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# **Cotton Lint Export Trade in the Midst of Distortion: What are the Competitiveness Statuses of Major Players in the Industry? Case of 12 Selected Countries**

**David Boansi<sup>1\*</sup>, Boris Odilon Kounagbé Lokonon<sup>2</sup> and John Appah<sup>2</sup>**

<sup>1</sup>*Department of Economic and Technological Change, Center for Development Research (ZEF), Bonn, Germany.*

<sup>2</sup>*West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Université Cheikh Anta Diop-FASEG, Senegal / Center for Development Research(ZEF), Germany.*

## **Authors' contributions**

*This work was carried out in collaboration between all authors. All sections beside section 2 were written by author DB. Section 2 was written in collaboration between all three authors DB, BOKL and AJ. Final Editing of the manuscript was done by authors DB and BOKL. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The world's cotton production and export industry has for some time now witnessed protests from various producers and exporters on distortionary measures (notably subsidies) instilled by some major players (including the United States, India and China) and the downward pressure such measures induce on world cotton prices. To complement research efforts made and findings so far following such protests, we sourced assessment of the competitiveness statuses of twelve major players in the industry amidst such distortions. In so doing, we made use of the logarithmic form of the comparative export performance index (ln (CEP)), basing our decisions on newly introduced thresholds founded on seven-year-mean performance indices. In addition, we used mean deviation for the last four of the seven years covered to identify recessions and improvements in export performance for the respective countries. The results show that, although such distortionary measures (specifically production and export subsidies) are instilled with a purpose of protecting respective local industries, they sometimes turn-

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\*Corresponding author: Email: [boansidavid@rocketmail.com](mailto:boansidavid@rocketmail.com);

out not only harming players from other economies, but also “push-out” extra revenues that may have been earned by some of the countries (primarily larger exporters like United States) that instill them. Based on seven-year mean index values used for the period 2005-2011 and new thresholds employed, we found Burkina Faso, Uzbekistan, Mali, Chad, Benin, Cameroon, and India to be “Highly Competitive”. The United States (US), Australia, and Côte d’Ivoire were found “Competitive”. Upon the index values observed (limited however by our inability to incorporate economic prices and account for differences in domestic resource costs and market structure), Brazil and China were respectively found “Weakly Competitive” and “Uncompetitive”. In spite of these statuses however, we discovered that export performances for the United States, Uzbekistan, and all the WCA countries (except Burkina Faso) have receded in recent years. Performances for India, Australia, China and Brazil have however improved, with the latter two witnessing relatively higher improvements. By this, we conclude that distortions do not only harm countries from the WCA and other developing nations, but also adversely affect performance of the United States. In countries like India, China and Brazil however, subsidies have yielded beneficial implications for export performance. These differences in effect of subsidies for the four subsidy-levying economies could be due to differences in resource, cost of production and exports, and market share.

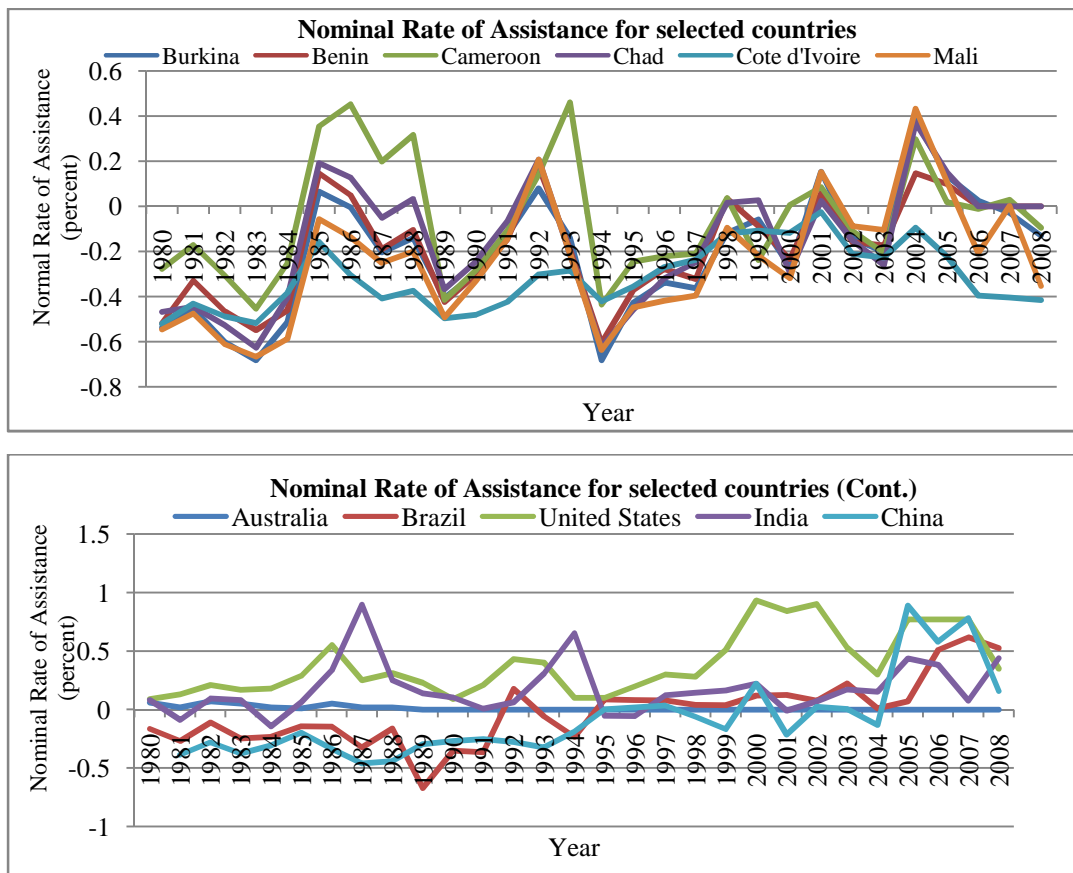
*Keywords: Competitive advantage; market share; nominal rate of assistance; thresholds.*

## **1. INTRODUCTION**

Agriculture as an activity and sector is not only sensitive to climatic conditions, but it is as well steered by forces operating in the marketing, economic and policy environments. This makes agricultural production and trade fragile. Upon this claim, governments in several countries worldwide have in diverse ways intervened in food and agricultural markets with a purpose of enhancing food security, reducing poverty and increasing foreign exchange earnings. In as much as attempts have been made since the early 1960s to justify such interventions, the instilled measures have been generally welfare reducing both within and beyond the respective economies in which such interventions are witnessed. Revelations along this line of argument can be found in studies such as [1-9]. Other studies including [10] and [11] have however refuted the welfare reducing claims of such interventions (specifically production and export subsidies), arguing that subsidies are primarily instilled as a response to declining world prices to shield farmers and exporters from economic losses. A commodity that has been subjected to such interventions worldwide and has for some time now attracted much research attention is cotton. Its attraction of research attention is justified on the grounds that, in most of the developing economies where the commodity is produced, it is widely regarded a strategic crop for reducing poverty, enhancing food security and founding economic development [12]. In West and Central Africa for example, specifically the C-4 economies (Burkina Faso, Benin, Mali and Chad), the cotton industry is believed to have as of the year 2005 employed about 16 million people who were engaged in production, processing and trading of the commodity [13]. The industry as revealed by [12] remains second-largest employer after the national governments in the C-4 economies. In these economies, cotton companies are noted to employ at least 4,000 permanent staff and 8,000 seasonal employees. In as much as there are annual variations in these figures, about 900,000 farm units are reportedly engaged in cotton farming [12]. This, according to [12] implies that, the industry provides employment to at least seven million actively farming adults in those units and provides livelihoods to about 13 million people (including children and non-farming adults) that comprise these farming units. In these countries, besides farmers and cotton exporting companies facing various financial, managerial and technological challenges, the farmers (who primarily depend on cotton production for

sustenance) are as well subjected to significant production taxes, thereby reducing the share of world price that reach them [14].

In contrast to this observation however, production in the relatively better-off economies have been mostly subsidized. As shown in Fig. 1, cotton production in West and Central African countries has over the period 1980 to 2008 been generally subjected to production tax, while completely the opposite was observed for the United States and India. In as much as farmers in Brazil and China were subjected to production tax during the period 1980 to 1995, production in Brazil has since the year 1996 been subjected to some subsidy (although below percentages for India and the United States), with same being noted in China after the year 2004. Besides potentially creating inefficiency in production, through encouraging overproduction, subsidies are believed to create a glut that lowers world prices of the commodity [3,7-9,15]. This adversely affects over 10 million farmers and export companies in the relatively poorer countries (who are rather taxed). In a country like Australia, however, the government has almost been neutral in this case as the annual nominal rate of assistance figures<sup>1</sup> as shown in Fig. 1 lie generally on the zero line.



**Fig. 1. Nominal rate of assistance for cotton output**  
Data source: Anderson and Nelgen [16]

<sup>1</sup> Nominal rate of assistance (NRA) refers to the percentage by which government policies (subsidies or taxes) have raised (or decreased in case of taxation of farm incomes) gross returns to farmers above (or below) what they would be without such intervention

Following protests by various countries, most importantly the C-4, that subsidies and other trade distortionary measures be abolished, several dimensions of cotton export trade have been researched to help inform policy decisions on the way forward. Among the studies that have investigated various dimensions of cotton export trade are [3,7,17-19]. To complement research efforts made and findings so far, we source assessment of the competitiveness statuses of 12 major players in the industry amidst prevailing distortions. The twelve countries covered in this study are the United States, India, Australia, Uzbekistan, Brazil, China, Burkina Faso, Benin, Cameroon, Côte d'Ivoire, Chad and Mali. Selection of these countries is based on the roles they play in world cotton production and trade. With exports of cotton being mostly in the form of lint (e.g. over 83% for C-4 countries), emphasis on cotton exports in this study would solely be placed on the lint component. In assessing the competitiveness of these countries in export of cotton lint, we make use of the logarithmic form of the comparative performance measure of competitiveness, basing our decisions on new thresholds proposed by [20].

## **2. DEVELOPMENTS IN WORLD COTTON LINT EXPORTS**

Amongst all the known fibres in the world, cotton is the most important with a share of about 40% of production [6] and represents an essential contributor to development in many developed and developing economies around the globe. Cotton as an important cash crop has for over three decades now in its export dimension undergone some major developments at the world, regional and national levels. Both the volume and value of world cotton lint exports have increased tremendously over the period 1980 to 2009, primarily due to overproduction by major players. As shown in Table 1, the volume of cotton lint exports at the global level is noted to have increased from a decadal average of 4,694,604 tonnes in 1980-1989 to 7,166,301 tonnes in 2000-2009 (representing a 1.42% annual growth rate in volume of exports). This development was enhanced possibly by exports from the Americas and Asia, as these two regions are as well noted to have witnessed major increases in volume and value of exports. With volume of world exports increasing by about 52.65% between the two aforementioned periods, volumes from the Americas and Asia increased respectively by 71.59% and 84.76%. These two countries also observed respective annual growth rates of 1.82% and 2.07% in volume of exports. The volume of cotton exports from Africa increased continuously in absolute terms over the three decades between the years 1980 and 2009 (thus 1980-1989, 1990-1999 and 2000-2009), although it fluctuated share-wise. Annual growth rate of 1.62% for volume of exports from Africa was observed over the period. In as much as export volumes from Europe have decreased continuously over the three decades between the years 1980 and 2009, entirely the opposite is observed for Oceania. With volume of exports from Europe decreasing by 61.41% between 1980-1989 and 2000-2009, volumes from Oceania increased by 245.49%. Exports from Europe decreased at a rate of 3.12% per annum over the period, while Oceania witnessed a 4.22% annual growth rate in volume of exports.

At country level, the United States remains leading exporter of the commodity over three decades within the period 1980 to 2009. For the respective decades, the United States held shares of 26.71%, 27.39% and 37.50%. Taking a closer look at figures in Table 1, it is quite evident that the countries outside West and Central Africa (WCA) region are generally major exporters of cotton lint, and this did not happen by chance. Most of the increases observed in export volumes for these countries have been enhanced through government interventions (distortions) in the form of subsidies purported on facilitating increased cotton production [6]. Due to decades of development efforts however, cotton became a dominant cash crop in WCA during the periods 1990-1999 and 2000-2009. Historically, cotton

production has two characteristics in Sub-Saharan Africa: vertical coordination and the fact that cotton has been a major export cash crop for decades [21]. These two characteristics led to a strong government intervention in cotton supply chains. With the exception of Chad that witnessed a decrease in export share between the periods 1980-1989 and 2000-2009, all the other WCA countries covered in this study witnessed an increase in share between the two aforementioned periods. In absolute terms however, volumes of export from all the WCA countries increased between the two periods.

**Table 1. Regional (and country) shares in volume (tonnes) of world cotton lint exports**

Region	1980 - 1989	1990-1999	2000-2009	Annual growth rate <sup>2</sup> , (%)
World	4,694,604	5,466,826	7,166,301.	1.42
Americas	1,806,247(38.47)	1,953,860(35.74)	3,099,353 (43.25)	1.82
Asia	1,096,385(23.35)	1,779,857(32.56)	2,025,718 (28.27)	2.07
Africa	721,886(15.38)	822,330 (15.04)	1,170,418 (16.33)	1.62
Europe	920,903(19.62)	464,511 (8.50)	355,401 (4.96)	-3.12
Oceania	149,183 (3.18)	446,269(8.16)	515,412 (7.19)	4.22
<b>Sub-Region</b>				
West Africa	209,186 (4.56)	423,248 (7.74)	651,957 (9.10)	3.86
Middle Africa	78,430 (1.67)	120,806 (2.21)	129,698 (1.81)	1.69
<b>Countries</b>				
United States	1,254,106(26.71)	1,497,526 (27.39)	2,687,170 (37.50)	2.57
India	66,831 (1.42)	124,389(2.28)	529,804(7.39)	7.14
Australia	149,182 (3.18)	446,269 (8.16)	515,411(7.19)	4.22
Uzbekistan	-	*719,207(13.16)	727,985(10.16)	N/A
Brazil	81,456 (1.74)	32,926 (0.60)	294,467(4.11)	5.88
China	310,695 (6.62)	136,569 (2.50)	82,271 (1.15)	-4.33
Burkina Faso	35,254 (0.75)	44,587 (0.82)	162,072 (2.26)	5.22
Benin	23,086 (0.49)	86,757 (1.59)	128,137 (1.79)	5.88
Cameroon	29,210 (0.62)	51,947(0.95)	82,818 (1.16)	3.53
Côte d'Ivoire	59,484 (1.27)	95,932 (1.75)	106,877 (1.49)	1.97
Chad	37,370 (0.80)	59,000 (1.08)	43,500 (0.61)	0.51
Mali	61,220 (1.30)	121,543 (2.22)	178,688 (2.49)	3.64

*Numbers in bracket are representative shares (percentages), - Data not available, \* Decadal average but with missing values for 1990-1991, N/A: cannot be computed due to missing data for the initial value (1980-1989), Source: Authors computation with data from FAO (FAOSTAT–Agricultural Trade Data)*

Among the 12 countries covered in this study, annual growth rates in volumes of export were relatively higher for India, Brazil, Benin, Burkina Faso and Australia. As the largest market share holder, the United States observed annual growth rate of 2.57% in volume of exports, while China (as the largest producer) observed a 4.33% annual decrease in volume of exports over the period 1980-2009. This could be due to increasing domestic demand for the commodity, as most of the lint produced in China is consumed

As shown below, Table 2 displays the distribution of export earnings from cotton lint at global, regional and national scales. Globally, earnings from cotton lint exports is noted to have increased from \$6,936,064 (thousand) to \$8,964,869 (thousand) between the periods 1980-1989 and 2000-2009, representing an increase of 29.25% and annual growth rate of

<sup>2</sup>Annual growth rate =  $100 \times (\text{average exports for 2000-2009} / \text{average exports for 1980-1989})^{1/30} - 100$   
Use of "30" as a divisor in the power implies that, the annual growth rate computed is for the three decades (30 years) between 1980 and 2009

0.86%. As per the table, the Americas held the largest share of earnings from cotton lint over the three decades between 1980 and 2009. Comparatively, shares in value of exports were significantly higher in non-WCA countries than in WCA countries. West and Central Africa jointly accounted for 10.27% of global export earnings for the period 2000-2009, while Africa as a continent/region accounted for 16.53%. By this, West and Central Africa accounted for 62.17% of total earnings from cotton lint exports for Africa.

**Table 2. Regional (and country) shares in value (\$1000) of world cotton lint exports**

Region	1980-1989	1990-1999	2000-2009	Annual growth rate, (%)
World	6,936,064	8,030,049	8,964,869	0.86
Americas	2,677,418(38.60)	3,015,909(37.56)	3,983,130(44.43)	1.33
Asia	1,396,768(20.14)	2,398,208(29.87)	2,386,746 (26.62)	1.80
Africa	1,170,422(16.87)	1,233,388(15.36)	1,481,620(16.53)	0.79
Europe	1,495,956(21.57)	702,977(8.75)	441,146 (4.92)	-3.99
Oceania	195,501(2.82)	679,567(8.46)	672,227(7.50)	4.20
<b>Sub-region</b>				
West Africa	271,444(3.91)	606,063(7.55)	765,651(8.54)	3.52
Middle Africa	105,436(1.52)	173,586(2.16)	155,524(1.73)	1.30
<b>Countries</b>				
United States	1,962,283(28.29)	2,407,539(29.98)	3,499,019(39.03)	1.95
India	88,855(1.28)	159,845(1.99)	693,545(7.74)	7.09
Australia	195,496(2.82)	679,566(8.46)	672,217(7.50)	4.20
Uzbekistan	-	- *972,565(12.11)	808,791(9.02)	N/A
Brazil	78,738(1.14)	41,612(0.52)	355,014 (3.96)	5.78
China	387,828(5.59)	206,554(2.57)	101,966(1.14)	-4.36
Burkina Faso	40,142(0.58)	58,861(0.73)	190,414(2.12)	5.33
Benin	27,964(0.40)	124,777(1.55)	151,016(1.68)	5.78
Cameroon	38,164(0.55)	69,268(0.86)	100,681(1.12)	3.29
Côte d'Ivoire	84,036(1.21)	139,714(1.74)	123,738(1.38)	1.30
Chad	52,771(0.76)	89,061(1.11)	51,679 (0.58)	-0.07
Mali	80,080(1.15)	166,054(2.07)	214,715(2.40)	3.34

Numbers in bracket are representative shares (percentages), - Data not available, \*Decadal average but with missing data for 1990-1991, N/A: cannot be computed due to missing data for the initial value (1980-1989),

Source: Authors computation with data from FAO (FAOSTAT-Agricultural Trade Data)

This comparatively smaller joint share of WCA sub-region in global exports may be attributed partly to unfavorable conditions in the world cotton lint markets and domestic institutional and structural constraints, mostly with poor price transmission (which discourages farmers from expanding and intensifying production of the commodity). In support of this attribution, [6] revealed that, even though cotton production has expanded rapidly in the WCA sub-region, the share of the international price paid to producers in WCA has been relatively low. In addition, inefficiencies have been noted in other cotton related activities like ginning, marketing and input distribution.

Just as was observed for volume of exports, annual growth rates for value of exports were relatively higher for India, Brazil, Benin, Burkina Faso, and Australia. The United States observed an annual growth rate of 1.95%, while China observed a 4.36% annual decrease in value of exports over the period 1980-2009.

### 3. METHODOLOGY

In this section, we discuss the basic foundations for the measure of competitiveness employed in our analysis and the data used. We begin the section with discussion on the relevant foundations and thereafter provide brief information on data used and sources.

#### 3.1 Measuring Competitiveness

Diverse opinions have been expressed in business and trade literature by experts on the definition of competitiveness and how best the concept can be measured. In this study however, we stick to the definition proposed by [22], who defines competitiveness as the ability of a country (a firm/or an entity) to offer products and services that meet local and international quality standards, worth domestic and global market prices and provide adequate returns on the resources used in producing them. By this definition, the term competitiveness covers four important aspects of trade and production; quantity (through offering of adequate volumes of a commodity), quality, price and efficiency. To be competitive in a commodity, a country (firm/entity) is expected to offer adequate quantity of that commodity in high quality (which attracts higher demand). This consequently sets ground for higher prices (and possibly premium<sup>3</sup>). In as much as the quality and price aspects are important, the concept by the definition above tries to draw the reader's attention to the fact that achieving anticipated quality standards and high prices involves efficient production, processing and marketing in the first place. These four dimensions *should* hold for a country/firm to be deemed competitive in a commodity both at the local and global scales. As a relative measure of performance, the most important index amongst the lot that comes to mind in expressing competitiveness is the Balassa index. Since the proposition of this index by [23], its definition has been revised and modified in several ways, leading to a plethora of measures [24]. By its original definition however, the Balassa index (also dubbed 'Revealed Comparative Advantage' (RCA)) is expressed as follows:

$$RCA_{ij} = \frac{(X_{ij}/X_{it})}{(X_{nj}/X_{nt})} \quad \text{eq.(1)}$$

Where X represents exports, *i* is a country, *j* is a commodity, *t* is a set of commodities and *n* is a set of countries. Blurrily perceived by most trade analysts and experts as a measure of comparative advantage, the definition of this index reflects success or failure of countries in exports of a commodity relative to world-wide norms [25]. Such successes and failures are mostly induced through subsidies and other distortionary measures or incentives. Thus, the index better reflects competitive advantage than comparative advantage. By the original definition as proposed by [23], the index is therefore more of a measure of competitive advantage than comparative advantage. Further derivations from this index will henceforth be a reflection of competitive advantage. In spite of being the foundation for development of various indices of competitiveness, the Balassa index is foremost flawed by deviation in index value observed as the set of countries used as reference changes. This makes the outcomes context and reference specific and sensitive to reference definition. The asymmetric nature of the index poses another flaw in its use. Should a country be found uncompetitive, the index value for such country ranges between zero and value less than 1. For competitive countries, the index ranges from one to infinity. The index is as well susceptible to double counting between pairs of countries. It is as well criticized for ignoring the import side of trade.

<sup>3</sup>Premium in this context refers to a price that is higher than the regular price (thus, a higher or extra value)

In building on this index and addressing identified flaws in the process, [26] offered three alternative specifications. The first among the alternative is the logarithm of relative export advantage (ln (RXA), which holds a definition similar to the original Balassa index but uses the world as a reference to avoid double counting between pairs of countries and addresses the asymmetry problem of the Balassa index). The other two alternatives are relative trade advantage ((RTA), which incorporates both the export and import (relative import advantage (RMA)) dimensions of trade) and revealed competitiveness ((RC), which holds a definition similar to the RTA but uses the logarithms of relative export and import advantages). The respective alternatives are expressed as follows:

$$\ln(RXA_{ij}) = \ln \frac{(X_{ij}/X_{it})}{(X_{nj}/X_{nt})} \quad \text{eq.(2)}$$

$$RMA_{ij} = \frac{(M_{ij}/M_{it})}{(M_{nj}/M_{nt})} \quad \text{eq.(3)}$$

$$RTA_{ij} = RXA_{ij} - RMA_{ij} \quad \text{eq.(4)}$$

$$RC_{ij} = \ln(RXA_{ij}) - \ln(RMA_{ij}) \quad \text{eq.(5)}$$

Where  $X$  represents export,  $M$  represents import,  $i$  represents country,  $j$  stands for commodity,  $n$  represents world and  $t$  stands for all product groups.

Following the proposition by [26] of these alternatives however, claims have been made in trade literature on the failure of either alternatives to appropriately correct for/capture the effect of government intervention and other distortionary measures on trade. Prior to proposition of these alternatives, [27] found that a country's performance in exports of a commodity is more affected by economic fundamentals than by government intervention, whereas the reverse holds for import behavior. Along this argument, [26] recommended the use of the ln (RXA) and RXA in preference to the RTA and RC as appropriate measures for assessing exports performance. This recommendation is backed by a suggestion that the ln(RXA) and RXA are less susceptible to policy-induced distortions. In addition to this suggestion, considering a single commodity, it is noted that most countries engage either in inter-industry trading (thus complete exports or imports) or irregularly/weakly engage in intra-industry trading. This could to a greater extent preclude the use of the RTA and RC as these measures may automatically converge to either RXA, RMA, ln(RXA) or ln(RMA) when there are zero imports or exports.

Along this line, our analysis is founded primarily on the ln(RXA) measure (which addresses the asymmetry problem of the RCA) of competitiveness. Although ln(RXA) is deemed more appropriate among the two alternatives recommended by [26], cross-sectorial distortions stand determining the outcome of the final index values observed. This could lead to misleading outcome for the index values observed. This claim is made on the grounds that, by the definition in eq. (2), in determining the performance of a country in exports of a commodity, use is made of "all product groups" as a divisor both at the national and world levels. To avoid such cross-sectorial influence, we make use of a more sector bound version of the ln(RXA) measure of competitiveness. By this, we use the logarithmic form of the Comparative Export Performance Index (ln(CEP)). This measure is expressed as follows:

$$\ln(CEP_{ij}) = \ln \frac{(X_{ij}/X_{it})}{(X_{nj}/X_{nt})} \quad \text{eq.(6)}$$



Where conceptually  $X$  represents value of exports,  $i$  represents country,  $j$  stands for cotton lint,  $n$  represents world and  $t$  stands for value of total agricultural exports. Like the  $\ln(\text{RXA})$ ,  $\ln(\text{CEP})$  yields values that are symmetric through the origin. In addition, the  $\ln(\text{CEP})$  measure holds a similar index interpretation as the  $\ln(\text{RXA})$ , where index value  $\geq 0$  reveal competitiveness. Noted in trade literature, in informing decision on the competitiveness status of a country in export of commodities, use has been made by several researchers of fewer randomly selected years (usually two or three years including [28]). In their study on "Market analysis and revealed comparative advantage", [28] had an RCA value of 1.0 in Kiwifruit for Iran in the year 2000, 23.3 in the year 2005 and N/A for the year 2009. Should the value for 2009 have turned out to be for example a value less than 1, what interpretation would analysts attach to such outcome? We believe, as usual, they would suggest the country is no more competitive based on the annual figures on which they base their decision. There could have been a possibility that values for the years between 2001-2004 and 2006-2008 were all above 1 or possibly below 1. Ignoring all these possibilities as we inform decision on the competitiveness statuses of countries could be misleading. Along this line, we make use of mean index values for the last seven continuous years (for which data is available)(2005-2011 for this study) in informing competitiveness statuses of the respective countries instead of using random years. This helps capture extremes (which usually mislead analysts who use annual figures for random periods) and their effect on preceding and subsequent years. Use of the  $< \geq 0$  bounds of the  $\ln(\text{CEP})$  in interpreting outcomes is deemed less informative and provides no room for accessing the effectiveness of policy measures purported on enhancing or depressing exports. Accordingly we make use of seven-year-mean index thresholds proposed by [20] for informing decisions in this study.

**Table 3. Seven-year-mean index thresholds for assessing competitive advantage**

<b>Classes</b>	<b>CEP</b>	<b>Ln (CEP)</b>	<b>SCEP</b>
Highly competitive	$\geq 4.20$	$\geq 1.44$	0.62-1.00
Competitive	1.73–4.19	0.55-1.43	0.27–0.61
Weakly competitive	1.00–1.72	0.00–0.54	0.00-0.26
Uncompetitive	$< 1.00$	$< 0.00$	$< 0.00$

Source: [20]

Having been used already by [20] in assessing the performance of exports for seven agricultural commodities during and after the agricultural diversification project in Ghana, these thresholds were not just randomly selected. The bounds were set at the respective upper and lower limits after several rotations for robustness. By this, for a country to move from one class to another would require some efforts in the form of efficient policy instruments, reduction of existing inefficiencies, improvement in trade (including appropriate liberalization of internal and external marketing) and minimization of distortionary measures which according to [29] reduces competitiveness. Although applied to the agricultural sector, these thresholds are valid for other sectors as long as definition for the measure used conforms to that in eq. (6) and is sector bound. When used in policy analysis, the thresholds could serve as useful guide in evaluating the effectiveness of various policy instruments purposed on enhancing export growth. Besides being quite effective in reflecting fragileness of export trade, these thresholds could be used to identify inefficiencies in export trade in less diversified and highly trade distorting environments and sectors.

To however assess improvements or recessions in performance of the respective countries over the seven year period, we use mean deviation<sup>4</sup> for the four latter years of the seven. Employed in this study, the mean deviation in performance is defined as follows:

$$\text{MeanDeviation} = \frac{\sum(\text{Annualperformanceindex} - \text{Seven-year-meanperformanceindex})}{4} \quad \text{eq.(7)}$$

The number “4” in the denominator reflects the fact that, we are considering only the four current annual performance figures (2008-2011). This number is deemed appropriate because it does not only cover more than 50% of the entire period (7 years), but also reflects performance for the four recent years for which data is available.

### 3.2 Data and Sources

In this study, use is made primarily of secondary data on national and world values for cotton lint and total agricultural exports. Data on these variables were gathered from the agricultural trade database of FAO (FAOSTAT). A total of 12 countries are covered in our analysis and these are the United States (US), India, Australia, Uzbekistan, Brazil, China, Burkina Faso, Benin, Cameroon, Côte d'Ivoire, Chad and Mali. The mean index for the respective countries covers all years from 2005 to 2011.

## 4. RESULTS AND DISCUSSION

By the thresholds employed in this study, and the mean performance indices observed, the twelve countries are placed in four distinct classes. The classes used are “Highly Competitive”, “Competitive”, “Weakly Competitive” and “Uncompetitive”. In as much as these classes provide indications for the competitiveness statuses of the respective countries, they give no further information on any improvement or recession in performance over the period. To provide a clearer picture on both the competitiveness statuses of the countries and how they have performed in recent years, use is made of both the thresholds for classification and a four-year mean deviation to inform decisions on improvements or recessions in performance. Given the classes, countries with mean index values of  $\geq 1.44$  are deemed “Highly Competitive”. Those with mean values between 0.55-1.43 are deemed “Competitive”, between 0.00-0.54 deemed “Weakly Competitive” and  $< 0.00$  deemed “Uncompetitive”. The use of the term “Weakly Competitive” is to reflect the fragileness of being in this category. Inappropriate policy interventions, shocks from the market, inefficiencies in fiscal and marketing environment and other socio-economic, financial and structural constraints on the part of producers and exporters could pull a country into the “Uncompetitive” class.

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<sup>4</sup>In this study, the word deviation conceptually refers to the difference between annual figures and the seven-year mean performance index. To assess improvements in performance over the seven year period, the four current out of the seven years used is employed in computing mean deviation in performance. Countries with relatively higher and positive figures reveal general improvement in their export performance over the period 2005-2011. (Caveat : this outcome however is no indication of competitiveness status but rather a general improvement in export performance. In considering such deviations, extremes on the negative side should as well be given a critical look and inefficiency addressed whenever necessary). The relevance of the seven-year mean competitiveness index lies in the mean deviation for the four current years to help identify the average improvement (or recession) in performance of the respective countries and to identify their competitiveness statuses for the entire period. The mean deviation in performance for the respective countries as shown in Table 6 is defined as follows: Mean Deviation =  $\sum(\text{Assessed performance figure} - \text{Seven-year mean performance index}) / 4$ . The number “4” in the denominator reflects the fact that, we are considering only the four current annual performance figures (2008-2011) and this is deemed appropriate because it covers more than 50% of the seven-year period.

Favorable conditions can as well push a country into a higher class (Possibly the “Competitive” class or “Highly Competitive” class if such conditions are extremely favorable). The use of “Competitive” for the next class is to reflect the fact that, although countries in this category are by the original bounds of the RCA (of Balassa) deemed competitive, there exists room for improvement by addressing some existing inefficiencies in their respective industries and lending more attention to the industry in a non-distorting way. Although such countries are usually less concentrated on the cotton industry, addressing prevailing inhibition to export growth and performance could lead to their movement into the “Highly Competitive” class. Countries in the “Highly Competitive” class are usually more dependent on cotton industry for sustenance, income generation, poverty reduction and foreign exchange earnings, and are potentially low cost producers due to abundance of relevant resources needed and low wage rates, the latter of which violates national labor law prescriptions.

**Table 4. Performance of selected countries in cotton lint exports**

Countries	Log of comparative export performance index, ln(CEP)							
	2005	2006	2007	2008	2009	2010	2011	Mean
United States	1.36	1.39	1.33	1.49	1.26	1.30	1.33	1.35
India	1.53	2.02	2.27	1.39	2.57	2.42	1.96	2.02
Australia	0.91	0.84	0.53	0.55	0.73	1.00	1.56	0.87
Uzbekistan	3.91	3.82	3.98	4.20	3.75	3.86	3.39	3.85
Brazil	-0.05	-0.47	-0.1	0.31	0.31	0.00	0.23	0.03
China	-2.67	-2.07	-1.93	-1.85	-1.86	-1.94	-1.90	-2.03
Burkina Faso	3.91	3.92	4.10	4.44	4.28	3.84	3.55	4.01
Benin	3.74	3.01	3.41	3.56	3.21	2.52	2.57	3.14
Cameroon	2.66	2.40	2.52	2.09	2.27	1.70	1.87	2.22
Côte d'Ivoire	1.10	0.83	0.77	0.69	0.34	0.52	0.27	0.65
Chad	3.46	3.54	3.59	3.70	3.42	2.98	3.49	3.46
Mali	3.98	3.84	3.88	4.15	3.70	3.55	3.70	3.83

*Source: Authors computation with data from FAOSTAT*

In interpreting the results as shown in Table 4, we note relatively higher mean index values in countries like Burkina Faso, Uzbekistan, Mali, Chad, Benin, Cameroon and India. By this, all the “Cotton-Four” countries, in spite of the current challenges faced by their respective cotton industries are noted to have higher competitive advantage over countries like United States (which holds a market share of over 3 times that of West and Central Africa together), Australia, Côte d'Ivoire, Brazil and China. The higher competitiveness indices observed for the C-4 countries can be attributed to their relatively lower cost of production (due to abundance of labor/farm hands and low wage rates) and exports compared to the US and other countries (like China) which have relatively higher cost of production and exports. In as much as cotton may be subsidized in the US and other major exporting nations like India, reduction in world prices as a result of such intervention does not only harm producers and exporters in developing economies, but also, it reduces potential earnings to the major exporters that levy such subsidies. Given the fact that China remains the major export destination for majority of the countries considered in this study and it being among the leading producers, stockholders and consumers, flooding the Chinese market with “cheap cotton” further lowers prices on the world market and reduces any potential gains that could have accrued to the US and India (who respectively accounted for 35.3% and 30.7% of cotton imports in China for the year 2010 [17]) in the absence of such interventions.

Flooding major destination markets with cheap cotton also yield detrimental implications on earnings for other competing nations especially countries from WCA and Uzbekistan.

Taking a closer look at the detailed world trade flows in Appendix 1, the US is noted to have had about 46 export destinations during the period 2006-2010 compared to about 17 on average for West and Central African cotton exports. Consequently, flooding the market with “cheap cotton” due to overproduction could harm competing nations who share common destination markets with the US, and also preclude the US from realizing any potential gains from increment in prices and export earnings. By the definition of the competitiveness measure employed (as specified in eq. 6), competitive advantage is measured by the value of cotton lint exports in total agricultural exports for the country compared to that for the world (the latter being a divisor). Upon this definition, putting in place measures to increase the national value (and not volume) for exports of the commodity, may induce a relatively higher effect at the national level than at the world level, thereby increasing the numerator in the equation for the US and cotton market distorting nations. Subsidizing cotton production and exports for major exporters could induce an inverse association between exports and competitiveness for the countries that initiates such intervention and has as well adverse implications for other economically-constrained and cotton production-and-export-dependent countries. Allowing the world cotton market to work things out by itself with reduced government interference could make the US and other cotton market distorting countries better off than they actually now are. For example, in simulating the effect of full liberalization of textile trade, [2] revealed that elimination of subsidies could raise cotton prices by 10.7 percent. Although such realization could to some extent reduce cotton production, the general welfare effect may be positive for majority of the exporting nations including the US. Although the primary goal for use of such interventions is to protect producers and exporters in the country that instills them, in comparing market shares and the index values for the US and other countries, we believe such interventions rather “push-out” extra revenue the country may have earned in their absence.

Using the seven-year-mean index values and bounds from Table 3, in a descending order as shown in Table 5, Burkina Faso, Uzbekistan, Mali, Chad, Benin, Cameroon, and India are found “Highly Competitive”. The United States, Australia and Côte d’Ivoire are found “Competitive”. Although limited by our inability to incorporate economic prices and account for differences in domestic resource costs and market structure, the output obtained from computation of eq (6) reveals that Brazil is “Weakly Competitive” and China “Uncompetitive” in cotton lint exports. The later observation is in part attributed to the relatively lower engagement of China in cotton lint exports. As shown in Appendix 2, cotton lint exports accounted for only 0.17% of value for total agricultural exports from China.

**Table 5. Competitiveness statuses of major players in world cotton industry based on new thresholds**

<b>Classes</b>	<b>Thresholds</b>	<b>Countries</b>
Highly Competitive	( $\geq 1.44$ )	Burkina Faso, Uzbekistan, Mali, Chad, Benin, Cameroon, India,
Competitive	( 0.55-1.43 )	United States, Australia, Côte d’Ivoire
Weakly competitive	( 0.00–0.54 )	Brazil
Uncompetitive	( $< 0.00$ )	China

*Source: Authors classification based on thresholds proposed by [20]*

In spite of these statuses however, as shown in Table 6, we note that although “Weakly Competitive” and “Uncompetitive” by status (based on the thresholds), Brazil and China respectively observed the highest improvement in performance over the period 2008-2011, with deviations from the mean being all positive for China, and positive in three out of four occasions for Brazil. In as much as the mean deviation in performance for Brazil was 0.18 during the aforementioned period, that for China was 0.14. Countries like India and Australia also observed respective positive mean deviations of 0.07 and 0.09. Although mostly within the “Highly Competitive” class, with the exception of Burkina Faso which observed a positive mean deviation of 0.02 (reflecting an improvement in export performance over the period 2008-2011), all the other countries from West and Central Africa covered in this study witnessed recession in performance over the period 2008-2011. Cameroon, Côte d’Ivoire and Benin performed poorer than countries like Mali and Chad. Having held over 37% by volume and 39% by value of world market share, the US is as well noted to have observed a recession in export performance. This outcome reflects inefficiencies in the international market and in current production and exports for most of the countries in the “Competitive” and “Highly Competitive” classes. Although initially poor performers (based on annual  $\ln(\text{CEP})$  figures for the years 2005, 2006 and 2007), Brazil and China have since the global commodities crisis of the year 2008 witnessed some major improvements in their cotton lint export performance. Being the most fragile amongst the lot based on the seven-year-mean  $\ln(\text{CEP})$  index however, Brazil needs to firmly anchor, sustain and/or improve upon measures that have ensured current improvements in the country’s performance and address any existing inefficiencies. Such initiative could shield the Brazilian cotton lint industry from future shocks which may counter the positive paths the industry has been set on since the year 2008.

**Table 6. Current improvements and recessions in export performance**

<b>Countries</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>Mean</b>
United States	0.14	-0.09	-0.05	-0.02	-0.01
India	-0.63	0.55	0.40	-0.06	0.07
Australia	-0.32	-0.14	0.13	0.69	0.09
Uzbekistan	0.35	-0.10	0.01	-0.46	-0.05
Brazil	0.28	0.28	-0.03	0.20	0.18
China	0.18	0.17	0.09	0.13	0.14
Burkina Faso	0.43	0.27	-0.17	-0.46	0.02
Benin	0.42	0.07	-0.62	-0.57	-0.18
Cameroon	-0.13	0.05	-0.52	-0.35	-0.24
Côte d’Ivoire	0.04	-0.31	-0.13	-0.38	-0.20
Chad	0.24	-0.04	-0.48	0.03	-0.06
Mali	0.32	-0.13	-0.28	-0.13	-0.06

*Shades: Grey—positive annual deviation from mean, Orange—recession in performance, Blue—improvement in performance*

## 5. LIMITATION OF STUDY

As advised by [3], the structure of world market for cotton lint is a key determinant of growth in production and export of the commodity. In addition, the analysis of developments in the industry is guided by several assumptions, with each having potentially different implications for export growth and performance. In assuming a perfectly fragmented market as against the rigid homogeneous global market for cotton assumption, [3] place a proposition that countries only stand benefiting from reductions in subsidies if they are already competing in

segments of the market where production is currently subsidized (*as is the case in this study*), adding that, this has relevant implications for developments in cotton price and for the distribution of benefits. Determination of the ability of countries to respond to developments in global trade and the influence of such responses on their performance to a greater extent requires effective consideration of their production and export structure including issues with domestic resource costs, market structure, economic prices and existing government policies on production and trade. In using the logarithmic form of the comparative export performance index and deviations from mean index in this study however, we are unable to appropriately account for influences from these development and trade indicators.

## **6. CONCLUSION**

Following recent debates in economic and trade literature on distortions in world cotton industry and their impacts on producers and exporters in developing economies, we sourced assessment of the competitiveness statuses of twelve major players in the global cotton industry. Along this line, we made use of seven-year-mean index values as against the fewer randomly selected years used by various analysts in trade literature. Our ultimate decision on the respective statuses was however based on new thresholds proposed by [20], and according to the four unique classes therein. In addition, we used mean deviation for the last four of the seven years covered to identify recessions and improvements in export performance for the respective countries. The results show that, although such distortionary measures (specifically production and export subsidies) are instilled with a purpose of protecting respective local industries, they sometimes turn-out not only harming players from other economies, but also “push-out” extra revenues that may have been earned by some of the countries (primarily larger exporters like United States) that instill them. Based on seven-year-mean index values used for the period 2005-2011 and new thresholds employed, we found Burkina Faso, Uzbekistan, Mali, Chad, Benin, Cameroon, and India to be “Highly Competitive”. The United States (US), Australia, and Côte d’Ivoire were found “Competitive”. Upon the index values observed (limited however by our inability to incorporate economic prices and account for differences in domestic resource costs and market structure), Brazil and China were respectively found “Weakly Competitive” and “Uncompetitive”. In spite of these statuses however, we discovered that export performances for the United States, Uzbekistan, and all the WCA countries (except Burkina Faso) have receded in recent years. Performances for India, Australia, China and Brazil have however improved, with the latter two witnessing relatively higher improvements. By this, we conclude that distortions do not only harm countries from the WCA and other developing nations, but also adversely affect performance of the United States. In countries like India, China and Brazil however, subsidies have yielded beneficial implications for export performance. These differences in effect of subsidies for the four subsidy-levying economies could be due to differences in resource, cost of production and exports, and market share.

## **COMPETING INTERESTS**

Authors have declared that no competing interests exist.

## REFERENCES

1. Anderson K, Kurzweil M, Martin W, Sandri D, Valenzuela E. Measuring distortions to agricultural incentives, Revisited. Policy Research Working Paper 4612, Development Research Group. Trade Team, World Bank; 2008.
2. Quirke D. Trade distortions and cotton markets: Implications for global cotton producers. Cotton Research and Development Corporation, Center for International Economics. Canberra, Australia; 2002.
3. Gillson I, Poulton C, Balcombe K, Page S. Understanding the impact of cotton subsidies on developing countries. Overseas Development Institute Working Paper; 2004.
4. Goreaux L. Prejudice caused by industrialized countries subsidies to cotton sectors in Western and Central Africa. Background Document to the Submission made by Benin, Burkina Faso, Chad and Mali to the WTO. TN/AG/GEN/4, Geneva: World Trade Organization; 2003.
5. Goldin I, Rogers H, Stern N. The role and effectiveness of development assistance: Lessons from World Bank experience. World Bank Research Paper; 2002.
6. Badiane O, Ghura D, Goreux L, Masson P. Cotton sectors strategies in West and Central Africa. IMF Working Paper 02/173, International Monetary Fund. African Department; 2002.
7. Alston JM, Brunke H. Impacts of reductions in US cotton subsidies on the world price of cotton and implications for West African Cotton Producers. Oxfam America Research Report; 2006.
8. Anderson K, Valenzuela E. The WTO's Doha cotton initiative: A tale of two issues. Mimeo, World Bank, Washington DC, 2006
9. Sumner DA. A quantitative simulation analysis of the impacts of US cotton subsidies on cotton prices and quantities. Presented to the WTO Cotton Panel; 2003.
10. Shepherd B. The impact of U.S. subsidies on the World cotton market: A reassessment. Grouped' Economie Mondiale, Institutd' Etudes Politiques de Paris; 2004.
11. Ray D. Low prices here and abroad: Are subsidies the cause or the result? Ag Trade News; 2002.
12. IFDC. Linking cotton and food security in the Cotton-Four (C-4) countries. IFDC Report. 2013;38(1).
13. Hussein K, Perret C, Hitimana L. Economic and social importance of cotton in West Africa: role of cotton in regional development, trade and livelihoods. Sahel and West African Club Secretariat/OEC; 2005.
14. Baffes J. The "cotton problem" in West and Central Africa: the case for domestic reforms. Economic Development Bulletin No. 11, CATO Institute. Center for Global Liberty & Prosperity; 2007.
15. Baffes J. Cotton and developing countries: A case study in policy incoherence. World Bank Trade Note 10, Washington DC; 2003.
16. Anderson K, Nelgen S. Updated national and global agricultural trade and welfare reduction indexes, 1955 to 2010. Available at: [www.worldbank.org/agdistortions](http://www.worldbank.org/agdistortions), World Bank, Washington DC; 2012.
17. Muhammad A, McPhail L, Kiawu J. Do U.S. cotton subsidies affect competing exporters? An analysis of import demand in China. Journal of Agricultural and Applied Economics. 2012;44(2):235-249.
18. Poulton C, Gibbons P, Hanyani-Mlambo B, Kydd J, Maro W, Larsen MN, et al. Competition and coordination in liberalized African cotton market systems. World Development. 2004;32(3):519-536.

19. Alston JM, Sumner DA, Brunke H. Impacts of reduction in U.S. cotton subsidies on West African cotton producers. Oxfam America Research Report; 2007.
20. Boansi D. Comparative performance of agricultural export trade: During and post-agricultural diversification project in Ghana. *British Journal of Economics, Management & Trade*. 2014;4(10):1501-1511.
21. Delpeuch C, Vandeplass A, Swinnen J. Revisiting the "cotton problem": A comparative analysis of cotton reforms in sub-Saharan Africa. LICOS Discussion Paper 290/2011; 2011.
22. Boansi D. Competitiveness and determinants of cocoa exports from Ghana. *International Journal of Agricultural Policy and Research*. 2013;1(9):236-254.
23. Balassa B. Trade liberalization and revealed comparative advantage. *The Manchester School Econ. Soc. Stud.* 1965;33(1):99-123.
24. Ferto I, Hubbard LJ. Revealed comparative advantage and competitiveness in Hungarian agri-food sectors. *The World Economy*. 2003;26(2):247-259.
25. Siggel E. International competitiveness and comparative advantage: A survey and a proposal for measurement. *The many dimensions of competitiveness*. CESifo Venice Summer Institute; 2007.
26. Vollrath TL. A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Weltwirtschaftliches Archiv*. 1991;130:265-279.
27. Vollrath TL, Vo DH. Agricultural competitiveness in an independent world. In: *Agricultural and Governments in an Independent World*. International Association of Agricultural Economists Occasional Paper No. 5 (Aldershot: Gower); 1990.
28. Bano S, Scrimgeour F. Market analysis and revealed comparative advantage. University of Waikato Working Paper in Economics 08/11. Department of Economics, New Zealand; 2011.
29. Vollrath TL. Competitiveness and protection in world agriculture. *Agricultural Information Bulletin No. 567*. Economic Research Service, US Department of Agriculture, Washington DC; 1989.



## APPENDIX

### Appendix 1. Detailed world trade flows for cotton lint exports

Country	Export destinations for the period 2006-2010			
	Between 0% and 1%	Between 1% and 10%	Between 10% and 25%	Between 25% and 100%
United States	Canada, Brazil, Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina, Chile, Iceland, United Kingdom, Norway, Finland, Russian Federation, Poland, Germany, France, Belgium, Netherlands, Spain, Italy, Switzerland, Morocco, Senegal, Liberia, Togo, Tunisia, Egypt, Saudi Arabia, Congo DR, Angola, Pakistan, India, Cambodia, Malaysia, Philippines, Japan, Australia, New Zealand	Mexico, Turkey, Bangladesh, Thailand, Vietnam, Indonesia	China	
India	United States, South Africa, Togo, Congo Republic, Tanzania, Kenya, Eritrea, Saudi Arabia, Oman, Turkey, Greece, Italy, France, Germany, Belgium, Netherlands, France, United Kingdom, Nepal, Thailand, Malaysia, Japan, Korea Republic	Pakistan, Indonesia, Bangladesh		China
Australia	India, Brazil, United States, Pakistan, Turkey, Italy, Malaysia, Philippines	Japan, Korea Republic, Indonesia, Thailand, Bangladesh	China	
Uzbekistan				
Brazil	United States, Venezuela, Ecuador, Bolivia, Paraguay, Chile,	Thailand, Vietnam, Japan, Bangladesh, Turkey, Argentina	China, Indonesia, Korea Republic	

Country	Export destinations for the period 2006-2010			
	Between 0% and 1%	Between 1% and 10%	Between 10% and 25%	Between 25% and 100%
	Morocco, Portugal Algeria, Italy, Germany, France, Belgium, Netherlands, Switzerland, India, Korea Democratic People's Republic, Malaysia, Philippines			
China		Nigeria, India, Pakistan, Bangladesh, Myanmar, Indonesia, Thailand, Vietnam, Japan, Korea Republic		Korea Democratic People's Republic
Burkina Faso	Cote d'Ivoire, Germany, Greece, Turkey, India, China, Pakistan, Indonesia	Togo	France, Belgium, Netherlands, United Kingdom	Switzerland
Benin	Turkey, Bangladesh, Tunisia, Morocco, Spain, France, Germany, Italy	Pakistan, Indonesia, Malaysia, Thailand, Vietnam, Portugal	China	
Cameroon	Nigeria, Morocco, Portugal, France, Germany, Belgium, Italy, Greece, Bulgaria, United Arab Emirates, Pakistan, India, Japan	Indonesia, Turkey, Bangladesh	China	
Côte d'Ivoire	Philippines, United Area Emirates, Ghana, Morocco, Portugal, Spain, Tunisia, France, Germany, Belgium, Greece	Italy, Malaysia, Thailand, Bangladesh,	China, Indonesia, Vietnam	
Chad				
Mali	Malaysia, Tunisia, Portugal, Italy, France, Germany, Netherlands	Japan, Indonesia, Thailand, Vietnam, Bangladesh, India, Pakistan, Togo, Cote d'Ivoire, Morocco	China, Senegal	

**Appendix 2. Share of cotton lint by value in total agricultural exports (%)**

Countries	Share of cotton lint exports by value in total agricultural exports (%)							
	2005	2006	2007	2008	2009	2010	2011	Mean
World	1.54	1.56	1.30	0.92	0.94	1.32	1.59	1.31
United States	6.00	6.31	4.94	4.09	3.35	4.84	6.02	5.08
India	7.09	11.84	12.68	3.72	12.40	14.91	11.21	10.55
Australia	3.84	3.61	2.22	1.60	1.96	3.60	7.59	3.49
Uzbekistan	77.14	71.45	70.35	61.47	40.31	62.65	46.88	61.46
Brazil	1.46	0.98	1.18	1.26	1.29	1.32	2.00	1.36
China	0.11	0.20	0.19	0.14	0.15	0.19	0.24	0.17
Burkina Faso	76.40	79.10	79.19	78.02	68.26	61.22	55.38	71.08
Benin	64.46	31.72	39.57	32.35	23.43	16.36	20.65	32.65
Cameroon	22.04	17.23	16.21	7.46	9.21	7.23	10.30	12.81
Côte d'Ivoire	4.63	3.57	2.82	1.84	1.33	2.22	2.08	2.64
Chad	49.06	53.85	47.52	37.38	28.89	26.10	51.82	42.09
Mali	82.28	72.89	63.21	58.67	38.22	45.83	63.93	60.72

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