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## Rethinking the Africa-China Trade: Some Policy Considerations and Implications

By

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*Trade between China and Sub-Saharan Africa (SSA) is characterized by China's importing mining and extraction from SSA and SSA's importing manufactured goods from China. We perform accounting and simulation exercises to analyze how trade policy and productivity shocks will reduce SSA's dependency on raw material export to China. Scenarios include tariff elimination by China, common external tariff in SSA, and free regional trade in SSA. We also include shifts in labour productivity in SSA's agriculture and manufacturing sectors and simulate technology spillover from SSA imports from China. Results show that tariff elimination by China increases SSA's employment and welfare. Raising tariffs on manufactured goods from China reduces welfare and employment by harming consumers and the agriculture sectors dependent on intermediate goods from China. Increase in labour productivity and technical progress in SSA's manufacturing sectors improve welfare but will not alter the high share of mining and extraction export to China.*





## 1. Introduction

In parallel with its economic and trade expansion, China's trade with Sub-Saharan Africa (SSA) has grown faster than ever in the last 10 years and in 2011 was estimated at 111 billion dollars (Cossou, 2011; Lu, 2011). But the SSA-China trade has been asymmetric and characterized by China's almost exclusive importing of raw materials (mining and fossil oil) from SSA to feed its strong manufacturing sectors and by SSA's importing of manufactured goods (including machineries and transportation equipment) from China (Kaplinsky et al, 2008; Kaplinsky and Morris, 2009).<sup>1</sup> The worry is that such a pattern will increase SSA's risky dependence on extraction and mining as a source of export revenue and undermine the development of its agriculture and manufacturing sectors, which are main sources of value addition and employment.<sup>2</sup> It is, therefore, important to review how trade between the two blocs can be diversified to contribute to solving economic and development problems (poverty, food insecurity, unemployment) facing many SSA countries.

The main purpose of this paper is to examine how countries in SSA can diversify their export and expand benefit from their trade with China. One way for SSA to seize and expand any gain, especially in employment and value addition from its trade with China and the rest of the world, is to increase the export share of processed manufactured goods. In this paper, we review first some trade policy options that have been tried or considered such as reduction and elimination of the tariff on China's importation of agricultural and manufactured products from SSA, and a common external tariff, i.e. increase in protection, against SSA's imports from China. But because an important requisite for diversification towards manufacturing is productivity growth and technical progress, we have to examine next how shifts in productivity, especially in manufacturing, will affect SSA's welfare and its trade with China. This emphasis on the impacts of productivity shifts requires attention because the lack of productivity growth and technical

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<sup>1</sup> 15% of China's total import in extraction mining comes from SSA, 10% comes from Central Africa and 3.4 % from Eastern Africa. Similarly, Central Africa and East Africa export about 26 and 43% of their total export in Extraction and Mining products to China.

<sup>2</sup> Past studies (Zafar, 2007; Kaplinsky and Morris, 2009; Haugen, 2011) concluded that, overall, SSA's gains from trade with China were minimal, especially in sectors such as agriculture and manufacturing.



progress has been widely known as one of the major constraints in manufacturing sectors in SSA countries.

Using a Computable General Equilibrium (GTAP by Hertel, 1997) model, we perform accounting and simulation exercises to analyse the impact of trade policy and productivity shocks on SSA's welfare. The model allows the study of the impacts across sectors and main agents (government, households, and firms). The innovation in this study is the use of recent estimates of labour productivity for all trading partners (see van Dijk, 2013). Moreover, we simulate that SSA's trade with China produce positive effects (spillover effects) on SSA's productivity. To our knowledge, these approaches have never been much used in the past, especially with regards to trade between China and Sub-Saharan Africa. We also study these scenarios in the context of free regional and continental trade in SSA, and differentiate the impacts among four major sub-regional groups (Western Africa, Eastern Africa, Central Africa and Southern Africa).

Past studies have highlighted the limited impacts of China-Africa trade on SSA's welfare and provided insights for our studies. Lu (2011) reports that since about 90% of China import from SSA is fossil oil, metal and mining products, Africa's trade balances in manufacturing and agriculture, where job creation and food security could thrive, have remained in deficit. As evidence, many SSA countries that export high volume of oil and mining products to China still face severe food insecurity and high unemployment.<sup>3</sup> In agriculture, Villoria (2009b) focuses on the case of Southern African countries and finds that there is no complementarity between China's import demand and Southern African countries' exports; even China's rising demand for agricultural products seems to have no direct impacts on food exports from these Southern African countries. Villoria (2009a) focuses on the impacts of Chinese exports of manufacturing to selected African countries and concludes that manufactured products (apparel and equipment) imported from China have lowered global manufacturing prices for consumers. However, the low global prices of manufactured goods have considerably depressed the export prices for manufactured goods from SSA, hence deteriorating the terms of trade in Africa's manufacturing sector and affecting manufacturing wages and employment negatively. Our analysis improves on

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<sup>3</sup> Similarly, Kaplinsky and Morris (2009), and Renard (2011) agree that despite the increase in investment (especially in agriculture) from China, the impacts on African countries' economies remain limited and, at best, mixed.



these past studies by focusing on key trade policy shocks and on productivity shifts that may reverse the trade imbalance caused by the prominence of mining and extraction in the China-SSA trade. We do so in an attempt to identify policy options that may spur the growth of processing and manufacturing sectors, leading to significant increase in employment and total welfare.

## **2. Review of Policies and Options**

### *2.1 Some policy considerations*

Sub-Saharan Africa (minus South Africa) remains a small trading partner for China. (We note that in our simulation exercises, we put South Africa in the same group as Brazil, Russia, and India, i.e. in the BRIS countries). Data show that only 2.4% of China's import comes from SSA and 90 % of China's import from SSA is crude oil and mining products. Moreover, China's export to SSA represents only 1.5 % of its total export. For SSA however, China is a significant import source, supplying 10% of SSA's imports. In 2008, for instance, SSA's import from China was valued at about USD 25 billion per year and mostly composed of products from the textile and apparel (24%) and light and heavy manufacturing (62%) sectors.

Concerning trade policies, it appears that there is not much manoeuvring left to do because China is already one of the most open markets for SSA. China's average tariffs towards least developed countries in general and SSA in particular are already low (see Dong (2013) and also table 1). Between 2005 and 2010, the weighted average tariff fell from 2 to 0.5% (average tariff fell from 7.14 to 2.83%). But because SSA's export volume to China is small, the tariff reduction has done little to increase welfare and to improve terms of trade. Similarly, subsidizing exports may not have positive lasting effects since many SSA countries are cash-strapped, and subsidies are often unsustainable, especially given the high competitiveness of Chinese manufacturing in the world market.

(Table 1, here)



A few feasible policies are, however, worth examining. First is the restriction on oil and mining extraction. Sub-Saharan Africa's leverage to further restrict and tax the export of crude oil and mining has been considered by local and national governments, although enforcement of such restriction remains problematic. For instance, local and national governments often have large shares in the oil or mining companies and cannot afford to lose revenue from reduced export volume. Similarly, raising the export tax on crude materials will increase government revenue. But all of these restrictions may have unintended consequences such as illegal trading (black market) especially when market institutions and enforcement are weak.

Another policy possibility is that SSA increases tariff on its imports of manufactured goods from China. While this import substitution policy may protect domestic manufacturing sectors, there is no guarantee that such a policy would increase welfare, especially if it may lead to increases in the prices of equipment and essential inputs (as intermediate inputs for SSA's manufacturing), and the production, employment and income from local firms shrink. Analysis of the welfare effects of such protection against Chinese imports remains important for decision making and is covered in this paper.

## *2.2 Manufacturing could play a bigger role*

While considering all the possible alternatives that could improve SSA's welfare significantly from its trade with China, it is important to examine closely the structure of SSA trade. Sub-Saharan Africa's trade is characterized by its low level of manufactured good exports: 60% of SSA's total export revenue comes from mining and extractions and only 13.5 % comes from manufactured goods other than food. This pattern is more pronounced in its trade with China: 90% of SSA's export to China is concentrated on mining and extractions while exports of manufactured goods represent less than 5%. Reversing this trend, i.e. diversifying towards more processing and manufacturing products, remains an option in the search of strategies to increase trade impacts on SSA's welfare.

China could play a big role in SSA's export diversification towards processing and manufacturing for three reasons. First, China remains a large export market for the rest of the world; as its per capita income continues to rise, the demands for semi-processed or even



processed goods will too. Second, China is a potential source of employment to the rest of the world: with the increase in income per capita in China, the opportunity costs of labour also increase, prompting manufacturers in China to outsource activities in many developing countries in Asia (e.g. Vietnam) and Africa, or even re-shore some activities back to the US<sup>4</sup>. Third, increased trade (export or import) in manufactured goods with China will increase the likelihood of technology and R&D spillover. After all, China is SSA's largest import source of manufactured goods: about a quarter of SSA's imports of manufactured goods, namely 14% for light and 11% for heavy manufacturing imports, comes from China alone. More important, 64% of the USD 25 billion SSA imports from China comes from the manufacturing sectors (Light Manufacturing 22%, Heavy manufacturing 42%) and from the textile and apparel (22%) sector. Overall, China's roles as an export market destination, a provider of employment and a source of technology and R&D spillover that have been overlooked in past studies are taken into account in our analysis.

### *2.3 Technology, productivity and human capital shifts*

Sub-Saharan Africa's manufacturing export has been lagging behind due to its low labour productivity and lack of technical progress. The lessons from the failure of the import substitution policies in the late 1970's and early 1980's show that skill and human capital are keys to any development in manufacturing sectors. For instance, it was often the case that investors (including Chinese investors) imported skilled labour to carry out specialized tasks as local skilled labour was scarce or less mobile across sectors. Table 2 compares the projection in labour-productivity growth rates by sector in selected regions and shows that China and Sub-Saharan Africa are at the two opposite ends of the labour-productivity spectrum. To be able to diversify exports towards semi-processed and processed goods or to benefit from spillover effects from manufacturing imports especially vis a vis China, SSA's labour and total factor productivities in the manufacturing sector need to grow fast. Unless its labour productivity increases, SSA will be unable to take advantage of the outsourcing of China manufacturing activities. The question is 'How much technological progress and labour-productivity increase is

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<sup>4</sup> See Wall Street Journal <http://finance.yahoo.com/news/manufacturing-moving-china-us-survey-065217238--finance.html>



needed to stimulate growth of SSA's manufacturing export?' We attempt to address such a question here.

(Table 2 here)

### **3. The Model, Data and Method**

#### *3.1 The model*

##### **3.1.1 Overview of the GTAP model**

We employ GTAP, a General Equilibrium model, to determine the impacts of a mix of trade policy and productivity shifts on SSA's trade with China, welfare, employment, and terms of trade. Global CGE models are useful for estimating policy impact, particularly with an inter-sectoral linkages and constrained resources/factors perspective. The GTAP model is one of the most widely used models and is defined in linearized difference equations; therefore, most of the variables are in percentage change. Each country or region is represented by a regional household, which has a Cobb-Douglas utility function that distributes aggregate demand into three different categories in every regional household, namely, savings, private household and government. A regional household's income comes from various taxes and primary factor payments. Savings from each region are accumulated into global savings, which is allocated to different regions as investment based on the movement of prices of capital goods as well as expected rate of return inferred from the capital stock in the beginning and end of the simulation period. Private households determine their expenditure based on a per-capita Constant Difference Elasticities (CDE) implicit expenditure function.

Various types of prices in the model are linked with each other through tax/subsidy wedges, which exist across the user types, outputs and sources of use and production. The Armington assumption helps differentiate domestic commodities from imports as well as among import sources. Trade links the regions, each of which has an identical model structure outlined herein. The percentage change in bilateral imports of a commodity, for example, is derived from two terms: an expansion term that arises from the overall change in aggregate imports in the importing region and a substitution term that captures the shift of demand from one source to



another, based on the Armington elasticity and the difference between percentage changes in bilateral import prices and those in the destination-generic aggregate prices.

Demand for commodities across user types is determined by a two-stage process: first, the user (firms, private household or government) decides the total demand, based on the regional household's utility function; secondly, each user decides how much of it needs to come from domestic sources and from imports. For firms, for example, the change in domestic consumption of a first commodity used in the production of another (second) commodity in a region is simulated by the overall change (domestic + imports) in this particular consumption (expansion effect) and the domestic-import Armington elasticity, multiplied by the differential between domestic prices of the first commodity used to produce the second commodity and aggregated (weighted average of domestic and imported prices) prices of the same.

Production is depicted in a multi-nest system. On the top, firms decide to produce certain quantities of output; a Leontief structure is then used to choose between the value-added composite commodity and intermediate input composite commodity; CES nests are then defined among the value-added categories (usage of various factors) and different intermediate inputs.

The model features market-clearing conditions for outputs (across domestic and exports), imports (by users as firms, households and government), domestic consumption (by users as assigned for imports) and endowment output (by usage in various sectors). Zero profits are assumed in the standard form of this model, implying perfect competition. This condition is employed to infer the endogenous output change in every sector.

Welfare of different regions is represented by Equivalent Variations (EV). Welfare effects may be decomposed into main components such as allocative efficiency, terms of trade, technology, endowment, and investment-savings adjustment effects. As in many CGE model, exogenous shocks such as a tariff reduction in one sector affects output prices and trade volumes in other sectors. Similarly, input uses and prices are affected, leading to re-allocation of the resources and if output among sectors. In our paper, the GTAP model simulation will be mainly focused on trade policy and productivity shocks and their effects on terms of trade, wages and employment of factors (especially labour) in the manufacturing and agricultural sectors.



### 3.1.2 Technical changes and Productivity shifts in the GTAP model

Because an important emphasis of this study is on the role of technical progress and productivity in SSA trade with China and the effects on welfare, we summarize here how shifts in productivity and technical progress are captured in the model. As stated earlier, the production function  $Y$  in the GTAP model is in a Leontieff form for which output is produced from primary inputs (mainly land, labour, and capital) nested in and source (i.e. domestic and foreign source) differentiated intermediate inputs. The primary inputs (land, labour and capital) are imperfect substitutes in a nested CES function  $Q_v$ . The technological shifts in the domestic production in the GTAP model are through Hicks-neutral (for overall productivity) shift at the Leontieff level and input productivity parameters at the second stage nested.<sup>5</sup>

In summary, the production function is

$$(1) Y = A_0 \min\{A_{i1}Q_{i1}, \dots, A_{in}Q_{in}; Q_v\}$$

where

$$(2) Q_v = \left[ \sum_e (A_e Q_e)^{-\rho} \right]^{-1/\rho} \quad (e = \text{land, unskilled labour, skilled labour, capital}).$$

$Y$  is output,  $A_0$  is Hicks-neutral change parameter;  $A_{ij}$  is output-per unit input coefficients, and  $Q_{ij}$  is quantity of intermediate input for country  $i$  from source  $j \neq i$ . Moreover,  $Q_v$  is the domestic second-stage CES production function using primary inputs  $e$ ;  $A_e$  is share parameter of input  $e = \{\text{land, unskilled labour, skilled labour, and capital}\}$ ; and  $-1 < \rho < \infty$  is the elasticity of substitution parameter. The neutral shift in overall productivity is due to shift in parameter  $A_0$ , and the shift in of the productivity in the intermediate and primary inputs are due to parameters  $A_{ij}$  and  $A_e$  respectively. For this study, the technical and productivity shifts of interest are particularly on  $A_0$  and  $A_e$  especially for  $e = \text{labour}$ . As (1) and (2) show, these technical and productivity shifts affect production directly, which affect price and the comparative advantage of an open economy. In an open economy, technical progress and increases in productivity lead to welfare gain due to increased competitiveness of production and export.

<sup>5</sup> Full explanations are found in van Meijl and van Tongeren (1999)



More important, domestically, an increase in labour productivity, for instance, leads to an increase in the marginal value products of other inputs (especially capital). This leads to an increase in technical efficiency which enhances welfare gain. And there can also be a gain in allocative efficiency when sectors that use labour intensively expand and attract productive labour from other sectors. This allocative efficiency effect is noticeable under full employment of resources, especially as rises in factor payments are expected. When there are unemployed resources (and factor returns are more or less fixed), the increases in labour productivity and production increase the demand and hiring of resources and, as a result, the country's or region's welfare increases. The welfare effect of such an increase of the use of formerly unemployed resource is termed endowment effects.

In this study, we intend to capture these welfare changes. In particular, we estimate the impacts of trade policy shocks for the SSA-China trade by taking into account differences in labour-productivity trajectories among all trading partners. The estimates of productivity growth across regions and sectors are obtained from van Dijk (2013), as shown earlier in Table 2, are introduced into the model. Through sensitivity analysis and by varying these values for SSA, we analyse what growth rates of labour productivity and technology enable SSA to benefit from trade and reverse its dependence on extraction and mining export, especially with China.

### *3.2 The Scenarios and closures*

The scenarios are summarized in Table 3. It is important to note that all the scenarios in this paper include the forecast values of labour productivity change (van Dijk, 2013). We started in Scenario 1, the benchmark, where the only shock to the model is the labour productivity growth rates as estimated in Van Dijk (2013). We continue in Scenario 2 to add the policy that China eliminates the already low tariff levels applied to its imports to SSA and other developing countries. In scenario 3, we examine the effects of import substitution policies by simulating a rise in protectionism against Chinese goods in SSA. In Scenario 4, we disaggregate the SSA region into four sub-regions and conduct sensitivity analysis to determine how the rates of



labour-productivity growth and spillover effects from trade with China affect welfare in the sub-regions of SSA.

(Table 3 here)

One of the main closures of the model employed here is that there is unemployment of unskilled labour and full employment of skilled labour in SSA for all scenarios. In other words, real wage is fixed for unskilled labour but is flexible for skilled labour. Such an assumption is justified by the high unemployment of young adults in both rural and urban areas, and the lack of specialized production or managerial skills in manufacturing sectors in many countries in SSA. Another important closure is that the trade balances are exogenous for SSA meaning that the shadow price of savings is flexible when demand for savings (or investment) varies. Similar closure on trade balance is also assumed for other developing region such as Latin America (without Brazil). The main assumption underlying the fixed trade balance closure is that many SSA countries and other developing countries are net recipients of investment flow. Full details of the scenarios and closures are in Appendix 1.

### *3.3 The Data*

The GTAP dataset is used in tandem with the GTAP model. This paper employs GTAP database version 8 (Narayanan and Walmsley, 2008) and the standard Global Trade Analysis Project (GTAP) model (Hertel, 1997; Hertel and Tsigas, 1997) to analyse welfare and macroeconomic impacts of different policy scenarios on trade between China and Sub-Saharan Africa. The version of the GTAP data base and model is obtained through aggregation of the original version, and includes seven regions, eight sectors and five factors. The regions are China and Hong Kong; Sub-Saharan Africa (minus South Africa); Middle East and North Africa (MENA); the group combining Brazil, Russia, India, South Africa (BRIS); Latin America; North America; the European Union (assembling 27 countries); and the Rest of the World. Later in the analysis,



we will break SSA region into 4 sub-regions (Western, Central, Eastern, and Southern Africa). The sectors include Raw Food and Agriculture, Processed Food, Extraction and Mining, Textile and Apparel, Light Manufacturing, Heavy Manufacturing, and Services. The factors are Land, Capital, Unskilled Labour, Skilled Labour, and Natural Resources. Details on model aggregation are shown in Appendix 2.

#### **4. Simulation Results and Interpretation**

##### *4.1 Benchmark: Differences in labour productivity growth rates across regions and across sectors are taken into account (Scenario 1)*

We first start with the benchmark (Scenario 1) in which regions follow the labour productivity path under the van Dijk (2013) projections in Table 2. We immediately note from the results summarized in Table 4 that because of its weak labour productivity especially in manufacturing, SSA is the only region that incurs welfare loss (of USD 604 million). This loss is mainly due to the losses in endowment effects (i.e. loss in employment) and in technical efficiency. Negative endowment effects mean that inputs (especially labour) become unemployed as the output production and input demand shrink. Technical efficiency loss occurs when the region's production frontier moves inward (lack of technological progress or lack of productive input) while input levels are held constant (e.g. making input less productive). In an open trade, inefficient sectors like SSA's manufacturing sectors lose output (hence employment) and export opportunities to other regions with more productive labour.

(Table 4 here)

##### *4.2 Effects of unilateral tariff elimination by China on SSA (Scenario 2)*

For this scenario, we assume that China eliminates all tariffs on imports from SSA (i.e. all tariff rates shown in Table 1 are eliminated). China's tariff towards LDCs had been low before the 2007 tariff cut, but the 2011 decision to reduce tariff by an average 1.5% for its import from LDC alone had a positive but very limited impact on welfare in LDCs (Dong and Yang, 2013). Comparison of Table 4 and 5 indicates that the elimination of tariff on imports from SSA to China would increase SSA's welfare only by USD 130 million. This relatively slight



improvement comes mostly from allocative efficiency (USD 40 million) and endowment (USD 63 million) effects. However, SSA remains the sole loser of global trade with a total loss of USD 475 million.

(Table 5 here)

The increase in employment of unskilled labour shown by the endowment effect is modest and affects all sectors except the ‘textile and apparel’ and the ‘extraction and mining’ sectors. The distribution of the allocative efficiency shows that the elimination of tariff makes the light and heavy manufacturing sectors slightly more efficient: the tariff cuts attract productive labour and capital to these two sectors, raising outputs and total welfare. We also note that SSA’s terms of trade effects improve welfare by about USD 32 million mainly because of the increase in both price and volume of exports following the tariff elimination.

Furthermore, in Scenario 2, Chinese exports to SSA and the other regions increase despite the elimination of tariff for LDC goods. This is mostly attributed to China’s strong labour productivity growth (according to Table 2) in almost every sector. With the tariff elimination, China’s terms of trade and investment and savings effects slightly declined by USD 25 and 5 million, but its allocative efficiency and endowment effects have increased by USD 24 and 35 million respectively. Overall, the elimination of tariff on imports from SSA improves China’s welfare by about USD 39 million, though this amount is small compared to the size of China’s trade. Overall, although the gains are relatively small, both SSA and China benefit from elimination of tariff on Chinese import of SSA’s goods. We also note that the tariff elimination has no significant effect on the structure of SSA’s export to China (see Table 6), as the export share of extraction and mining products remains high.

(Table 6 here)

#### *4.3 Import substitution effects and protection (Scenarios 3a and 3b)*

We now examine the effects of the inward-looking policy, portrayed in Scenario 3a by simulating a 10% tariff increase on imports for all manufactured goods (processed food, light and heavy manufacturing, and textile and apparel) from China to SSA. The results of such



protection are presented in Table 7, showing that with the 10% tariff increase, SSA's total welfare would be USD 1.1 billion lower than in Scenario 2 and USD 0.98 billion lower than under the benchmark in Scenario 1. These results are consistent with the fact that SSA remains a minor export destination for China's vast manufacturing sectors, and the increases in SSA's government revenue and producer surpluses are far smaller than consumers' loss. Moreover, the welfare decomposition from Scenario 3a indicates that in comparison with the benchmark (scenario 1), the terms of trade effects increase by USD 430 million, but this gain is outstripped by the losses in endowment effects (down by USD 500 million) and in allocative efficiency effects (down by USD 770 million).

(Table 7 here)

These significant losses in allocative efficiency and endowment (especially employment) deserve some explanations. The allocative efficiency loss is due to the reallocation of unskilled labour from more productive sectors (such as light and heavy manufacturing) towards less productive sectors like textile and apparel. The 10% increase in tariff across all manufacturing sectors yields a higher increase in protection in the textile and apparel sector than in any other manufacturing sector because the initial tax on textile and apparel is already high. This causes output and price changes to be higher in the textile and apparel sector than in the other manufacturing sectors (see Table 8), prompting employees to move mostly to that sector.

(Table 8 here)

We note however that the decomposition of the tax effects (see Appendix 3) shows that more than half of SSA's loss in allocative efficiency as a result of the 10% increase in protection across sectors is attributed to production (or output) tax. In other words, the reallocation of resources due to the increase in tariff generally does more harm to SSA's domestic production than to its imports. This is mainly because domestic production in SSA relies on manufactured goods (i.e. intermediate goods) from China, and the increased protection against Chinese manufactured goods affects domestic production negatively, especially in large sectors such as 'raw food and agriculture', 'processed food', 'extraction', and 'service'. The shrinking of these large sectors prompts some of their labour force to move to the textile and apparel sector or,



because such industries cannot absorb them all, go unemployed. This is consistent with the loss in overall employment expressed by the loss in endowment effects in the simulation results.

We recall in particular from Table 8 that for the two key sectors dealing with food security, namely the raw and processed food and agricultural product sectors, outputs decline and prices rise. Such results indicate that increases in protection against manufacturing imports from China would hamper SSA efforts to reduce food insecurity. The GTAP core data show that more than 70% of the imported intermediate goods in SSA's raw food and agriculture sector come from imported light and heavy manufacturing products; for the raw food and agriculture, the corresponding figure is 31%. Since manufacturing imports from China account for more than a quarter of total SSA imports in manufacturing products, it is not surprising that any restriction on manufacturing products from China has a noticeable reduction in outputs in the raw and processed food and agriculture.

Under this scenario, the contribution of terms of trade to welfare increases as the volume and price of imports decline, but it remains small relative to the contribution of the combined effects of allocative efficiency and endowment. Overall, the import substitution policy by taxing Chinese goods will reduce welfare and employment in SSA.

We also analyse some perhaps extreme export restriction measures for raw material exports (Scenario 3b) by simulating the effects of a 10 % tax increase on SSA's raw food and agriculture products exported to China and an arbitrary 50% on SSA's extraction and mining products exported to all regions. The welfare impacts are reported in Appendix 4, which shows that although total welfare will increase mainly because of increased terms of trade and government revenues, the structure of SSA's exports remains unchanged: raw materials and especially extraction and mining products still account for more than 50% of its export revenue. With regards to its exports to China, the SSA's export share of the extraction mining products remains large (82%).

#### *4.4 Productivity and sensitivity analyses (Scenario 4)*

Our analyses so far have shown that lagging labour productivity growth harms SSA's welfare and that heightening protection against Chinese manufacturing goods will deepen the loss. The



question is then ‘how can SSA overcome the welfare loss and benefit from world trade, especially its trade with China?’ One of the direct answers would be ‘by improving its labour productivity growth rate’, but then, the next question is ‘by how much?’ Scenario 4a and 4b attempt to address these questions analytically. Two additional sets of changes are made in the model: (i) disaggregation of SSA into four sub-regions in order to differentiate among the impacts of policy changes across sub-regions and (ii) elimination of internal tariff within and among the sub-regions to capture how these free trade areas affect China and SSA trade.

#### 4.4.1 Effects of elimination of tariffs on Chinese goods in a disaggregated SSA

We divide the SSA region into 4 sub-regional groups as indicated in Table 9. These regional groups approximate the existing Regional Trading Areas.

(Table 9 here)

From here, we take Scenario 2 as the starting point, i.e. we maintain in the model both the Van Dijk labour productivity estimates shown in Table 2 and the elimination of tariffs (listed in Table 1) between China and SSA. We then repeat the simulation of Scenario 2 but with the disaggregation of SSA into four sub-regions. The results of the simulation with disaggregated regions in Scenario 4a are summarized in Table 10: it shows that although SSA as a whole loses, the welfare impacts vary widely among the sub-regions. The West African (loosely ECOWAS) and Central African (CA) countries seem to gain from the elimination of import tariff by China, but these gains are cancelled by the losses in East African (EA) and Southern African (loosely SADC minus South Africa, the latter is counted in the BRIS region) .

(Table 10 here)

Explanation of these differentiated impacts goes back to the structure of trade between China and the sub-regions. Appendix 5 provides an explanation: relative to the rest of the subgroups, ECOWAS has always been the largest export destination for China while CA is the largest import source for China. As Table 11 shows, most of the gains come from terms of trade effects as export volume generally increases, especially in ECOWAS countries. Why CA gains much in terms of trade remains puzzling. (Perhaps because of Gabon’s and Congo Republic’s mining resources.) Table 11 indicates that increases in export volumes especially in raw food and



agriculture and light manufacturing products contribute to this improvement of terms of trade effects, especially for ECOWAS. However, these increases remain relatively modest.<sup>6</sup>

(Table 11 here)

#### 4.4.2 Sensitivity Analysis: Increases in productivity

We now focus on Scenario 4b to examine how welfare in these sub-regions will change if labour productivity improves and if there are positive R&D spillover effects from Chinese imports that shift output. The basis of comparison for the sub-regions is results from Scenario 4a (shown in table 10 above).

Since it is in manufacturing sectors that labour productivity in SSA is currently lagging far behind, we simulate some modest increases in labour productivity and in total productivity in general for the manufacturing sectors. Accordingly, we first simulate a 1% increase of labour productivity in all four manufacturing sectors (Food and ag. Processing; Textile; Light Manufacturing; and Heavy Manufacturing) in the model, then we redo the simulation by adding a 1% increase in overall productivity in all of these four manufacturing sectors. The results of these simulations are summarized in Table 12 and Table 13.

(Table 12 here)

(Table 13 here)

Results show that 1% increase in labour productivity, a stark contrast from the -6% current projection, may lead to a significant increase in overall welfare in the four sub-regions, especially in ECOWAS. As expected, the technical efficiency effects (gain to the economy as the production frontier moves outward while input levels are held constant) of such an increase contribute most to the welfare increases. We note also a significant increase in the endowment effect (job creation) in ECOWAS. Moreover, the increase in overall productivity by 1% almost doubles total welfare in the four sub-regions (Table 13). This modest increase in overall

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<sup>6</sup> Our simulation results (not reported here) show that even without tariff elimination, ECOWAS and CA do relatively well but EA and SADC do worse if the current productivity growth path continues to hold. Massive unemployment (a negative endowment effect) occurs mostly in EA.



productivity in all manufacturing sectors mimics what a spillover effect of trade with China could have been, i.e if we simply assume that manufacturing trade with China affects a 1% increase in overall productivity in manufacturing in SSA. These results support the relatively high response of the sub-regions' economies even to a modest increase in productivity.

#### *4.5. Free Trade within and between RTAs in SSA*

How will these findings change in the context of a free trade within and among the SSA sub-regions (that is, if all tariffs within and among the SSA subgroups are zero). We examine this possibility while maintaining zero tariff for SSA's manufacturing goods imported by China, a 1% increase in labour productivity and a 1% technological shift due to the spillover effects of trade on R&D. The results are reported in Table 14, which shows that SSA gains about USD 2.2 billion from the free trade within and among its sub-regions. Half of that gain is registered in ECOWAS countries. Note that for China, the free trade within and among SSA sub-regions will cause a loss (i.e. loss from trade diversion) of USD 180 million, which is small relative to China's USD 150 billion welfare increase in the world trade.

(Table 14 here)

We are also intrigued by how the combination of the elimination of tariff on SSA's goods by China, the increase in labour productivity and technological shift in manufacturing, and free trade within and among the four SSA sub-regions affects the structure of trade between SSA and China. To answer that question, we maintain all shocks in the latest simulation except that we allow a 7% increase in labour productivity. The results are summarised in Table 15, which shows that although such a combination of policies and technological shifts will increase welfare, it has no significant effects on the structure of China-SSA trade.

(Table 15 here)



## 5 Summary of the Findings and Implications

### *5.1 Summary of the Findings*

As many countries in SSA still struggle against severe food insecurity, unemployment and poverty, their heavy reliance on the export of raw materials as sources of revenue to solve these problems has long been put into question. In this paper, we focus on the asymmetry of SSA-China trade characterized by SSA's high dependency on the exports of raw materials to and imports of manufactured goods from China. The current state of SSA-China trade is a fresh reminder of SSA's colonial past, when SSA served mainly as a provider of raw commodities (including oil, fish, and extraction and mining products) and as an importer of processed goods, often from the same raw materials it exported. The serious concern is that such asymmetry and especially the dependence on raw materials especially mining and extraction products as main sources of export revenue from China may yet hamper the creation of value added, a reliable source of growth and employment. In rethinking the SSA-China trade, our aim was to explore relevant trade and development policies to alter the current pattern and increase SSA's welfare. Our approach was to examine how manufacturing sectors in SSA can thrive and increase its export shares on sectors other than extraction and mining products. Such an approach implies that SSA's lack of technical advances and low productivity of inputs in manufacturing need to be addressed.

We developed various scenarios and performed simulations involving a mix of policies and labour productivity shifts. We took into account the context of free trade within and among sub-regions in SSA. We also simulated a tariff-free export of SSA's manufactured goods to China. The main innovation in our study is the inclusion of estimates of different labour productivity growth rates across regions and across sectors in the General Equilibrium GTAP model. These labour productivity growth estimates show huge gaps between China and SSA especially in manufacturing, and ignoring these gaps would have biased any estimation. The other innovation is the simulation that the imports from China would yield some technology spillover on productivity in SSA. Our work is still in progress but our early findings can be summarized as follows.



- With its current low labour productivity growth rates especially in manufacturing sectors, SSA continues to lose from global trade, including from its trade with China.
- For SSA-China trade, manoeuvring room for trade policies is limited as Chinese tariffs on imports from Africa are already low. Bringing these tariffs down to zero will lead only to a modest increase in welfare and employment for SSA without altering SSA's dependence on raw material export.
- Likewise, raising tariffs on manufactured goods imported from China will modestly increase domestic manufacturing outputs but significantly reduce SSA's household consumption. Such a protection will also reduce outputs in the production of raw and processed food and agriculture because it strains the import of intermediate goods in SSA's domestic production. As a result of the protection, employment and total welfare will decline.
- Even some modest exogenous increases in labour productivity and technological shifts in manufacturing sectors (due to the R&D spillover effects from its trade with China) will significantly improve SSA's employment and welfare. These productivity increases, however, may not alter the high dependency on raw material exports.
- Similarly, free trade among and within SSA sub-regions will further increase employment and improve welfare in SSA with only a minimal loss for China.
- However, all of these trade policy and productivity and technology shocks on manufacturing have no significant effects on the structure of China-SSA trade. Countries in Central and Eastern Africa continue to be the most dependent on extraction and mining export.



### *5.2 Implications*

These findings have several implications. One important implication is that despite some concerns that African markets are being flooded by Chinese goods, import restriction on these goods would have negative impacts on food security and employment because SSA's households and firms currently depend so much on them. The only sector that benefits from the protection against Chinese import is textile and apparel, but even this sector is unable to either absorb the entirety of the labour force that moved out of the other sectors or offer higher skill jobs that can improve allocative efficiency. Moreover, such restriction would cancel any spillover effect of trade on SSA productivity.

Another implication is that SSA's dependence on export of raw materials as main source of revenue remains difficult to reverse. Our simulation results show that trade policies and productivity shifts in manufacturing have limited effects on reversing the current China-SSA trade pattern. Only a high export tax or a voluntary quantitative restriction by SSA countries' governments on natural resource exports will alter the pattern. Still, these restrictions remain controversial as they often are sources of political conflicts and black markets in countries where market institutions often remain weak.

The findings, nevertheless, imply that SSA shall continue to pursue higher growth rates in labour productivity to capture the loss in international trade. Our simulation results show that even small increases in productivity would have significant impacts on welfare and employment. This high responsiveness is not surprising given the current low level of technology in SSA.

Additionally, free trade within and among the sub-regions would benefit SSA. Moreover, according to our simulation results, China should not fear for such African free trade because its loss, caused by trade diversion, is minimal.

One of the aims of this study is to explore ideas and offer some directions for future research. On the basis of this first wave of findings, the scope of the analysis can be greatly expanded. For instance, we have included an arbitrary and minimal rate of 1% as the productivity shift due to the R&D spillover effect of trade on productivity, but the actual rate may be higher; estimation of the spillover effects on technology by data calibration, or better, by econometric estimation



will be a valuable addition. In the wake of the growing inflows of Chinese Foreign Direct Investment (FDI) to Africa, it may also be worth examining how much of this FDI goes to key sectors such as agriculture and manufacturing, and how FDI will affect production and productivity, employment, and especially trade in these sectors. Such studies can contribute to the search for ways to use the Africa-China trade link to improve welfare in many poor countries in SSA. That said, future research will likely share the same assumptions that heavy reliance on raw material exports as source of revenue is both risky and unsustainable and that to benefit from its trade with China and the rest of the world, SSA needs to do more to revamp its manufacturing sectors through investment in human capital and in R&D, generating a more skilled labour force able to accommodate technological progress.

## Appendix 1

### Details of the scenarios

#### Scenario 1: (Benchmark)

- China exports and SSA continues imports of low-end manufacturing products (for agriculture and services and industries); SSA exports raw materials and extraction.
- Technology progress and labour productivity in China, SSA, other countries are computed using van Dijk's estimation with some adjustment.
- Unemployment exists for unskilled labour, i.e. real wage is fixed for SSA.
- There is full employment for skilled labour (wages may increase).
- The trade balance is exogenous (imposed) for SSA, MENA, Latin America, Rest of the World.

#### Scenario 2: Accounting for labour productivity and trade policy shocks

- SSA continues imports of low-end manufacturing products (for agriculture and services and industries) and SSA exporting raw materials and extraction
- Technology progress and labour productivity in China, SSA, other countries using van Dijk's estimates with some adjustment
- Elimination of all tariffs on China import from SSA, except in raw food which is already subject to very low tariff. (Current tariff levels on imports from SSA are summarized in Table 4.)
- Unemployment exists for unskilled labour, i.e. real wage is fixed for SSA
- Full employment for skilled labour (wages may increase)
- Trade balance exogenous (imposed) for SSA, MENA, Latin America, and Rest of the World.



### Scenario 3: Protection, import substitution

Scenario 3a: SSA Import substitution: trade policy

- China tariffs eliminated as in Scenario 1
- SSA raises import tax on semi-processed and processed from China: processed food, textile and apparel; light Manufacturing), and heavy manufacturing : rate 10%
- Unemployment exists for unskilled labour, i.e. real wage is fixed for SSA
- Full employment for skilled labour (wages may increase)
- Trade balance exogenous (imposed) for SSA, MENA, Latin America, Rest of the World).

Scenario 3b (export taxes): is the same as 3a except that we increase SSA export taxes on raw food and agriculture to China by 10% and on extraction and mining to all regions (including China) by 50%.

### Scenario 4: Technology shocks and labour productivity shifts

Scenario 4a

- Labour (Skilled and Unskilled) productivity shocks as in Van Dijk's paper for the rest of the region.
- Unemployment of unskilled labour in SSA , i.e. real wage is fixed for SSA;
- China tariff eliminated as in Scenario 2
- Full employment for skilled labour (wages may increase)

Scenario 4b

- TFP shock of 1% in processed food, textile and apparel, and light & heavy manufacturing sectors for SSA;
- Labour (Skilled and Unskilled) productivity shocks of 2% for SSA in processed food, textile and apparel, light & heavy manufacturing sectors for SSA, and services;
- Technology progress and labour productivity as in Michiel's paper for the rest of the regions.
- Unemployment of unskilled labour in SSA , i.e. real wage is fixed for SSA;
- China tariff eliminated as in Scenario 2
- Full employment for skilled labour (wages may increase)

## Appendix 2

### Model Structure

	Regions
1	China and Hong Kong



2	Sub-Saharan Africa (minus South Africa)
3	Middle East and North Africa
4	BRIS (Brazil, Russia, India, South Africa)
5	Latin America
6	North America
7	EU-27
8	Rest of the World

Later in the analysis, we disaggregated Sub-Saharan Africa region into 4 sub regions

### Sectors

1. **Raw Food and Agriculture:** Paddy rice; Wheat; Cereal grains nec; Vegetables, fruit, nuts; Oil seeds; Sugar cane, sugar beet; Plant-based fibers; Crops nec; Cattle,sheep,goats,horses; Animal products nec; Raw milk; Wool, silk-worm cocoons; Meat: cattle,sheep,goats,horse; Meat products nec;.
2. **Processed Food:** Vegetable oils and fats; Dairy products; Sugar; Food products nec; Beverages and tobacco products. Processed rice
3. **Extraction** (Mining and Extraction): Forestry; Fishing; Coal; Oil; Gas; Minerals nec.
4. **TextWapp** (Textile and Apparel): Textiles; Apparel.
5. **LightMnfc** (Light Manufacturing): Leather products; Wood products; Paper products, publishing; Metal products; Motor vehicles and parts; Transport equipment nec; Manufactures nec.
6. **HeavyMnfc** (Heavy Manufacturing): Petroleum, coal products; Chemical,rubber,plastic prods; Mineral products nec; Ferrous metals; Metals nec; Electronic equipment; Machinery and equipment nec.
7. **Services:** Electricity; Gas manufacture, distribution; Water; Construction; Trade; Transport nec; Sea transport; Air transport; Communication; Financial services nec; Insurance; Business services nec; Recreation and other services; PubAdmin/Defence/Health/Education; Dwellings.

### Factor inputs

Land	
Capital	
Unskilled labour	
Skilled labour	
Natural Resources	



### Appendix 3

#### Production tax and Output taxes of Allocative Efficiency

CNTalleffkr	factor price	Prod tax	Input tax	Cons tax	Gov tax	exp tax	imp tax	Total
1 China	1306.81	844.02	764.96	4869.45	445.56	3614.96	779.33	10011.47
2 BRIS	2234.87	1537.04	1145.97	2161.65	33.54	837.96	1095.95	9046.97
3 NAmerica	102.16	6679.93	1117.81	3687.26	0	21	940.8	12548.95
4 LatinAmer	97.34	237.54	23.56	427.65	12.66	-27.25	239.3	1010.78
5 EU_27	347.62	4956.19	2019.21	8848.91	5.08	-35.01	820.25	16962.25
6 MENA	73.66	322.21	24.3	39.99	6.39	-10.33	319.86	776.08
7 SSA	-6.11	-510.95	-77.83	-1.97	13.52	-100.85	-330.71	-1014.89
8 RestofWorld	6642.67	12621.26	2881.62	4336.77	70.32	99.82	1788.75	28441.22
Total	8185.39	26687.25	7899.6	24369.7	587.07	4400.3	5653.53	77782.83

OTAX	China	BRIS	NAmerica	LatinAmer	EU_27	MENA	SSA	RestofWorld	Total
1 Land	0	0	0	0	0	0	0	0	0
2 UnSkLab	847.52	1272.58	0	55.62	0	94.83	-294.77	6731.7	8707.49
3 SkLab	0	0	0	0	0	0	0	0	0
4 Capital	0	0	0	0	0	0	0	0	0
5 NatRes	0	0	0	0	0	0	0	0	0
6 RawFood	-6.89	-139.94	8.12	15.38	70.05	20.99	0.77	-24.66	-56.19
7 ProcFood	0.09	58.29	51.39	12.47	715.46	17.79	-0.92	497.22	1351.78
8 Extraction	0.03	9.89	493.59	32.51	83.65	65.62	0.38	284.16	969.83
9 TextWapp	0.2	19.81	0.8	-4.12	4.64	-0.75	0.36	-0.19	20.75
10 LightMnfc	0.6	54.27	109.58	-6.86	821.28	9.21	-15.42	475.18	1447.84
11 HeavyMnfc	1.09	91.28	278.17	14.54	1188.46	-23.7	-150.09	1786.98	3186.72
12 Services	1.37	170.85	5738.28	118	2072.65	138.24	-51.26	2870.89	11059.02
13 CGDS	0	0	0	0	0	0	0	0	0
Total	844.02	1537.03	6679.93	237.54	4956.19	322.21	-510.95	12621.26	26687.25



#### Appendix 4:

#### Simulation Results for Scenario 3b

(Increasing export taxes by 10% on raw food and agriculture products and 50% on extraction and mining)

**Table A4.1 Welfare Effects**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total
China	9361.6	44167.21	96708.56	-19127	2539.33	133649.7
Brazil, Russia, India and South Africa	8177.25	8556.13	32567.9	4186.35	19.04	53506.66
North America	12442.83	0	144923.9	-2657.51	-3230.17	151479.1
Latin America (without Brazil)	643.83	-381.27	4219.24	3636.61	-38.25	8080.15
European Union (27 countries)	16493.83	0	108247.9	-9348.84	-1203.07	114189.8
Middle East and North Africa	774.64	757.55	3843.39	5579.28	-75.84	10879.01
Sub-Saharan Africa	1650.45	8844.5	-2412.37	6309.21	675.07	15066.86
<i>Rest of the of the World</i>	24206.04	32512.36	88908.16	11421.93	1313.89	158362.4

**Table A4.2 Export (value) composition after the increase in tax on raw materials**

VIWS	China	BRIS	North America	Latin America	EU_27	MENA	RestofWorld	Total
1 RawFood	0.032	0.057	0.02	0.015	0.128	0.451	0.128	0.08
2 ProcFood	0.008	0.012	0.007	0.008	0.091	0.062	0.034	0.047
3 Extraction	0.823	0.553	0.797	0.809	0.339	0.049	0.31	0.508
4 TextWapp	0.002	0.011	0.028	0.005	0.032	0.009	0.006	0.025
5 LightMnfc	0.01	0.023	0.01	0.009	0.076	0.073	0.046	0.043
6 HeavyMnfc	0.078	0.268	0.045	0.034	0.162	0.178	0.277	0.177
7 Services	0.047	0.075	0.093	0.12	0.172	0.179	0.198	0.12
Total	1	1	1	1	1	1	1	1



### Annex 5: Import value from row region to column region (million USD)

	1 China	2 BRIS	3 NAmerica	4 LatinAmer	5 EU_27	6 MENA	7 ECOWAS	8 CA	9 EA	10 SADC	11 RestofWorld	T
VIMS												(
1 China	75954.28	94815.31	402420.4	32341.4	349104.9	21383.11	13328.59	3665.74	5834.59	2144.67	489654.6	
2 BRIS	70105.29	29971.07	124487.4	48161.37	345500.2	21713.91	9178.41	5746.13	6511.1	14434.94	259312.8	
3 NAmerica	116476.9	89526.66	932298.3	115809.4	419712.5	25161.04	10523.06	6152.72	2904.69	1753.51	454107.3	
4 LatinAmer	38233.55	37771.04	130775.7	63370.82	88423.04	4705.84	1701.08	687.51	393.29	334.95	66664.27	
5 EU_27	164011.6	291059.6	556532.9	68316.09	3653450	102983.3	36303.75	21575.97	11020.65	6420.4	941927.3	
6 MENA	7360.16	25884.39	52935.77	2022.97	130703.9	13364.23	1769.87	678.63	1749.82	223.63	42478.23	
7 ECOWAS	3186	19464.54	35185.13	2035.24	23310.26	587.03	7075	903.02	54.59	39.11	6904.79	
8 CA	16645.22	4614.1	27554.43	3293.74	13637.77	250.2	721.46	421.47	77.06	291.41	6121.23	
9 EA	6038.65	1757.86	2920.31	285.86	6866.58	660.98	237.26	448.32	2800.16	372.63	10028.73	
10 SADC	1407.09	5167.35	3644.14	237.57	14440.58	338.44	201.06	842.01	471.18	2437.62	5945.39	
11 RestofWorld	661408.5	279227.3	651476.3	51000.13	1000938	64258.26	21357.87	6553.83	13202.56	4620.96	1502716	
Total (import	1160827	879259.2	2920231	386874.5	6046087	255406.4	102397.4	47675.34	45019.69	33073.82	3785860	

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## Tables and Figures

**Table 1. Average advalorem import taxes facing SSA countries (%)****Table 4. Initial average advalorem import taxes facing SSA countries (%)**

rTMS	1 China	2 BRIS	3 NAmerica	4 LatinAmer	5 EU_27	6 MENA	7 SSA	8 RestofWorld	Total
1 RawFood	2.39	14.17	2.66	6.23	0.28	8.98	3.87	7.98	46.56
2 ProcFood	5.07	3.76	3.83	10.31	9.47	22.85	10.47	5.58	71.34
3 Extraction	0	5.79	0	5.52	0	4.75	2.6	0.76	19.43
4 TextWapp	5.21	1.44	0.39	4.39	0	8.21	10	5.11	34.77
5 LightMnfc	4.37	3.97	1.06	7.35	0	19.11	11.12	2.6	49.59
6 HeavyMnfc	2.21	1.79	0.31	3.97	0	1.44	6.15	1.72	17.59
7 Services	0	0	0	0	0	0	0.23	0	0.23

Sources: From GTAP (Narayanan, Walmsley, 2008)

**Table 2. Labour productivity growth: Projection 2006-2050 (% per year)**

Sector	Industrialized countries	China	India	Asian Tiger	Asian Dev	Brazil	Rest of Latin America	SSA	RoW
Agriculture	3.43	4.11	1.48	4.23	2.59	4.87	2.39	2.14	2.59
Construction	-1.05	3.96	-0.18	0.38	-1.49	0.29	-0.64	-2.69	2.59
Finance and insurance real estate	1.32	1.72	-4.86	0.28	-1.14	-1.52	-1.55	-0.57	
Manufacturing	1.74	7	1.59	4.55	1.82	-0.98	0.46	-6.3	1.82
Transport storage and communication	2.37	5.4	4.22	3.05	0.86	-2.17	1.17	2.04	1.82
Wholesale and retail trade	1.41	3.11	2.96	2.29	-1.81	-2.04	-2.34	-4.89	0.95
Other Services	-0.63	4.58	3.42	0.89	0.95	0.27	0.05	-4	
Overall	1.17	5.46	3.17	2.38	1.53	-0.14	0.42	0.37	1.53

Source: van Dijk, 2013

**Table 3. Simulation Scenarios**

	<b>Scenario 1 Benchmark</b>	<b>Scenario 2: Tariff elimination by China</b>	<b>Scenario 3: Protection, Import substitution</b>	<b>Scenario 4: Productivity and policy shocks</b>
Model closure	-Unemployment for unskilled labour in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World	-Unemployment for unskilled labour in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World	-Unemployment for unskilled labour in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World	-Unemployment for unskilled labour in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World
Tariffs on China imports from SSA	No Change	Eliminated	Eliminated	Eliminated
Tariffs on SSA imports from China	No change	No change	10 % increase for processed food, textile and apparel, light manufacturing	No change
Export tax on raw materials and mining and extraction from SSA to all regions	No change	No change	3a: none 3b: Increase by 10% for raw food and agriculture, 50% for extraction and mining	No change
Labour productivity*	Shocks (Van Diik)	Shocks (Van Diik)	Shocks (Van Diik)	a: Shocks(Van Diik) b: Various shocks on manufacturing
TFP shock	None	None	None	a: none b: 1% for processed food, textile and apparel, light and heavy manufacturing
Human capital (Skilled labour) stock	No change	No change	No Change	No Change

**Table 4. Benchmark: Welfare Changes (US millions) under labour productivity projection in million USD (Scenario 1)**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total effect
China	10408.65	49373.74	96708.56	-13779.9	1596.56	144307.6
Brazil, Russia, India and South Africa	8813.74	12093.56	32567.9	1872.1	-81.26	55266.03



North America	12491.15	0	144923.9	1481.57	-889.22	158007.4
Latin America (without Brazil)	1002.19	1031.48	4219.24	1910.13	-67.72	8095.32
European Union (27 countries)	16866.63	0	108247.9	-2914.03	-866.36	121334.1
Middle East and North Africa	752.6	1091.34	3843.39	2644.02	-23.13	8308.21
Sub-Saharan Africa	-241.66	-1185.13	-2412.37	3330.78	-96.02	-604.4
<i>Rest of the of the World</i>	28370.55	40210.43	88908.16	5455.37	427.11	163371.6

**Table 5. Welfare effects of China elimination of tariffs on imported goods from SSA (Scenario 2) in million USD**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total
China	10432.98	49408.66	96708.56	-13805.4	1601.63	144346.4
Brazil, Russia, India and South Africa	8814.78	12091	32567.9	1874.41	-81.1	55266.98
North America	12492.67	0	144923.9	1476.4	-893.97	157999
Latin America (without Brazil)	1001.66	1029.4	4219.24	1911.16	-67.53	8093.93
European Union (27 countries)	16864.4	0	108247.9	-2921.7	-866.21	121324.4
Middle East and North Africa	752.93	1091.39	3843.39	2647.5	-23.22	8311.99
Sub-Saharan Africa	-202.75	-1122.57	-2412.37	3362.61	-99.82	-474.9
<i>Rest of the of the World</i>	28363.11	40197.57	88908.16	5455.02	430.17	163354

**Table 6 Structure of SSA's export to China**

	When Chinese import tariffs are zero				When tariffs remain unchanged			
	ECOWAS	CA	EA	SADC	ECOWAS	CA	EA	SADC
1 RawFood	12.6%	0.4%	3.2%	13.0%	11.8%	0.4%	3.0%	13.1%

2 ProcFood	1.7%	0.0%	1.0%	1.8%	1.5%	0.0%	0.9%	1.7%
3 Extraction	75.5%	95.6%	89.2%	30.9%	76.3%	95.9%	89.6%	31.4%
4 TextWapp	0.2%	0.0%	0.4%	1.0%	0.1%	0.0%	0.3%	0.9%
5 LightMnfc	1.1%	0.2%	1.0%	3.3%	1.0%	0.2%	0.8%	2.9%
6 HeavyMnfc	2.0%	2.7%	1.5%	35.2%	1.8%	2.4%	1.3%	33.5%
7 Services	6.9%	1.0%	3.8%	14.7%	7.4%	1.1%	4.1%	16.5%
		17623.6						
Total	3409.16	1	6312.93	1543.68	3186	16645.22	6038.65	1407.09

**Table 7. Welfare effects of the increase in SSA's tariff on manufactured good imports from China in million USD**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total
China	10011.47	48370.35	96708.56	-15297.7	1892.69	141685.4
Brazil, Russia, India and South Africa	9046.97	12348.74	32567.9	2156.55	-123.07	55997.08
North America	12548.95	0	144923.9	1643.92	-946.95	158169.8
Latin America (without Brazil)	1010.78	1026.46	4219.24	1936.01	-72.34	8120.14
European Union (27 countries)	16962.25	0	108247.9	-2634.14	-891.23	121684.8
Middle East and North Africa	776.08	1120.48	3843.39	2688.32	-30.27	8398
Sub-Saharan Africa	-1014.89	-1693.24	-2412.37	3757.49	-210.97	-1573.98
Rest of the of the World	28441.22	40313.11	88908.16	5749.56	382.1	163794.2

**Table 8. Comparing the changes (%) in key variables****(a) Change (%) in levels of endowment and production (%)**

qo[*SSA]	Sc. 3	Sc.1	Base dat
Land	0	0	14123.21
UnSkLab	-0.98	-0.69	202786.8
SkLab	0	0	53737.97
Capital	0	0	220473
NatRes	0	0	39691.68
RawFood	0.24	0.43	179824.7
ProcFood	-1.68	-1.47	66596.05
Extraction	0.18	0.39	177885.1
TextWapp	-1.49	-7.03	15275.06
LightMnfc	-4.39	-5.39	41411.28
HeavyMnfc	-4.47	-5.11	79368.37
Services	-1.3	-1.03	411723.6
CGDS	-2.18	-1.19	114409.5

**(b) Change in output price %**

ps[*SSA]	Sc3	Sc1
RawFood	-1.35	-1.87
ProcFood	0.77	0.32
Extraction	1.04	1
TextWapp	1.6	0.53
LightMnfc	1.26	0.69
HeavyMnfc	1.12	0.64
Services	0.23	-0.26
CGDS	0.34	-0.33

**Table 9: The sub-regional groups**

Sub-region	Countries
Economic Community of West African States (ECOWAS)	Benin; Burkina Faso; Côte d'Ivoire; Ghana; Guinea; Nigeria; Senegal; Togo; Rest of Western Africa
Central Africa (CA)	Cameroun; Central African Republic; South Central Africa
Eastern Africa (EA)	Ethiopia; Kenya; Rwanda; Tanzania; Uganda; Rest of Eastern Africa
Southern Africa Development Community (SADC)	Botswana; Madagascar; Malawi; Mauritius; Mozambique; Namibia; Zambia; Zimbabwe; Rest of South African Customs (except South Africa)

**Table 10. Welfare effects (in USD millions) of inclusion of labour productivity projection and China's elimination of tariffs on imported goods from sub-regions in SSA (Scenario 4a)**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total
China	10429.38	49371.96	96708.56	-13833.9	1615.96	144292
Brazil, Russia, India and South Africa	8802.63	12073.49	32567.9	1883.03	-73.3	55253.74
North America	12496.88	0	144923.9	1476.86	-884.41	158013.2
Latin America (without Brazil)	996.38	1020.27	4219.24	1917.87	-65.78	8087.99
European Union (27 countries)	16873.99	0	108247.9	-2878.23	-853.19	121390.5
Middle East and North Africa	752.78	1089.4	3843.39	2659.13	-22.46	8322.24
ECOWAS (West Africa)	56.8	-336.93	-71.45	1432.72	0.31	1081.45
CA (Central Africa)	129.82	68.73	-910.43	1303.82	-178.48	413.47
EA (Eastern Africa)	-299.11	-615.26	-860.6	282.62	18.93	-1473.42
SADC (Southern Africa)	-68.71	-306.19	-569.88	269.13	-7.14	-682.79
Rest of the of the World	28344.33	40166.59	88908.16	5486.96	449.5	163355.5

Note: For this study, South Africa is in the BRIS region, not in SADC sub region

**Table 11. Change in export volume caused by Elimination of China Tax (million \$)**

DQXS	ECOWAS	CA	EA	SADC
1				
RawFood	39.4	7.18	18.63	18
2				
ProcFood	7.77	0.79	8.21	3.84
3				
Extraction	-0.34	-5.74	-1.85	-0.49
4				
TextWapp	1.55	0.82	4.91	3.96
5				
LightMnfc	7.28	5.75	11.45	10.07

Note: For this study, South Africa is in the BRIS region, not in SADC sub region

**Table 12. Welfare effects of 1% increase of labour productivity in manufacturing (in million USD)**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total
China	10413.49	49354.12	96708.56	-13834.1	1595.6	144237.7
Brazil, Russia, India and South Africa	8799.59	12081.17	32567.9	1961.88	-85.06	55325.47
North America	12490.21	0	144923.9	1497.31	-879.56	158031.9
Latin America (without Brazil)	997.25	1016.62	4219.24	1930.56	-68.92	8094.75
European Union (27 countries)	16843.09	0	108247.9	-2771.18	-870.84	121449
Middle East and North Africa	754.46	1091.76	3843.39	2674.72	-24.83	8339.51
ECOWAS (West Africa)	488.86	691.34	1898.85	1280.47	-4.9	4354.61
CA (Central Africa)	199.22	154.49	540.94	1233.77	-74.07	2054.35
EA (Eastern Africa)	278.67	416.62	883.84	261.23	1.23	1841.59
SADC (Southern Africa)	63.47	157.71	366.16	175.23	-6.42	756.15
Rest of the of the World	28319.21	40151.73	88908.16	5590.14	417.71	163387



**Table 13. Welfare effects of 1% increase of labour productivity in manufacturing + 1% output augmenting technology shift in manufacturing**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total
China	10386.64	49273.38	96708.56	-13904.1	1601.47	144066
Brazil, Russia, India and South Africa	8760.86	12012.42	32567.9	2008.69	-85.75	55264.12
North America	12484.65	0	144923.9	1443.98	-906.16	157946.4
Latin America (without Brazil)	992.74	996.78	4219.24	1955.51	-69.63	8094.64
European Union (27 countries)	16780.05	0	108247.9	-2857.37	-881.7	121288.9
Middle East and North Africa	754.42	1087.86	3843.39	2714.52	-26.28	8373.91
ECOWAS (West Africa)	675.44	1209.27	2444.06	1270.12	-4.75	5594.13
CA (Central Africa)	283.71	331.45	948.43	1240.18	-62.51	2741.26
EA (Eastern Africa)	533.03	993.9	1536.72	309.18	25.05	3397.88
SADC (Southern Africa)	132.55	473.31	749.72	152.23	-11.56	1496.25
<i>Rest of the of the World</i>	28225.15	40015.21	88908.16	5667.01	421.76	163237.3

**Table 14. Welfare change under a 1% increase of labour productivity, 1% technological progress in all manufacturing sectors and Free trade within and among the SSA sub regions**

Regions	Allocative efficiency effect	Endowment effect	Technical efficiency effect	Terms of trade effect	Investment and saving effect	Total
China	10369	49188.61	96708.56	-13993.2	1605.12	143878.1
Brazil, Russia, India and South Africa	8712.91	11909.56	32567.9	1969.33	-89	55070.7
North America	12484.83	0	144923.9	1388.84	-954.99	157842.6
Latin America (without Brazil)	989.34	980.39	4219.24	1974.31	-71.08	8092.2
European Union (27 countries)	16714.98	0	108247.9	-3052.21	-906.04	121004.6
Middle East and North Africa	751.48	1078.92	3843.39	2741.49	-27.36	8387.92
ECOWAS (West Africa)	1030.58	1803.97	2444.06	1402.16	-4.39	6676.37
CA (Central Africa)	440.7	409.38	948.43	1229.99	-4.05	3024.44
EA (Eastern Africa)	757.08	1242.79	1536.72	382.61	50.91	3970.1
SADC (Southern Africa)	214.21	643.88	749.72	272.33	-16.55	1863.58
<i>Rest of the of the World</i>	28147.74	39892.88	88908.16	5684.36	417.38	163050.5

**Table 15. Structure of SSA-China Trade****(a) Composition of SSA exports to China**

	With all shocks*				Without any shock			
	ECOWAS	CA	EA	SADC	ECOWAS	CA	EA	SADC
1 RawFood	0.13	0.005	0.031	0.124	0.119	0.004	0.029	0.129
2 ProcFood	0.018	0	0.009	0.018	0.015	0	0.008	0.017
3								
Extraction	0.737	0.952	0.89	0.262	0.757	0.958	0.898	0.279
4								
TextWapp	0.002	0	0.003	0.011	0.001	0	0.002	0.009
5								
LightMnfc	0.011	0.002	0.01	0.034	0.009	0.001	0.007	0.029
6								
HeavyMnfc	0.021	0.03	0.015	0.387	0.018	0.025	0.013	0.354
7 Services	0.08	0.011	0.042	0.164	0.08	0.011	0.043	0.183
Total	1	1	1	1	1	1	1	1

**(b) Composition of SSA Imports from China**

	With all shocks*				Without any shock			
VIMS	ECOWAS	CA	EA	SADC	ECOWAS	CA	EA	SADC
1 RawFood	0.012	0.007	0.004	0.006	0.013	0.007	0.005	0.006
2 ProcFood	0.025	0.013	0.006	0.011	0.026	0.015	0.006	0.011
3								
Extraction	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
4								
TextWapp	0.251	0.063	0.166	0.243	0.271	0.071	0.168	0.246
5								
LightMnfc	0.262	0.259	0.228	0.19	0.253	0.259	0.229	0.194
6								
HeavyMnfc	0.373	0.389	0.536	0.39	0.36	0.385	0.535	0.384
7 Services	0.077	0.268	0.059	0.158	0.076	0.262	0.057	0.157
Total	1	1	1	1	1	1	1	1

Note: the shocks are zero tariff for SSA manufacturing goods imported by China, a 7% increase in labour productivity and a 1% technological shift due to the spillover effects of trade on R&D. All tariffs within and among SSA subgroups are zero.