Effects of Tariff Reform on Sudan's Economy: Applied General Equilibrium Analysis[1]

By

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Abstract

Import tariff reduction is the main policy tool recommended by the IMF and the World Bank for trade liberalization as it would open countries to international trade competition. Its far affecting effects can be captured by computable general equilibrium (CGE) model based on a social accounting matrix (SAM). This paper had used the CGE model to simulate the impact of import tariff and activity tax reduction on the GDP, balance of trade, total absorption, investments and sectoral output, imports and exports levels of Sudan.

The simulations results indicated that the reduction of import tariff and/or activity tax by 50% and 100%, reflecting compliance of the Government of Sudan to move to zero tariff rate, would improve the performance of the GDP despite the consequent deterioration in the balance of trade. The results also indicated that the reduction of import tariff had more dominant effect on the GDP and balance of trade than that of activity tax given their differential role in government budget revenue. In addition, the model results revealed that the elimination of import tariff and/or activity tax

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would reduce government revenue with a concomitant requirement for an increase in direct tax levies to compensate for the expected losses in government revenue. Furthermore, the model results showed that the reduction of import tariff would increase the consumption of final goods rather than of intermediate goods and this will not help the economic sectors activities depending heavily on imported inputs.

Trade Liberalization Policy in Sudan

Sudan adopted the stabilization and adjustment programs supported by IMF in 1978 to improve its macroeconomic imbalances (Banaga, 2002). The adopted economic programs during the 1980's included the Economic Recovery Program (1978-1985), and the Four-Year Economic Salvation program (1986-1989). Since the economy remained weak, the Three National Economic Salvation Program (1989-1992) and the Comprehensive National Strategy program (1992-2002) were introduced in the 1990's to declare "full liberalization" of the economy transferring it from a centrally planned into a market oriented economy. The new policy reforms included liberalization of trade, more flexible exchange rate, removal of subsides, restructuring of taxes and privatization (Ministry of Finance and Economic Planning, 1990).

Import tariff (a tax imposed on an imported commodity) is the main policy tool recommended by the IMF and the World Bank for trade liberalization since tariff reduction is expected to open countries to international trade competition (Devarajan *et al*., 1994). The activity tax (a term to indicate net indirect tax on production sectors) is considered as a source of price distortions, as it affects the price of both producers and consumers.

Sudan applied an 8-digit tariff nomenclature according to the Harmonized Commodity and Coding System (HS 96) as of July 1992. The Sudan tariff consists of two columns:

1. The general duty rates, in which the customs duty rates are ad valorem duty rates applied to the c.i.f. import value.
2. The preference duty rates provide tariff exemptions to investment projects that encourage development of export capacities of the country (Article 10 of the Encouragement of Investment Act of 1996). The preferential duties were applied to many agreements such as the Interregional Agreements of the Arab Free-Trade Zone, the Regional and Sub-Regional Agreements of the Common Market for East and South Africa (COMESA), and for the Bilateral Agreements such as those between Sudan and Egypt, Sudan and Saudi Arabia, Sudan and Syria and between Sudan and Jordon.

Therefore, Sudan being committed to these agreements has to reduce its import tariff gradually into a zero tariff. Such tariff and tax policy actions had advantages and disadvantages to the economy of Sudan.

Objectives

The main objective of this paper is to assess the impact of tax (import tariff and activity tax) liberalization on Sudan economy. Specifically, it analyzed the effect of import tariff reduction and activity tax reduction on Gross Domestic Product (GDP), balance of trade, total absorption, investments (fixed investment and stock change) and sectoral output, imports and exports levels.

Analytical Framework

From a research point of view, the comprehensive analysis of trade liberalization and macroeconomic shocks can be captured within the context of a computable general equilibrium (CGE) model using the social accounting matrix (SAM). SAM is a comprehensive, economy-wide national database presented in a square matrix containing information about the flow of resources associated with transactions taking place between economic agents in a certain economy during a certain period (Löfgren *et al*., 2002).

The CGE model provides a comprehensive macro-economic framework to simulate market-oriented economies comprising three actors, the consumers, the producers, and the markets. The consumers maximize utilities depending on their endowments and demand decision for commodities and services; the producers maximize profits based on their demand for inputs and supply of outputs and services. Consumers demand and producers supply of commodities and services clear the markets by equilibrium prices.

This paper used the standard computable general equilibrium model, which was developed by the International Food Policy Research Institute (IFPRI) (Löfgren *et al*., 2002). The model specification followed the neoclassical-structuralist modeling tradition presented in Dervis *et al*. (1982). The model separated between production activities and commodities since activities were assumed to consist of producers who were behaviorally distinct in the model. The commodity account corresponded to the domestic market for all products, with supplies coming from producers and imports. Furthermore, the distinction permitted activities that produce multiple commodities and commodities produced by multiple activities.

In this paper, the Sudan CGE model is based on Sudan SAM for year 2000 (Table 1). There are six main accounts in Sudan SAM including factors of production, institutions, activities, commodities, rest of the world and the aggregate capital accounts. Given data limitations, each account was disaggregated to reflect more detailed structural classification of the economy and to meet policy modeling simulations needs. The factor account was divided into labor and capital, while the institutions account was divided into households and government. The activities account comprised the four agricultural, industrial, trade and services sectors, and the commodities account consisted of four groups (agricultural, industrial, trade and services sectors).

Table 1: Social Accounting Matrix of Sudan Economy for Year 2000(SD[5] Billion)

Receipts / Expenses		Production factor		Current accounts		Capit. acc.	Production activities account				Goods and services account				Rest of the world	total
		Labor	capital	Hous.	Gov.		Agric.	industry	trade	Service	Agric.	industry	trade	service		
Production factor account	Labor						218.7	131.7	201.2	356.1						907.8
	Capital						979.5	310.1	626.2	459.7						2375.6
Current accounts	Household	907.4	2221.8		32.8											3162.0
	Govern.		153.8	39.1			5.2	34.5	11.9	-0.5	16.8	10.6	30.6	19.6		321.6
Capital account				95.3	104.3										189.2	388.3
Production activities	Agric.										1524.4					1524.4
	Industry											1060.9				1060.9
	Trade												1126.3			1126.3
	Services													1291.3		1291.3
Goods and services account	Agric.			872.9	11.6	37.3	132.6	259.2	90.5	218.7					91.1	1713.9
	Industry			456.1	1.5	57.1	16.9	131.6	42.7	95.9					357.0	1158.9
	Trade			607.1	2.9	215.2	99.8	136.1	102.4	88.0					5.5	1257.0
	Services			1004.4	168.6	79.1	71.5	57.6	51.3	73.4					36.6	1542.6
Rest of the world acc.		0.4		87.2							172.7	87.5	100.1	231.7		679.5
Total		907.8	2375.6	3162	321.6	388.8	1524.4	1060.9	1126.3	1291.3	1713.9	1158.9	1257.0	1542.6	679.5	

Source: Elbushra (2007)

[5] SD denotes Sudanese Diner, with one US$ = 257.1 SD in year 2000.

Production is carried out by activities that were assumed to maximize profits subject to their technology limitations. In this model, the activity level is assumed to have a constant elasticity of substitution (CES) function of value added and aggregate intermediate input use. CES function was also used to specify the value added and factor demand functions. The Armington function was employed to express composite commodities supplied domestically by domestic and imported inputs with imperfect substitution between them. The Armington function also implied that consumers have chosen an optimum mix of imports and domestic products, which maximize their utility depending on their relative prices as captured by the import domestic demand function.

The constant elasticity of transformation (CET) function was applied to total domestic output for domestic sale or for exports with imperfect transformation between the two, combining them optimally in the export domestic supply function.

Three model closure rules namely, government balance, external balance and saving-investment balance were applied. The government closure, determines the manner of government modeling. The government savings was assumed to be flexible, while direct tax rates were assumed to be fixed in this model. The external balance closure defined how the domestic economy would interact with the rest of the world. In this model, foreign savings was assumed to be fixed while the real exchange rate was taken as the equilibrating variable. For the savings-investment balance, the model was investment–driven indicating a fixed investment and a flexible savings variable.

The model mathematical presentation is presented in appendix (1).The model is calibrated[6] using some elasticity values and other parameter values from the SAM data. The common rule of Sadoulet and Janvry (1995) in CGE modeling was adopted by using approximate values for elasticity of substitution since there are no published elasticities for Sudan.

Sudan CGE model was implemented using General Algebraic Modeling System (GAMS) software that computed both equilibrium prices and quantities and their percentage changes in response to policy shocks.

Model Simulations and Results

In line with simulations applied in Uganda CGE (Mugisha, 1999), Bangladesh CGE (Norman, 2002) and Nepal CGE (Cockburn, 2002), the performed simulations for Sudan included reduction of import tariffs and activity tax by 50% and 100%. This complied with the World Trade Organization (WTO) regulations to reform tax policy (scenarios 1 to 5).

One critical tax policy issue in developing countries is the revenue implications of the tariff reduction given its high share in the public revenue. Given this situation, it would be imperative to look for alternatives for compensation of such budget revenue reduction. An increase in the direct tax was seen as a second best approach. As such, the model opted for estimating the expected increase in the direct taxes for offsetting the effect of the reduction of tariff revenue to prevent deterioration of government revenue and of the balance of payment (Devarajan *et al*, 1994).

In 2000, Sudan import tariff and activity tax represented 24% and 16% of the total government income respectively. Reduction of these taxes would

[6] Calibration of the CGE model to the SAM requires the determination of parameter values for the various behavioral functions in the model such that the model reproduces the benchmark data set as equilibrium solution.

reduce government savings, which would negatively affect total investment. Therefore, a possible compensating source would be to increase the direct tax (scenarios 6 to 8), which constituted about 12% of total government revenue in 2000.

Based on the above, the following eight scenarios have been developed (Table 2).

Table 2: Scenario Codes and Definitions

Scenario Codes	Scenario Definitions
Scenario 1	50% reduction of import tariff (Partial liberalization)
Scenario 2	Full liberalization of import tariff with fixed government saving
Scenario 3	50% reduction of activity tax (Partial liberalization)
Scenario 4	Full liberalization of activity tax with fixed government saving
Scenario 5	full liberalization of import tariff and activity tax
Scenario 6	full liberalization of import tariff and flex government savings
Scenario 7	full liberalization of activity tax and flex government savings
Scenario 8	full liberalization of import tariff and activity tax with flex government savings

Source: Author calculation

The model results (Table 3) revealed that reduction of the import tariff (scenario 1 and 2) would improve the GDP irrespective of the deterioration in the balance of trade, due to the improvement in the total absorption, which was achieved by low cost imports. The slight decrease in the fixed investments was due to the decrease in government savings brought about by the decrease in government income as was expected.

The Table also indicated that reduction of import tariff would lead to an increase in consumption of final goods rather than that of intermediate ones, being captured by decreased output of the trade and the services sectors. Thus, the agricultural and industrial sectors would draw more resources from the other two sectors and would increase their domestic outputs levels. On the other hand, the greatest increase in exports would take place in the trade sector, by virtue of its smaller share in total exports in year 2000 (less than 1.13%).

Table 3: Impact of Import Tariff Reduction on Sudan Economy

Item	Base value (10 Billion SD)	Percentage change from the base	
1. Macroeconomic Variables		**scen 1**	**scen 2**
Government savings	10.45	-32.47	-69.86
Total Absorption	351.29	0.03	0.02
Fixed Investment	32.7	-0.6	-1.29
Stock change	6.23	0.06	0.13
GDP	328.18	1.04	2.18
Balance of trade	-17.97	1.84	4.01
2. Total imports	**67.03**	**3.03**	**6.45**
Agriculture	18.97	2.06	4.17
Industry	9.83	2.81	5.81
Trade	13.09	7.75	17.39
Service	25.14	1.39	2.73
3. Total exports	**49.06**	**3.47**	**7.35**
Agriculture	9.12	3.37	7.18
Industry	35.69	3.44	7.28
Trade	0.57	4.81	10.43
Service	3.68	3.73	7.95
4. Total output	**500.26**	**0.084**	**0.17**
Agriculture	152.42	0.01	0.02
Industry	106.1	1.00	2.12
Trade	112.64	-0.41	-0.89
Service	129.11	-0.14	-0.31

Source: Model Results

The model results (Table 4) showed that the reduction of activity tax (scenario 3 and 4) would increase the GDP, as it would improve prices to the producers and consumers with increased total absorption. However, the balance of trade would deteriorate because of the slight increase in exports values, which was not sufficient to offset the subsequent relatively larger increases in imports value. Total exports and output would increase mainly due to increases in exports of the industrial sector, being the most affected sector contributing about 67% of total activity tax payments in 2000. As a result, the switch of the production resources from other sectors would reduce their output and exports levels. When eliminating both activity tax and import tariff (scenario 5), the GDP, total and sectoral imports and exports would improve much better despite the pronounced deterioration in the balance of trade and government savings.

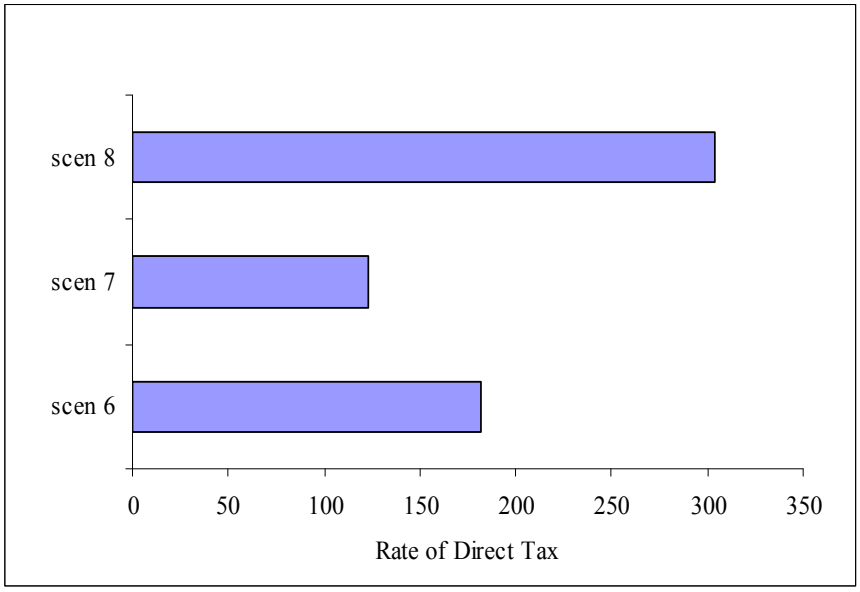
Table 4: Impact of Activity Tax Reduction on Sudan Economy

Variables	Base value (10 Billion SD)	Percentage change from the base		
1. Macroeconomic Variables		**scen 3**	**scen 4**	**scen 5**
Government Savings	10.45	-23.6	-47.10	-118.5
Total Absorption	351.29	0.02	0.04	0.04
Fixed Investment	32.7	-0.03	-0.07	-1.35
Stock change	6.23	-0.13	-0.26	-0.13
GDP	328.18	0.82	1.64	3.85
Balance of Trade	-17.97	0.19	0.37	4.40
2. Total imports	**67.03**	**0.44**	**0.87**	**7.35**
Agriculture	18.97	0.54	1.07	5.25
Industry	9.83	0.02	0.05	5.86
Trade	13.09	0.45	0.90	18.42
Service	25.14	0.52	1.03	3.76
3. Total exports	**49.06**	**0.53**	**1.05**	**8.43**
Agriculture	9.12	-1.41	-2.79	4.28
Industry	35.69	1.30	2.58	9.96
Trade	0.57	-1.10	-2.16	8.10
Service	3.68	-1.90	-3.74	3.94
4. Total output	**500.26**	**0.06**	**0.11**	**0.28**
Agriculture	152.42	-0.11	-0.21	-0.20
Industry	106.1	0.70	1.38	3.52
Trade	112.64	0.00	0.00	-0.90
Service	129.11	-0.23	-0.45	-0.78

Source: Model Results

In order to maintain the government revenue and prevent it from deterioration, the direct tax would increase by 182.2% with full reduction of import tariff, 123.3% with full reduction of activity tax and 303.7% with full reduction of both import tariff and activity tax (Figure 1).

Figure 1: Impact of Import Tariff and Activity Tax Reduction on the Rate of Direct Tax to Sustain Government Savings



The study concluded that The reduction of import tariff had greater effect on improving the performance of the GDP despite deterioration in the balance of trade than that of the reduction of activity tax. In addition, the reduction of import tariff had more dominance on the balance of trade than on the GDP, while the opposite was true for the activity tax. It was also revealed that the elimination of both import tariff and activity tax would increase the GDP more than each policy alone, with a need for higher direct tax rate to compensate for government revenue losses. Moreover, the reduction of import tariff would increase the consumption of final goods rather than of intermediate ones.

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Appendix 1: Mathematical Model Statement

The model equations are classified into four blocks: prices, production and trade block, institutions block and system constraint block.

Prices Block

$$PM_c = pwm_c * (1 + tm_c) * EXR$$

$$PE_c = pwm_c * (1 - te_c) * EXR$$

$$PX_c = (PDS_c * QD_c + PE_c * QE_c) / QX_c$$

$$PINTA_a = \sum PQ_c * ica_{c\,a}$$

$$CPI = \sum PQ_c * cwts_c$$

Production and Trade Block

$$QA_a = \alpha_a^a * (\delta_a^a * QVA_a^{-\rho_a^a} + (1 - \delta_a^a) * QINTA_a^{-\rho_a^a})^{-1/\rho_a^a}$$

For the CES function

$$\sigma = 1/1 + \rho$$

$$QVA_a = \alpha_a^{va} * (\sum_{f \in F} \delta_{f\,a}^{va} * QF_{f\,a}^{-\rho_a^{va}})^{-1/\rho_a^{va}}$$

$$WF_F * WFDIST_{f\,a} = PVA_a(1 - tva_a) * QVA_a * \sum_{f \in F} \delta_{f\,a}^{va} * QF_{fa}^{-\rho_a^{va}})^{-1} * \delta_{fa}^{va} * QF_{f\,a}^{-p_a^{va}-1}$$

$$QQ_c = \alpha_c^q * (\delta_c^q * QM_c^{-p_c^q} + (1 - \delta_c^q) * QD_C^{-\rho_c^q})^{-1/\rho_c^q}$$

$$QM_c \div QD_c = \left(PDD_c / PM_c * (\delta_c^q / 1 - \delta_c^q)\right)^{1/1 + p_c^q}$$

$$QX_c = \alpha_c^t * (\delta_c^t * QE_c^{p_c^T} + (1 - \delta_c^t) * QD_C^{-\rho_c^t})^{1/\rho_c^t}$$

$$QE_c \div QD_c = \left(PE_c / PDS_c * (1 - \delta_c^t / \delta_c^t)\right)^{1/p_c^t - 1}$$

For CET function

$$\Omega = 1/(1 + \rho)$$

Institutional Block

$$YF_f = \sum WF_f * WFDIST_{f\,a} * QF_{f\,a}$$

$$YIF_{i\,f} = shif_{i\,f} * ((1 - tf_f) * YF_f - trnsfr_{row\,f} * EXR)$$

$$YI_h = \sum YIF_{h\,f} + trnsf_{h\,gov} + trnsfr_{h\,row} * EXR$$

$$EH_h = (1 - \sum shii_{ih}) * (1 - MPS_i) * (1 - TINS_h) * YI_h$$

$$YG = \sum TINS_i * YI_i + \sum tf_f * YF_f + \sum tva_a * PVA_a * QVA_a + \sum ta_a * PA_a * QA_a +$$
$$\sum tm_c * pwm_c * QM_c * EXR + \sum tq_a * PQ_a * QQ_a + \sum YIF_{gov\,f} + transf_{gov\,row} * EXR$$

$$EG = \sum PQ_c * QG_c + \sum trnsfr_{i\,gov} + GSAV$$

System Constraint Block (Model Closures)

$$\sum QF_{f\,a} = QFS_f$$

$$\sum pwm_c * QM_c + \sum trnsfr_{row\,f} = pwe_c * QE_c + \sum trnsfr_{i\,row} + FSAV$$

$$S = I$$

$$S = \sum S_i + S_g + S_f * EXR$$

So

$$\sum MPS_i * (1 - TINS_i) * YI_i + GSAV + EXR * FSAV = \sum PQ_c * QINV_c + \sum PQ_c * qdst_c$$

Where

Item	Name of the Item
ta(A)	rate of tax on producer gross output value
te(C)	rate of tax on exports
tf(F)	rate of direct tax on factors
tm(C)	rate of import tariff
tq(C)	rate of sales tax
tva(A)	rate of value-added tax
EG	government expenditures
QQ_c	Quantity of exports
EH_h	consumption spending for household
$QF_{f\,a}$	Quantity demanded of factor f from activity a
EXR	exchange rate (LCU per unit of FCU)

QG	government consumption demand for commodity
QH_{ch}	Quantity consumed of commodity c by household h
GSAV	government savings
$QINT_{ac}$	Quantity of commodity c as intermediate input to activity a
$QINV_c$	Quantity of investment demand for commodity
MPS_i	marginal propensity to save for household
QM_c	Quantity of imports of commodity
PA_a	Activity price (unit gross revenue)
QQ_c	Quantity of goods supplied to domestic market (composite supply)
PDD_c	Demand price for commodity produced and sold domestically
PDS_c	supply price for commodity produced and sold domestically
QX_c	aggregated quantity of domestic output of commodity
PE_c	export world price (domestic currency)
$QXAC_{ac}$	Quantity of output of commodity c from activity a
PM_c	import world price (domestic currency)
TABS	total nominal absorption
PQ_c	composite commodity price
$trnsf_{h\,\mathrm{gov}}$	transfers from domestic government institution to household institution
$trnsf_{h\,\mathrm{rov}}$	transfers from domestic rest of the world to household institution
PVA_a	Value-added price
WF_F	economy-wide factor wage
PX_c	aggregate producer price for commodity
YIF_{if}	Transfer of income to domestic institution I from factor f
$PXAC_{ac}$	producer price of commodity c for activity a
YG	government revenue
QA_a	Quantity (level) of activity *a*
YI	Income of domestic non-government institution
QD_c	Quantity sold domestically of domestic output
FSAV	foreign savings (FCU)
$TINS_h$	direct tax rate for domestic institution i or factor f
$WFDIST_{fa}$	wage distortion factor for factor f in activity a
IADJ	investment adjustment factor
pwm_c	World price of import (in hard currency)
pwe_c	World price of export (in hard currency)