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

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Abstract

As many countries in Sub-Saharan Africa (SSA) 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. The trade between China and SSA is characterized by China's importing mining and extraction from SSA and SSA's importing manufactured goods from China. We analyse the asymmetric SSA-China trade and focus on how trade policy and productivity shocks will reduce SSA's dependency on raw material export to China. We perform accounting and simulation exercises using the General Equilibrium GTAP model. The main innovation in our study is the inclusion of estimates of different labor productivity growth rates across regions and across sectors in the model. These labor productivity growth estimates show that the gaps between China and SSA especially in manufacturing are huge; 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. We examine several scenarios that include tariff elimination by China, common external tariff in SSA, and free regional trade in SSA.

We find that with its current low labor productivity growth rates especially in manufacturing sectors, SSA continues to lose in the global trade, including in its trade with China. More important, manoeuvring room for trade policies is limited. China tariffs on imports from Africa are already low and bringing these tariffs down to zero will lead only to a modest increases in welfare and employment for SSA without altering SSA's dependence on raw material export. Raising the tariffs on manufactured goods from China will reduce SSA's welfare and employment by harming consumers and the agriculture sectors dependent on intermediate goods from China. Increases in labor productivity and technical progress in SSA's manufacturing sectors are welfare improving, but will not alter the high share of mining and extraction export to China unless such increases in productivity are accompanied by a voluntary restriction on these raw material exports. As such a voluntary restriction is being practically hard to apply and sustain, SSA shall continue to liberalize internal markets and pursue higher growth rates in labor productivity to cut the losses in international trade. Our simulations show that freer intra-African trade with small and steady increase in productivity can have significant impacts on welfare and employment.

JEL Classification: D61, F16, J24.

Keywords: trade policy, labor productivity, welfare; employment, Africa, China.

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1. Introduction

In parallel with its economic and trade expansion, China's trade with Sub-Saharan Africa (SSA) has grown faster than ever. Between 2010 and 2019, China's import from SSA rose from 45 to 70 billion USD whereas China's export to SSA rose from 35 to 46 billion USD (World Bank, 2022). But such a growing 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: World Bank 2019).[1] 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.[2] 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, but how? 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 import of agricultural and manufactured products from SSA, and a common external tariff, i.e. increase in protection, against SSA's imports from China. 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 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 some estimates of labor productivity for all trading partners (see van Djiik, 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 not 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.[3] 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.

[1] 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.
[2] 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.
[3] Similarily, 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.

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 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 regional group as Brazil, Russia, and India, i.e .in the BRIS countries). 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 2018, 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. Table 1 shows average import taxes facing the SSA countries in entering various markets. We note that import taxes in raw food from SSA are highest in BRIS countries (about 14%), whereas import taxes on processed foods are highest in the MENA region (23%). Conversely, Import taxes of goods and services from SSA to China are relatively low and vary between 0 (for extraction and mining) and 5.2% (textile and wearing apparel). Moreover, Dong (2013) and GTAP data base show that between 2005 and 2010, the weighted average tariff on SSA's goods and services entering China fell from 2 to 0.5% (average tariff fell from 7.14 to 2.83%). Since 2010, following the Forum on China–Africa Cooperation (FOCAC) which represents a collective dialogue between China and African countries, such weighted average tariff continued to fall. Since 2018, for instance, 31 SSA countries pay no tariff to China on 60% of their tariff lines, and 11 additional SSA countries pay no tariff on 97% of all their tariff lines (Sun and Omoruy, 2021). Despite these tariff eliminations, SSA's export volume to China has remained small, and their impacts on welfare and terms of trade have been limited.

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

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

Sources: GTAP (Narayanan, Walmsley, various years).

Another SSA trade policy consideration is subsidizing its exports to China, but that policy would be ineffective and unsustainable. Matching the high competitiveness of Chinese manufacturing in China domestic market, let alone in the world market will require enormous financing sacrifice. Many SSA countries are now too cash-strapped to afford subsidizing their exports to China.

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Nevertheless, a few feasible policies are worth examining. First is the restriction on oil and mining extraction. Sub-Saharan Africa's leverage to further restrict the volume or tax the export of crude oil and mining has been considered by provincial and national governments, but the implementation and enforcement of such restriction remain problematic. Some provincial and national governments which receive large shares in the oil or mining companies will find it hard to lose revenue from reduced export volume. Similarly, raising a high export tax on crude materials would not necessarily increase export revenue as export volume may as a consequence drop sharply. Overall, these restrictions may have unintended consequences such as illegal trading (black market) especially when market institutions and enforcement in many SSA countries are notoriously weak.

Another policy possibility is that SSA increases tariff on its imports of manufactured goods from China. Although 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 as a result, the production, employment and income in SSA will shrink fast. 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 traditionally 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 labor 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 and Europe[4]. 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 46 billion SSA imports from China in 2019 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 labor 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 labor to carry out specialized tasks as local skilled labor was scarce or less mobile across sectors. Table 2 compares the projection in labor-productivity growth rates by sector in selected regions and shows that China and Sub-Saharan Africa are at the two opposite ends of the labor-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 labor and total factor productivities in the manufacturing sector need to grow fast. Unless its labor

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

productivity increases, SSA will be unable to take advantage of the outsourcing of China manufacturing activities. The question is 'How much technological progress and labor-productivity increase are needed to stimulate growth of SSA's manufacturing export?' In this paper, we attempt to address such a question.

Table 2. Labor 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.

3. The Method and Data

3.1 The models and scenarios

Our aim is to choose realistic scenarios mixing trade policies and productivity shifts and to determine the impacts on welfare, employment, terms of trade and trade patterns with China. 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. We estimate the impacts of trade policy shocks between China and SSA by taking into account differences in labor-productivity trajectories among all trading partners. The estimates of productivity growth across regions and sectors are obtained from van Dijk (2013). Through sensitivity analysis, we analyse what growth rates of labor productivity and technology enable SSA to benefit from trade and reverse its dependence on extraction and mining export, especially with China.

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 the GTAP Data Base is the dataset used in tandem with this model as well as several other global CGE models. The GTAP model 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.

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.

Various types of prices in the model are linked with each other through tax and subsidy wedges, which exist across the user types, outputs and sources of use and production. The Armington assumption helps differentiate

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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. An additional, though typically exogenous, variable *ams* captures the technological change augmented by a particular bilateral trade flow.

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. Labor productivity affects the labor prices (wages) as well as labor demand by the firms, thereby changing the commodity prices and market-clearing levels of output in the model.

Private households determine their expenditure based on a per-capita Constant Difference Elasticities (CDE) implicit expenditure function. 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. Welfare of different regions is represented by Equivalent Variations (EV). This may be decomposed into many different components from the model and various aspects such as allocative efficiency, terms of trade, technology, endowment effect, investment-savings adjustment, etc.

The production function *Y* in the GTAP model is in a Leontief form for which output is produced from primary inputs (mainly land, labor, and capital) nested in and source (i.e. domestic and foreign source) differentiated intermediate inputs (see Annex 1). The primary inputs (land, labor and capital) are imperfect substitutes in a nested CES function *Qv*. The technological shifts in domestic production in the GTAP model are through a Hicks-neutral (for overall productivity) shift at the Leontieff level, and input productivity parameter shift at the second stage.

The scenarios are summarized in Table 3 with more details in Annex 2) . It is important to note that all the scenarios in this paper include the forecast values of labor productivity change provided by Van Dijk (2013). We started in Scenario 1, the benchmark, where the only shock to the model is the labor 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 labor-productivity growth and spillover effects from trade with China affect welfare in the sub-regions of SSA. Full details of the scenarios are in Annex 2. Results in each scenario will be mainly based on terms of trade, technological progress, wages and employment of both skilled and unskilled labor in the manufacturing and agricultural sectors. Implications for food production and trade are also important.

Table 3. Simulation Scenarios

	Scenario 1 Benchmark	Scenario 2: Tariff elimination by China	Scenario 3: Protection, Import substitution	Scenario 4: Productivity and policy shocks
Model closure	-Unemployment for unskilled labor in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World	-Unemployment for unskilled labor in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World	-Unemployment for unskilled labor in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World	-Unemployment for unskilled labor in SSA -Trade balance exogenous (imposed) for SSA, MENA, Latina America, Rest of the World

Table 3 (cont.). Simulation Scenarios

	Scenario 1 Benchmark	Scenario 2: Tariff elimination by China	Scenario 3: Protection, Import substitution	Scenario 4: Productivity and policy shocks
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
Labor 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 labor) stock	No change	No change	No Change	No Change

Source: Authors.

3.2 Data

The version of the GTAP data base 8 and model we use by aggregating the original version 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); Brazil, Russia, India, and South Africa (BRIS); Latin America; North America; the European Union (assembling 26 countries, and the UK); and the Rest of the World. Later in the analysis, we will break SSA region into four 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 Labor, Skilled Labor, and Natural Resources. Details on model aggregation are summarized in Appendix 3.

4. Simulation Results and Interpretation

4.1 Benchmark: Differences in labor 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 labor productivity path under the van Dijk (2013) projections shown in Table 2. We immediately note from the results summarized in Table 4 that because of its weak labor 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 of employment) and in technical efficiency. Negative endowment effects mean that inputs (especially labor) become unemployed as output production and, hence, demand for inputs 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 labor.

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Table 4. Benchmark: Welfare Changes (US millions) under labor 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
Rest of the of the World	28370.55	40210.43	88908.16	5455.37	427.11	163371.6

Source: Authors' compilation of GTAP simulation results.

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

For this second scenario, we assume that China eliminates all tariffs on imports from SSA. 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). A comparison of Table 4 with 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. 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
Rest of the of the World	28363.11	40197.57	88908.16	5455.02	430.17	163354

Source: Authors' compilation of GTAP simulation results.

The increase in employment of unskilled labor 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 labor 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 to the other regions increase despite the elimination of tariff for LDC goods. This is mostly attributed to China's strong labor 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. 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. 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%
Total	3409.16	17623.61	6312.93	1543.68	3186	16645.22	6038.65	1407.09

Source: Authors' compilation of GTAP simulation results.

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 indicate that in comparison with the benchmark, 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 (down by USD 770 million).

Table 7. Welfare effects of a 10% 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

Source: Authors' compilation of GTAP simulation results.

These significant losses in allocative efficiency and endowment (especially employment) deserve explanation. The allocative efficiency loss is due to the reallocation of unskilled labor 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, prompting employees to move mostly to that sector (see Table 8 and Table 9).

Table 8. Change (%) in levels of endowment and production (%)

	Scenario 3	Scenario1	Base data
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

Source: Authors' compilation of GTAP simulation results.

Table 9. 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

Source: Authors' compilation of GTAP simulation results.

We note however that the decomposition of the tax effects (see Annex 4) shows that more than a half of SSA's loss in allocative efficiency as a result of the 10% increase in protection across sectors is attributed to production (i.e. 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 labor force to move to the textile and apparel sector or, because such industries cannot absorb them all, to

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 Tables 8 and 9 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 such a contribution remains small relative to the allocative efficiency and endowment effects. 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 50% on SSA's extraction and mining products exported to all regions. The results are reported in Annex 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 show that the lagging labor productivity growth harms SSA's welfare and that the heightening of the 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 from its trade with China?' The direct answer would be: by improving its labor productivity growth rate. But then, the next question is 'by how much?' Scenario 4 attempts to answer these questions. 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 four sub-regional groups as indicated in Table 10. These regional groups approximate the existing Regional Trading Areas.

Table 10. 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)

Source: Authors.

From here, we take Scenario 2 as the starting point, i.e. we maintain in the model both the Van Dijk labor productivity estimates as in Table 2 and the elimination of tariff between China and SSA (initial tariffs are in the China column in Table 1). We then repeat the simulation of Scenario 2 but with the disaggregation of SSA. The results of the simulation with disaggregated regions in Scenario 4a are summarized in Table 11: it shows that although SSA as a whole loses, the welfare impacts vary widely among the sub-regions. The ECOWAS and CA countries seem to gain from the elimination of import tariff by China, but these gains are cancelled by the losses in EA and SADC countries (minus South Africa, which in this study is counted in the BRIS region) .

Table 11. Welfare effects (in USD millions) of inclusion of labor 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.

Source: Authors' compilation of GTAP simulation results.

Explanation of these differentiated impacts goes back to the structure of trade between China and the sub-regions. Annex 6 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 12 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 12 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.[5]

Table 12. Change in export volume caused by Elimination of China Tax (million $)

	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.

Source: Authors' compilation of GTAP simulation results.

[5] 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.

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 labor 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 table 12 above. Since it is in manufacturing sectors that labor productivity in SSA is currently lagging far behind, we simulate some modest increases in labor productivity and in total productivity in general. Accordingly, we first simulate a 1% increase of labor productivity in all four manufacturing sectors, then we redo the simulation by adding a 1% increase in overall productivity in all four manufacturing sectors. The results of these simulations are summarized in Table 13 and Table 14.

Table 13. Welfare effects of 1% increase of labor 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

Source: Authors' compilation of GTAP simulation results.

Table 14. Welfare effects of 1% increase of labor 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
Rest of the of the World	28225.15	40015.21	88908.16	5667.01	421.76	163237.3

Source: Authors' compilation of GTAP simulation results.

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Results show that 1% increase in labor 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 15). This modest increase in overall 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 labor productivity and a 1% technological shift due to the spillover effets of trade on R&D. The results are reported in Table 15, 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 15. Welfare change under a 1% increase of labor 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
Rest of the of the World	28147.74	39892.88	88908.16	5684.36	417.38	163050.5

Source: Authors' compilation of GTAP simulation results.

We are also intrigued by how the combination of the elimination of tariff on SSA's goods by China, the increase in labor 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 labor productivity. The results are summarised in Table 16, 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 16. Structure of China-SSA trade with and without shocks

(A) Compositions 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

Source: Authors' compilation of GTAP simulation results.

(B) Compositions 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 impoarted by China, a 7% increase in labor productivity and a 1% technological shift due to the spillover effets of trade on R&D. All tariffs within and among SSA subgroups are zero.

Source: Authors' compilation of GTAP simulation results.

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 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 escape 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.

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We developed various scenarios and performed simulations involving a mix of policies and labor 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 labor productivity growth rates across regions and across sectors in the General Equilibrium GTAP model. These labor productivity growth estimates show that the gaps between China and SSA especially in manufacturing are huge; 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 findings can be summarized as follows.

- With its current low labor 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 labor 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 the 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 labor 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 remain weak.

Nevertheless, the findings imply that SSA shall continue to pursue higher growth rates in labor 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, China should not fear for such African free trade because our simulation results show that 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 these 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 China-Africa 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 labor force able to accommodate technological progress.

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Annex 1

In summary, the production function in the GTAP model

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

where,

$$Q_v = [\sum_e (A_e.Q_e)^\rho]^{-\frac{1}{\rho}} \quad (2)$$

and 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 $j \neq i$. Q_v is the domestic second-stage CES production function using primary inputs e; A_e is share parameter of input e = {land, unskilled labor, skilled labor, and capital}; and $-1 < \rho < \infty$ is the elasticity-of- substitution parameter. The neutral shift in overall productivity is due to a shift in the parameter A_0, whereas the shifts in the productivity in the intermediate and primary inputs are due to parameters A_{ij} and A_e respectively

Annex 2. 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 labor productivity in China, SSA, other countries is computed using van Dijk's estimation with some adjustment.
- Unemployment exists for unskilled labor, i.e. real wage is fixed for SSA.
- There is full employment for skilled labor (wages may increase).
- The trade balance is exogenous (imposed) for SSA, MENA, Latin America, Rest of the World.

Scenario 2: Accounting for labor 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 labor 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 labor, i.e. real wage is fixed for SSA
- Full employment for skilled labor (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 labor, i.e. real wage is fixed for SSA
- Full employment for skilled labor (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 labor productivity shifts

Scenario 4a

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

Scenario 4b

- TFP shock of 1% in processed food, textile and apparel, and light & heavy manufacturing sectors for SSA;
- Labor (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 labor productivity for the rest of the regions.
- Unemployment of unskilled labor in SSA , i.e. real wage is fixed for SSA;
- China tariff eliminated as in Scenario 2
- Full employment for skilled labor (wages may increase)

Annex 3. Model Structure

Regions

	Regions
1	China and Hong Kong
2	Sub-Saharan Africa (minus South Africa)
3	Middle East and North Africa (MENA)
4	Brazil, Russia, India, South Africa (BRIS)
5	Latin America
6	North America
7	European Union and the United Kingdom (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 (RawFood): 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 (ProcFood): Vegetable oils and fats; Dairy products; Sugar; Food products nec; Beverages and tobacco products. Processed rice
3. Mining and Extraction (Extraction): Forestry; Fishing; Coal; Oil; Gas; Minerals nec.

4. Textile and Wearing Apparel (TextWapp): Textiles; Apparel.
5. Light Manufacturing (LightMnfc): Leather products; Wood products; Paper products, publishing; Metal products; Motor vehicles and parts; Transport equipment nec; Manufactures nec.
6. Heavy Manufacturing (HeavyMnfc): 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

Input name	Abbreviation
Land	Land
Capital	Capital
Unskilled (or less skilled) labor	UnSklab
Skilled labor	Sklab
Natural Resources	NatRes

Annex 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
Rest of the of the World	24206.04	32512.36	88908.16	11421.93	1313.89	158362.4

Source: Authors' compilation of GTAP simulation results.

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

	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

Source: Authors' compilation of GTAP simulation results.