Impact of World Cotton Markets Liberalization on Cotton Trade of Africa: A Case Study of Sudan

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Abstract: In this paper, the impact of full liberalization of world cotton markets on Sudan and some selected African countries was estimated. Last version of Agricultural Trade Policy Simulation Model (ATPSM) was ap¬plied after updating cotton data for Sudan. The results of the simulation are consistent with expectation that the liberalization of cotton markets will lead to an increase in the world market price of cotton. The higher world market prices of cotton have a positive impact on the production and trade of the selected countries. Also, a moderate gain for the cotton producers and total welfare is registered. The paper concluded that the removal of all distorted policies from cotton markets could bring a greater benefit for Sudan and African countries in terms of production and trade. Also, reforming of cotton markets in Sudan and African countries is vital to increase the gain from a liberalized, competitive world cotton market.

Keywords: World Cotton market liberalization, Sudan cotton trade, Partial equilibrium analysis

1 Introduction

Agricultural markets in most countries have been the object of considerable government controls and other interventions. For instance, it is well known that in the OECD countries such policies result in annual transfers to farmers in the vicinity of $290 billion, with subsidies of various types making up in some cases 60-80 percent of farmers' revenues (Poonyth et al. 2004). These interventions have resulted in excess production by many subsidizing countries, depressed world prices, and frequent trade disputes.

For decades cotton has been subjected to various marketing and trade interventions. It was claimed that cotton subsidies, both domestic and export, granted by some countries, have led to artificially depressed world market prices and thus negatively impacted both export earnings as well as production levels in non-subsidizing countries. U.S cotton subsidies have been the focus of attention for many researchers e.g. ICAC (2002), Sumner (2003) and Goreux (2004). Cotton production is also subsidized in other countries including China, EU, India, Egypt, Mexico and Turkey. The total U.S. support for cotton production and for cotton exports in 2004/05 amounted to $2.2 billion and $0.45 billion, respectively, while for the rest of the world production support and export subsidy of cotton are estimated at $2.3 billion and $0.28 billion, respectively (ICAC, 2005).

In Hong Kong's ministerial conference, a decision has been taken to remove all forms of export subsidies for cotton, and the developed countries agreed to give duty and quota free access for cotton exports from least-developed countries (LDCs) from the commencement of the implementation period. Also, as an outcome for the negotiations, trade distorting domestic subsidies for cotton production must be reduced more ambitiously than under whatever general formula is agreed and that it should be implemented over a shorter period of time than generally applicable (WTO, 2005).

As cotton production and trade in Sudan and many other African countries is considered one of the major commodities that contribute a larger share to their foreign exchange earnings and livelihood of farmers, the purpose of this paper is to analyze the likely impact of complete elimination of subsidies, domestic support mechanisms and market access restrictions in the world cotton market on cotton production and trade in Sudan and some selected African countries. We present some fresh estimates of the impacts using the UNCTAD-FAO ATPSM model. The model includes the actual data of cotton production and trade for Sudan, which might give a realistic expected impact on both aspects.

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2 Cotton Production and Trade in Sudan

Cotton production in Sudan has its roots back to 1839 when it was introduced by the Turks during their colonial rule in Sudan. Then, an experiment with cotton production began in 1911 at Tayba which became a nucleus for the Gezira scheme. The construction of Sennar Dam in 1925 signaled the real take-off for commercial cotton production in Sudan.

Cotton in Sudan is mainly produced under irrigated farming system in Gezira, Rahad and Girba schemes. Also, cotton is produced in small scale under rain fed conditions. On average, Sudan cultivated annually about 486 thousand feddan with cotton and produced about 398 thousand bales of cotton lint during 1994-2005 (Table 1). The area cultivated with cotton and its production fluctuates greatly from year to year. There are many factors behind this fluctuation: First, there are the high costs of production and low productivity of cotton in Sudan e.g. cotton productivity in Sudan is about 50% of that of Egypt, 30% of Syria and sometimes it is lower than productivity in West African countries (Faki, 2006). Second, one of the major factors affecting fluctuation of cotton production in Sudan are the fluctuations of cotton prices both domestically and internationally due to domestic or international policies, which in turn affect returns to farmers.

Cotton exports from Sudan have a small share in the world cotton market as, on average, Sudan exported 70 thousand metric tons of cotton lint annually to the world markets during 1990-2005, which represented only about 1.1% of world cotton trade and 6.7% of African cotton exports. The African share in the world cotton trade was about 18% for the same period (Table 2). The figures in Table 2 indicated a wide range of fluctuations of cotton export volumes for both Sudan and Africa. But, at least there is an indication of increasing trend for the African cotton trade unlike the case of Sudan.

Cotton is one of the most important items in the lists of agricultural exports and hard currency earnings in Sudan, although its relative share in total export earnings has declined since 1999 after oil exploitation. During the period 1994-1998, cotton exports contributed, on average, about 21.5% of agricultural exports earnings and about 19% of total export earnings annually. These shares declined respectively, to 18% and 3% for agricultural exports earnings and total export earnings during the period 1999-2005 (Table 3). The drop in the contribution of cotton exports to agricultural exports is attributed to the reduction of export volume as a result of contraction in area and production, and to the lower and fluctuating world market prices of cotton. The reduction of cotton exports share in the total export earnings is connected with the recent limited share of agricultural exports in the total export earnings of Sudan after Sudan started exporting oil products in 1999.

Table 1 Cotton area, production and productivity, 1994-2005

Year	Area (000 fed.)	Production (000 bales)	Yield (Kg/fed.)
1994	303.0	249.5	514
1995	456.0	437.7	591
1996	637.0	547.1	519
1997	755.0	553.4	429
1998	474.0	461.0	564
1999	475.0	241.6	557
2000	463.0	275.4	361
2001	436.0	395.6	574
2002	351.0	378.1	512
2003	422.0	438.9	640
2004	544.0	358.4	609
2005	516.0	450.8	-

Source: Bank of Sudan Annual Reports

Table 2 Cotton lint exports of Sudan and its share in African and world cotton lint exports, 1990 – 2005 (Thousand tons)

Year	Sudan	Africa	Sudan share in Africa (%)	Sudan share in world market (%)	Africa share in world market (%)
1990	103.0	728.0	14.1	2.0	14.3
1991	86.0	756.0	11.4	1.4	12.4
1992	58.0	679.0	8.5	1.0	12.3
1993	89.0	854.0	10.4	1.5	14.4
1994	62.0	838.0	7.4	1.0	13.3
1995	45.0	815.0	5.5	0.7	13.6
1996	91.0	1108.0	8.2	1.5	18.3
1997	82.0	1219.0	6.7	1.3	20.4
1998	55.0	1239.0	4.4	1.0	22.5
1999	46.0	1131.0	4.1	0.7	18.3
2000	34.0	1094.0	3.1	0.6	18.8
2001	57.0	1073.0	5.3	0.8	16.7
2002	64.0	1433.0	4.4	1.0	22.4
2003	80.0	1393.0	5.7	1.2	21.7
2004	79.0	1425.0	5.5	1.2	22.1
2005	70.0	1445.0	4.8	1.1	22.1
Average	**70.0**	**1102.0**	**6.7**	**1.1**	**18.0**

Source: International Cotton Advisory Committee Statistics

Table 3 Cotton export value and its share in agricultural and total exports of Sudan, 1994-2005

Year	Export value (million US$)	Share in Agric export (%)	Share in total export (%)	Unit value (US$)
1994	96.90	20.5	18.4	232.4
1995	123.0	25.2	22.1	278.5
1996	128.2	23.9	20.7	266.6
1997	105.0	20.4	17.8	242.0
1998	95.5	18.0	16.0	241.0
1999	44.8	10.5	5.7	213.0
2000	53.0	14.0	2.9	222.8
2001	44.4	17.9	2.6	189.8
2002	62.2	17.1	3.2	156.5
2003	107.8	26.9	4.2	235.0
2004	93.8	19.5	2.5	264.5
2005	107.2	20.6	2.2	234.9

Sources: Bank of Sudan Annual Reports

3 Methodology

The Agricultural Trade Policy Simulation Model (ATPSM) was used for the analysis. The ATPSM is developed jointly by UNCTAD and FAO. The model is a comparative-static, multi-commodity, multi-region, partial-equilibrium global trade model designed primarily for simulating agricultural trade policies, especially in the context of the WTO Agreement on Agriculture. It can simulate the effects of a range of trade policy instruments e.g. reduction of tariff, reduction of domestic subsidies and reduction of export subsidies.

ATPSM is a deterministic (i.e. there are no stochastic shocks or other uncertainties), static, partial equilibrium model. It analyzes the effects of trade policy changes on supply and demand using a system of simultaneous equations that are characterized by a number of data and behavioral relationships designed to simulate the real world. The model solution gives estimates of the changes in trade volumes, prices and welfare indicators (Poonyth et al 2004)

The model explicitly covers 176 countries or country groups (the EU is one such country group) and a total of 36 agricultural commodities. It allows users to define groups of countries and commodities, e.g. LDCs or SSA or cotton, and applies different reduction rates (policy reforms) to selected countries and commodities.

The model is calibrated to a base period data set (average of 1999-2001), which described a world trade equilibrium in that period. In any given period observed in the real world, the domestic market will equilibrate at some prices. Once they are specified for all countries, then the model can be used to simulate alternative equilibriums under different policy regimes. This implies that for a fully specified model one needs base period values for all the quantities demanded and supplied by all countries, the values of all policy induced price wedges, as well as the elasticity of supply and demand. In ATPSM, besides the usual base period quantities and values, all policy instruments are defined in ad-valorem equivalents terms. Thus, specific tariffs are converted to ad-valorem rates and both domestic and export subsidies are expressed in their respective ad-valorem equivalents.

3.1 Model Structure and Specification

The four key variables that are part of an equilibrium accounting relationship are quantities of production, import, export and consumption, with production plus import being equal to consumption plus export. Of these, production and consumption depend on domestic prices. Imports and exports clear the world market. Domestic prices are determined as a function of world market prices and policy variables, e.g. support measures, tariffs, subsidies and quotas. The world prices are linked to domestic prices by price transmission equations that allow world price changes not to be transmitted fully to the domestic market, if that is the reality. In the version of the model utilized here these transmissions are assumed to be complete. As domestic prices are linked to world prices, the basic equilibrium variables are world prices, with domestic prices being determined by the respective policy wedges. Both demand and supply specifications account for substitution effects among commodities.

The base period equilibrium of the model can be expressed as follows (see Peters et al. 2004):

$$\sum_{i=1}^{n}\left\{D_{i,j}\left(P_{i,j,d},P_{i,\{k\},d}\right)+X_{i,j}\right\}=\sum_{i=1}^{n}\left\{S_{i,j}\left(P_{i,j,s},P_{i,\{k\},s}\right)+M_{i,j}\right\} \tag{1}$$

$$P_{i,j,d}=P_{j,w}\cdot\left(1+t_{i,j,c}\right) \tag{2}$$

$$P_{i,j,s}=P_{j,w}\cdot\left(1+t_{i,j,p}\right) \tag{3}$$

Where the subscript i denotes the country, the subscripts j and k denote commodities, D(.) and S(.) denote the domestic demand and supply functions respectively for the jth commodity in country i, M and X denote

imports and exports respectively of commodity j in country i, $P_{i,j,d}$ denotes the domestic demand price of commodity j in country i, $P_{i,j,s}$ denotes the domestic supply price of commodity j in country i, the group {k} in the subscripts of the second price terms in the demand and supply functions denote the prices of other commodities that substitute or compete for resources for commodity j in country i, n is the total number of countries that produce and trade the commodity in question, $P_{j,w}$ is the world price of commodity j, and t_c t_p denote the consumption and production tariff equivalent wedges between domestic and international prices for commodity j in country i. The endogenous variables are the quantities demanded and supplied, as well as the world prices. Exogenous variables are the demand and supply policy wedges, as well as all other variables that affect supply and demand.

Equation (1) above represents the world equilibrium in the market for commodity j in some period, while equations (2) and (3) summarize the impacts of various policies on domestic consumer and producer prices respectively.

In a fully specified model, the values for all variables in this equilibrium are observed in the base period. A new equilibrium, after some changes in the policy variables, can be computed by estimating the proportional (or percentage) changes from the base values of all endogenous variables of the base equilibrium indicated in equation (4) as follows: ^ denotes a proportional change and ΔD absolute change. Once these percentage changes are estimated, the new level values of all variables can be computed as follows:

Changes in domestic demand for commodity j in country i (see Peters et al. 2004):

$$\hat{D}_{i,j} = \frac{\Delta D_{i,j}}{D_{i,j}} = \eta_{i,j}\left[\hat{P}_{j,w} + \frac{\Delta(1+t_{i,j,c})}{(1+t_{i,j,c})}\right] + \sum_{k=1}^{K}\eta_{i,j,k}\left[\hat{P}_{k,w} + \frac{\Delta(1+t_{i,k,c})}{(1+t_{i,k,c})}\right] \tag{4}$$

where η denotes demand elasticity (own and cross) in country i, and K is the number of other commodities that substitute in consumption,

Changes in domestic supply for commodity j in country i (see Peters et al. 2004):

$$\hat{S}_{i,j} = \varepsilon_{i,j}\left[\hat{P}_{j,w} + \frac{\Delta(1+t_{i,j,p})}{(1+t_{i,j,p})}\right] + \sum_{k=1}^{K}\varepsilon_{i,j,k}\left[\hat{P}_{k,w} + \frac{\Delta(1+t_{i,k,p})}{(1+t_{i,k,p})}\right] \tag{5}$$

where $\acute{\varepsilon}$ denote the own and cross elasticities of supply of the jth commodity in country i.

The changes in imports and exports of commodity j in country i are expressed as follows (see Peters et al. 2004):

$$\Delta M_{i,j} = D_{i,j}\,\hat{D}_{i,j} - S_{i,j}\,\hat{S}_{i,j} + \Delta X_{i,j} \tag{6}$$

$$\Delta X_{i,j} = \gamma_{i,j}\Delta S_{i,j} \tag{7}$$

where Y_i is the ratio of exports to production (assumed fixed in the model).

There are four equations for the changes of the endogenous variables for each country. The export equation implies that the change in export in each market is some proportion of the change in production. This proportion is estimated by the base year ratio of exports to production, and stays fixed for the simulations. The solution to the model is obtained by making the sum of all changes in exports of the commodity from all countries, equal to the sum of all changes in imports.

3.2 Impact Indicators

The impact indicators like changes in production, demand, volume of exports and imports, and world and domestic prices are ready following a simulation run. The impact on trade revenue following a policy

change is computed for each country and commodity as the difference between changes in export earnings and import bills for the commodity in question e.g. cotton:

$$\text{Change in export earnings} = (P_w^{\,1} X^1 - P_w^{\,0} X^0) \tag{8}$$

$$\text{Change in import costs} = (P_w^{\,1} M^1 - P_w^{\,0} M^0) \tag{9}$$

where, the superscripts 0 and 1 indicate base period and simulation values, respectively.

Another key indicator is total welfare and its constituent parts, namely producer and consumer surpluses and government revenue. Total welfare is the sum of the producer surplus, consumer surplus and government revenue. For each country and commodity, changes in producer and consumer surpluses are defined as follows (see Peters et al. 2004):

$$\Delta PS = \Delta P_s \left[S^0 + 0.5(\Delta S) \right] + c\Delta U \tag{10}$$

$$\Delta CS = \Delta P_d \left[D^0 + 0.5(\Delta D) \right] \tag{11}$$

where, cΔU is the change in quota rent received, and thus added to producer surplus[1].

The change in net government revenue, the third term of total welfare, includes changes in various government revenues, notably tariff revenue, export subsidies, domestic support expenditure and change in quota rent not received by exporters.

As summary, the model generates outputs for the following variables/indicators:

- Changes in quantities - production, consumption, imports and exports
- Changes in trade values - export, import, and net trade balance
- Welfare effects - producer surplus, consumer surplus, government revenue and total welfare
- Prices - world market prices, and domestic farm and consumer prices[2]

3.3 Data Sources

The world market prices in the model have been developed using several sources e.g. IMF, FAO trade yearbook and UNCTAD price statistics. As the model includes 176 countries, the data used is for main cotton producing and trading countries; other countries are included separately in the model. The data set for cotton production and trade in Sudan has been changed to the data collected from Bank of Sudan and State Ministry of Agriculture. Then, the model has been run for complete liberalization of world cotton market. The results for Sudan and for selected African countries (major cotton traders in Africa) are presented in the next section.

4 Results and Discussion

4.1 Impact on World Market Price of Cotton

The world market price of cotton is expected to rise by 4.2% under free market condition. The increase in the world market price of cotton in this analysis using ATPSM is considered small compared to the results of other studies e.g. FAPRI (2002) found that under global agricultural trade liberalization the world market price of cotton would increase over the baseline scenario by 12.7% over a ten year period, and Sumner (2003) used a modified version of the FAPRI model and found that the removal of domestic and export subsidies on cotton by the United States would increase world market price of cotton by 12.6%, and Tockarick (2003) found that multilateral trade liberalization in all agricultural products would induce a 2.8% increase in world market price of cotton.

1 Changes in quota rent in this analysis are equal to zero as there is no quota in cotton for Sudan and selected African countries.

2 For more details about model specification and structure see http://192.91.247.38/tab/atpsm.asp

Based on the level of distortion in the base period, most of the impact on world market price can be attributed to the removal of the U.S. subsidy, which would lead, according to the simulation results, to a reduction of U.S. production and exports of cotton by 35% compared to the base line scenario. Although there are other countries subsidizing cotton production and exports, it seems to be that their interventions in cotton market have small effect on world market price of cotton compared to the effect of U.S. policy.

4.2 Impacts on Production and Trade

After the removal of subsidies (or tariffs) from cotton world market, production would get smaller in size in subsidized countries, which in turn reduces net exports. The resulting higher world market price induces production in non-subsidizing countries and therefore, their production and trade expands. This process continues until a new equilibrium is reached. The direction of most simulation results in this analysis is anticipated. From a theoretical point of view, when a positive relation between world market price changes and the resulting impacts on production and exports exist, the magnitude of this relationship need not be strong. For example, when supply responses are strong, especially in non-subsidizing countries, the change in the world market price could be small but there could be clear impacts on production and trade. By contrast, with inelastic supply responses, the change in the world market price could be large, but production and trade effects would be small.

Tables 4 and 5 show estimated impacts on production and exports for Sudan and the selected African countries. The simulated effects on production and trade of cotton for Sudan and the selected African countries are consistent with expectation. The production of cotton for the countries under question is expected to increase, on average, by 8.5 thousand tons which represents about 4.2% increase compared to base line scenario. The strong supply response for the simulated scenario is registered for Sudan, Benin, Togo and Zambia. This may reflect a higher potential of cotton production in these countries.

Regarding trade effects, there is a strong relationship between production and trade especially in Sudan and other countries under investigation. All selected countries gain from cotton trade when subsidizing countries eliminated subsidies. The cotton export quantities and values in Sudan, in response to the increase in domestic production, are expected to increase by 12 thousand tons (19.5%) and US $ 41 million (15%), respectively. A higher increase in cotton export revenues is also registered for Benin, Zimbabwe, Zambia and Togo, where their revenues from cotton exports will rise by US$ 22.6 million, US$ 22.8 million, US$ 25.2 million and US$ 16.9 million, respectively.

Table 4 Impact of full liberalization on production of cotton in Sudan and the selected African countries

	Change in production (000 tons)	Percentage change
Sudan	12.0	5.1
Benin	9.9	4.2
Chad	2.8	4.2
Burkina Faso	4.7	4.2
Tanzania	3.6	4.2
Zambia	22.5	4.2
Cameroon	3.8	4.2
Togo	9.2	4.2
Zimbabwe	8.1	4.2
Average	**8.5**	**4.3**

Source: Model simulation results

Table 5 Impact of full liberalization on exports of cotton in Sudan and selected African countries

	Export quantity (000 tons)	Percentage change	Exports revenues (million US $)	Percentage change
Sudan	12.0	19.5	41.5	15.1
Benin	9.9	11.3	22.6	21.8
Chad	2.6	91.4	3.7	109.5
Burkina Faso	4.7	7.5	13.1	17.5
Tanzania	3.3	12.1	7.3	22.7
Zambia	18.7	180.7	25.2	207.2
Cameroon	3.7	130.5	5.1	152.3
Togo	9.2	20.2	16.9	31.6
Zimbabwe	8.1	7.4	22.8	17.5
Average	8.0	51.8	17.6	66.1

Source: Model simulation results

4.3 Impact on Welfare Indicators

Table 6 shows impacts on key welfare indicators for Sudan and selected African countries. The indicators are changes in producer surplus, consumer surplus and total welfare. The changes in government revenues are not presented in the table due to its small or negligible changes. The results in the table are self-explanatory, as a positive gain is expected for the cotton producers in the selected countries striving from positive changes in world market prices and production, and negative impact is expected for cotton consumer's welfare. In Sudan, the producer surplus and total welfare will increase by US $ 26 million as a small negative impact is expected for consumer surplus from trade liberalization because most of the cotton produce is exported as raw material. For other selected countries, the same expected effects are like Sudan except for changes in consumer surplus, where there is a moderate loss for domestic consumers of cotton due to higher world market prices of cotton e.g. in Zambia consumer surplus will decrease by US$ 60 million. Nevertheless, positive net welfare effects are registered for the selected countries.

Table 6 Impact of full liberalization of cotton market on welfare measures for Sudan and the selected African countries (Million US $)

	Producer surplus	Consumer surplus	Total welfare
Sudan	26.8	-0.14	26.6
Benin	27.3	-16.9	10.3
Chad	7.6	-7.2	0.4
Burkina Faso	12.9	-5.7	7.2
Tanzania	9.8	-6.5	3.2
Zambia	62.3	-60.3	1.8
Cameroon	10.5	-10.0	0.5
Togo	25.2	-19.6	5.6
Zimbabwe	22.3	-9.6	12.7

Source: Model simulation results

5 Conclusion

One of the issues that attract attention in terms of analysis in recent times is the impact of agricultural trade distortions on global market on economies of individual countries. Distortions in cotton market are considered one of the important items in this debate as it has a long history of distorting policies applied mainly by the developed countries and have a great impact on the world cotton market. Cotton production and trade in Sudan and many other African countries is considered one of the major commodities that contribute a larger share for their foreign exchange earnings and livelihood of farmers. Cotton production and trade are negatively affected by the depressed world market prices of cotton that resulted from distorted policies (export subsidies, domestic support and higher import tariff) of the developed countries. In Hong Kong ministerial conference, a decision has been taken to remove all forms of export subsidies for cotton, and the developed countries agreed to give duty and quota free access for cotton exports from least-developed countries. The analysis carried out in this paper proves that removal of all distorted policies from cotton markets could bring a greater benefit for Sudan and African countries in terms of production and trade. Therefore, African countries including Sudan, must struggle to achieve full liberalization of cotton markets and other agricultural commodities under the WTO rules and negotiations. Moreover, reforming cotton markets in Sudan and African countries is also vital to increase the gain from liberalized and competitive world cotton markets.

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