGT0	*-0.13%*	*-0.47%*	*0.00%*	*0.00%*	*-0.35%*	*0.00%*	*-0.84%*	*-0.26%*
	FGT1	*-0.66%*	*-0.93%*	*-0.52%*	*-0.72%*	*-0.65%*	*-1.01%*	*-1.71%*	*-0.77%*
	FGT2	*-0.88%*	*-1.16%*	*-0.75%*	*-0.93%*	*-0.86%*	*-1.09%*	*-2.08%*	*-0.96%*

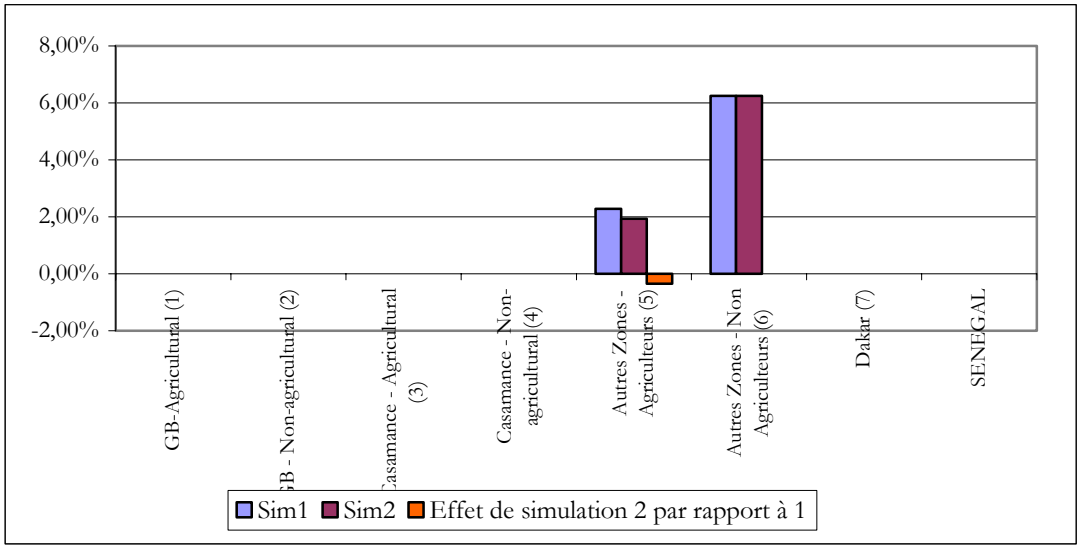
Source : Figures computed by the authors on the basis of ESAM 1995 with DAD 4.3 and GAMS *Ide software.*

In the context of the first simulation, poverty not only to increase nationally but also in all the sub-groups studied. Poverty incidence in Senegal increases by 2.66%. The non-agricultural households of the other producing regions exhibit the highest poverty rate increase (6.25%). Farmers residing in these regions experience an increase just below the national change (2.28%). On the other hand, in the groundnut basin and Casamance, agricultural households appear to have

less negatively affected by this policy than the agricultural households of other regions. When poverty aversion parameter increases, the amplitude of the negative impact is amplified with the exception of the non-agricultural household group residing in the other regions (6). As it appears, the consequence of this policy is an increase in the number of poor with aggravated poverty depth and inequalities among the poorest groups. Lastly, the Dakar households, suffer more then the national average (4.52%, 6.19% and 6.48% respectively). This can be explained by the fact that the households of this group are wage earners and both wages decrease.

When looking at the results of the second simulation it appears that its effects are more or less the same as in simulation 1. However, when isolating the specific import tax component we observe beneficial effects of this policy. This holds for all groups for poverty depth and severity. When combining the policies as is the case for simulation 2 we note that the positive effect just highlighted attenuates the negative impacts observed in simulation 1.

Figure 3 : Effects of Simulations 1 and 2 on FGT0 and the Impact of Suppressing the Specific Tax.



Source : Figures computed by the authors on the basis of ESAM 1995 with DAD 4.3 and GAMS *Ide software.*

The cause of poverty increase is a rather direct one. It is indeed due to both an increase in the poverty line and a decrease in agricultural capital payment as well as the decrease of both

unqualified and non qualified wages. These factor payments are the most widespread source of income of households. As demonstrated in the previous section, the reform is favorable to the "Other Industries" and "Mining Industries" where the poor are not necessarily well represented. Thus, this common external tariff and VAT harmonization policy appears to have a negative impact both at the national level and on most of the population sub-groups analyzed. The suppression of the specific tax on edible oil imports attenuates this negative impact although the Dakar households seem to have benefited most from this measure.

Moving on to the second set of simulations which are presented Table 7 we note only slight increases for incidence at the national level (0.08%) and the Casamance households headed by farmers (0.71%) for the third simulation. This negative effect tends to be stronger where a poverty aversion parameter increases with the exception of group 3 (Casamance farmers) and 6 (other regions non-farmers). These variations, however, remain marginal and partly reflect the slight effect on the poverty line.

Table 7: Poverty Indexes and Post Simulations 3 and 4 Variation

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	SEN
Sim 3	*FGT0*	*0.00%*	*0.00%*	*0.71%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.08%*
	FGT1	*0.28%*	*0.00%*	*0.22%*	*0.06%*	*0.24%*	*0.00%*	*0.01%*	*0.16%*
	FGT2	*0.36%*	*0.05%*	*0.29%*	*0.10%*	*0.32%*	*-0.02%*	*0.01%*	*0.23%*
Sim 4	*FGT0*	*0.85%*	*-0.66%*	*0.71%*	*0.00%*	*0.49%*	*0.13%*	*-0.49%*	*0.25%*
	FGT1	*1.57%*	*-0.07%*	*1.22%*	*0.27%*	*1.36%*	*-0.11%*	*-0.11%*	*0.89%*
	FGT2	*2.06%*	*0.19%*	*1.65%*	*0.49%*	*1.83%*	*-0.22%*	*-0.11%*	*1.29%*

Source : Figures computed by the authors on the basis of ESAM 1995 with DAD 4.3 and GAMS *Ide software.*

Simulation 4 is similar to simulation 3 but with stronger amplitude. The impact of this shock on the Senegalese economy translates into a slight 0.25% increase in poverty headcount at the national level. The agricultural households residing in groundnut-producing regions (group 1 and 3) appear to be most negatively affected by this shock though the increase in poverty rate never exceeded 1%. Yet, the poverty effects of this shock variables between sub-groups. In fact, the Dakar households and the non-agricultural households living in the groundnut basin (group 2) see

their poverty rates decrease (0.49% and 0.66% respectively). The same downward trend is observed in poverty depth and severity indices for the Dakar households. For group 2 the trend is reversed when using the severity index and for group 6 the negative poverty headcount change becomes a decrease of depth and severity.

Thus, simulations 3 and 4 characterizing an exogenous shock on the Senegalese economy through a fall in the world export prices seem to have marginal and mixed effects on poverty. It is important to point out that most of the negative effects of these two external shocks are absorbed by *SONACOS* whose earnings decrease significantly. As producers are paid a fixed price for their groundnut production, they are not exposed to the volatility of international price fluctuations. It is clear that if private stocking companies (PSC) opted for a lower producer price in order to adjust to the drop in world prices, the negative effects will then be fully or partially transmitted onto the producers[24]. Let's now analyze the effects of these policies or shocks on inequality at the national level and sub- groups. The results obtained are presented in

Table 8.

Table 8 : Post Simulations Variation of the Gini Index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	SEN	Inter-groups	Intra-group
Sim 1	*0.00%*	*-0.51%*	*-0.08%*	*-0.35%*	*-0.04%*	*-0.57%*	*-0.21%*	*0.12%*	*0.18%*	*-0.14%*
Sim 2	*0.00%*	*-0.50%*	*-0.08%*	*-0.34%*	*-0.04%*	*-0.57%*	*-0.21%*	*0.14%*	*0.20%*	*-0.12%*
Sim 2/Sim 1	*0.00%*	*0.01%*	*0.00%*	*0.01%*	*0.00%*	*0.01%*	*0.00%*	*0.02%*	*0.03%*	*0.01%*
Sim 3	*0.00%*	*0.00%*	*-0.01%*	*0.01%*	*0.00%*	*-0.01%*	*0.00%*	*0.04%*	*0.04%*	*0.01%*
Sim 4	*0.00%*	*0.00%*	*-0.04%*	*0.07%*	*-0.03%*	*-0.06%*	*0.00%*	*0.22%*	*0.25%*	*0.09%*

Source : ESAM 1995, computed with DAD 4.2 and GAMS *Ide software.*

First, we observed an increase Gini index at the national level for the first and second simulations but a reduction in inequality for all groups (except group 1 with no change). These results are a consequence of a reduction of intra-group inequality (-0.14% for simulation 1 and -0.12% for

[24] For a detailed description of the impact of a lower producer price the reader can refer to Boccanfuso, Cabral and Savard (2005) in which this specific policy was analyzed. One of the surprising results of this price change is that the impacts are much more diffuse than those anticipated i.e. urban households are strongly affected along with agricultural producers.

simulation 2) and an increase in inter-group of 0.18% and 0.20% for simulation 1 and 2 respectively. The strongest decrease is observed for group 6 for both simulations (1 and 2) at -0.57%. The isolated specific import duty on edible oil produces only slight increase in inequality for three groups (2, 4 and 6) and at the national level. For the last two simulations, they have a very weak impact on the Gini index. The strongest effect is observed at the national level for simulation 4 where the inequality increases by 0.22%. For the decomposition analysis we have the strongest increase for group 4 (Non-farm Casamance) and strongest decrease for group 6 (Non-farm other regions) at -0.06%. These last two effects are for simulation four.

VI- CONCLUSION

Most actors of the sector agree to reducing distortion in the groundnut producing sector to improve the performance of the sector. However, much tension prevails on appropriate reforms and approaches to implement. The mitigated effects of the privatization of SONAGRAINES certainly contribute to keeping tensions alive. Analyzing poverty and distributional with a CGE-IMH can help to shed some light on some of the policies being debated as part of the liberalization process of the sector (Boccanfuso *et al* (2003b)).

Within the model developed for this paper, we have focused on the price-effects linked to recent and ongoing tariff affecting the groundnut industry directly or indirectly. An important one is the elimination of the specific tax protecting *SONACOS* from foreign competition but which, on the other hand, imposes higher prices for vegetal oil consumption in Senegal. It is difficult in principle to know whether the final effect of this reform will be positive or negative. In our analysis, we have assumed that *SONACOS* will maintain its employment and producer price levels; given these hypothesis, we observed that this policy is favorable to all household groups although only marginally. On the other hand the tariff reform and VAT reform seems to produce negative effect at the macro and micro levels.

With regards to the second set of simulation, we have obtained relatively weak effects although negative for most rural groups. However the *SONACOS* is quit negatively affected and if it would be forced to balance its budget, it is likely that the negative effects of this policy would be transmitted onto the producers via a fall in groundnut purchase prices. In this case the negative effect on rural households is likely to be even stronger.

In conclusion, we can state that the removal of the specific import tax on edible oil on the policy agenda would be positive for the households since the price-effect seems to dominate the income-effect. However, it does not benefit *SONACOS* for which there is a fall in its income and production. Yet, let's not forget that we have assumed that *SONACOS* will maintain all of its employees and assuming a scenario in which *SONACOS* lays off some employees the positive effect could be mitigated albeit to a small degree as SONACOS does not employ a large number of workers. Therefore, it is unlikely that the effect will be strong.

For the second group of simulations, it is very interesting to observe that the fixed producer price partly protects producers against the volatility in world prices. As we mentioned we did not analyze the case of a price change to groundnut producer as this was extensively analyzed in Boccanfuso *et al* (2005) but they clearly demonstrated wide spread negative effect of decreasing producer price to increase income of SONACOS. It is also important to mention at this point that the negative effect of *SONACOS*' deficit is not fully captured in these scenarios. This effect is felt through a fall in the Government revenue which is expected to absorb *SONACOS*' deficit and subsequently reduce its investments and hence the positive externalities associated with these spending. Modeling public expenditure externalities such as Savard and Adjovi (1998) for Benin would certainly have yielded stronger negative effects. This analysis is grounds for extension of this analysis.

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VIII- APPENDICES

Table 9: Structure of Social Accounting Matrix Key-Variables

	Output	Value-Added	Exports	Imports	Invest-ment	Hsld Cons.	Taxes	Import Duties
Agriculture	13.6	16.6	4.5	14.6	14.6	28.2	1.6	16.2
Fishing	3.9	2.4	4.2	1.1	7.3	0.3	0.4	0.0
Groundnut	3.0	3.5	1.6	0.0	6.4	1.0	0.0	0.0
SONACOS	2.2	0.4	6.8	2.7	1.1	2.3	3.9	4.9
Other Food Indust.	12.3	6.8	18.3	6.9	15.0	15.0	14.7	20.9
Mining Industries	1.5	1.5	4.9	5.5	1.5	0.2	0.3	0.4
Other Industries	22.9	14.1	33.6	50.2	44.3	22.4	66.4	57.8
Other Services	33.9	46.1	26.2	19.0	9.7	30.6	12.7	0.0
Public Services	6.6	8.6	0.0	0.0	0.0	0.0	0.0	0.0
Total	100	100	100	100	100	100	100	100

Sources : SAM built by authors.

Table 10: Representativeness of Target Groups

	Frequencies	Percentage	Cumulative %
Groundnut Basin-Agric.	157234	20.2	20.2
Groundnut Basin–Non-Agric.	164960	21.2	41.4
Casamance - Agric.	57287	7.4	48.8
Casamance – Non-agric.	42222	5.4	54.2
Other Regions - Agric.	104604	13.4	67.6
Other Regions – Non-agric.	64143	8.2	75.9
Dakar	187764	24.1	100.0
Senegalese Total	778214	100.0	

Source : ESAM 95

Table 11 : Distribution of Agricultural Incomes in Groundnut-Producing Regions

		Non-agric head of household	Agric. Head of household
Groundnut-producing regions	**Groundnut Basin**	49.4%	50.6%
	Casamance	42.4%	57.6%
	Other groundnut- regions	38.1%	61.9%
Dakar		98.9%	1.1%
Senegalese Households Total		58.7%	41.3%

Source : ESAM 95

Table 12: Definition of Model Variables

Variables	Definition
s	Qualified Salary
sn	Unqualified Salary
yg	Government Revenue
sg	Government Savings
ye	Company Incomes
yops	Private Stocking Company Incomes (OPS)
it	Total Investment
PIB	Gross Domestic Product
e	Exchange Rate
Ysonacos	Sonacos Company Income

Variables	Definition
pq	Market Price
pfob	Free on Board Price
exd	Demand for Exports
pp	Groundnut Producer Prices
ps	Price paid for Groundnut by SONACOS
ld	Demand for Employment
Va	Sectoral Value-Added
Q	Total Domestic Demand
xs	Sectoral Production
ci	Intermediate Consumptions
di	Sectoral Demand for Intermediate Goods
ccii	Total Consumption of Intermediate Goods by SONACOS
dia	Groundnut Consumption by SONACOS
c	(Aggregated) Household Consumption
r	Rate of Return on Capital