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How can the African Continental Free Trade Area help Green African Trade?

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Abstract

Africa has contributed little to Climate Change (CC), though being hardest hit, especially African agriculture, both in the short-run (fast-onset events like droughts and floods) and in the long-run through lower productivity in agriculture (slow-onset events from warming). The paper starts with a template of the dimensions of the trade environment nexus in Africa, then reviews evidence on the role of international trade in helping African countries mitigate and adapt to CC. Much of the focus is on the AfCFTA and on the contribution of the AERC GVC phase II to the state of knowledge.

The AERC papers concentrate on the expected effects of reductions in tariffs on the carbon dioxide (CO_2) intensity of intra African trade flows, how CO_2 emissions will be affected by tariff-induced changes in African trade flows, but also on the longer-term implications of the AfCFTA for the prospects of Africa's transition towards a greener economy. .../...

Keywords: CO_2, Africa, AfCFTA, emission intensity.

JEL Codes: Q50; Q56; F18; F64.

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.../... Relying on the recent Resolved Multi-Regional Input-Output (RMRIO) data base on CO2 emissions, the papers cover contours of the CO2 intensity of current import and export baskets across Africa; the exception lists, timing of tariff elimination and implied trajectories of CO2 emissions during implementation for two Regional Economic Communities (RECs) the East African Community (EAC) and the Economic Community of West African States (ECOWAS).

Two papers estimate CO2 emissions elasticities to tariff cuts, one for the EAC5 (Burundi, Kenya, Rwanda, Tanzania, Uganda) for significant exports and main partners, the other for 22 countries covering 50 tradable sectors. The resulting emission elasticities are suggestive of which countries /sectors are likely to become cleaner/dirtier following AfCFTA implementation.

A third paper focuses on the role of Global Value Chains (GVCs) on the development, adoption and diffusion of environmental goods using firm-level customs data for Kenya and Malawi. The paper contrasts trade in clean and dirty goods between GVC and non-GVC firms. Being a GVC firm increases the probability of starting to import rather than starting to export green goods. Supply chain trade is essentially a conduit for access to clean technologies.

The paper concludes with do's and don'ts for phase I and recommendations on how to mainstream the trade-environment nexus in AcFTA phase II.

Contents

1 Introduction

On the world stage, Africa's contribution to Climate Change (CC) has been and will remain small even as the region with highest population growth. With 18% of world population, Africa only accounts for 4% of CO2 emissions, and Africa is the region with the lowest CO2 per capita footprint. [1] The CC threat is adding to Africa's already formidable challenge of lifting a growing population out of poverty. Intra and extra-regional trade will play an important role in Africa's quest to embark on a sustainable development path.

This is so especially for African agriculture, the most vulnerable sector to CC, both in the short-run (fast-onset events like droughts and floods) and in the long-run through lower productivity in agriculture (slow-onset events from warming). CC will also affect agricultural yields unevenly, so countries will have to resist imposing restrictions to intra-African trade in food products between food surplus and food deficit countries[2].

The African Continental Free Trade Area (AfCFTA) is the only flagship on the AU2063 agenda that addresses the environment, albeit indirectly since the preamble does not mention protection of the environment. AfCFTA's phase I is to remove tariffs and reduce policy-imposed non-tariff Barriers (NTBs) on substantially all intra-African trade. (Members are also committed to liberalize trade in services.) Phase II is to bring explicitly links between trade and the environment into the Treaty.

This paper reviews the dimensions of the trade environment nexus, the potential role of the AfCFTA in dealing with the effects of climate change and the contribution of the AERC GVC phase II to the debate. Section 2 reviews the key drivers of CC, focusing on how trade and trade policy like the AfCFTA affects the outcome. Section 3 focusses on the importance of trade in alleviating food insecurity caused by climate shocks (fast-onset shocks like droughts and floods and slow-onset shocks like warming).

The remaining sections report on the headline results from phase II of the GVC project. Section 4 shows how the AfCFTA negotiation process has played out for EAC and ECOWAS, two Regional Economic Communities (RECs) that have submitted acceptable exclusion lists to the Secretariat. Exclusion lists have high MFN tariffs and are typically more CO2 intensive. Section 5 reports on estimates of full AfCFTA implementation on CO2 emissions. Section 6 analyzes the patterns of trade in green goods across Africa. Section 7 concludes.

[1] According to Our World in Data, in 2023, per capita CO2 emissions from fossil fuels and industry were 0.96 ton in Africa and 4.73 in Asia.

[2] The Global Agro-Ecological Zones (GAEZ) project estimates that, for Africa, the average percentage fall in yield for 35 crops will be 40% by 2080, three times the world average (Casella and Melo (2022).

2 Africa's Trade Challenge under climate change[3]

During the golden age of globalization, Africa's share in world trade fell by half. Even in the absence of the Climate Change (henceforth CC) threat, the challenge of raising a growing population out of poverty is a formidable task for the many countries across the continent that continues to have close to zero adjusted net savings per capita.[4] Embarking on a sustainable development path remains a huge challenge to which flagship initiatives like the AfCFTA can play a substantial role in mitigating and adapting to CC.

Key drivers of this outcome are indicated in the top part of figure 1. As shown at the top on the left side of the figure, Africa's geography is a powerful barrier to trade which is so vital for the many African countries with limited domestic markets. On the right-hand side, extensive restrictive border measures (some informal like road checks) have contributed to the current high trade costs. Measures to protect the environment are largely absent in the Regional Economic Communities (RECs) along which continental integration is taking place.

Intra-African trade has grown from 10% to 16% over the past 20 years but it is still only in the 5-15 percent range of total trade across African regions with a concentration in agricultural products)[5]. Export baskets are highly concentrated in primary products: agricultural products (15%) and minerals and fuels (50%). Limited migration so far, completes this aperçu of Africa's position in global trade.

The middle portion of figure 1 sketches the trade-related impacts resulting from selected slow and fast onset components of CC (for obvious reasons, fast onset events like storms are best documented so far). On the slow-event side, a rise in average temperatures (and associated sea level rise)[6] will be accompanied by increased aridity. A modification in local climate regimes will shift precipitation patterns, temperature, and overall seasonality of weather events. On the fast-event side, the occurrence of extreme events such as heat waves and torrential rains is expected to continue to increase as it has in the recent past[7]. For Africa, shocks are negative (no significant increase in agricultural productivity) but can be dampened by trade and by changes in trade and climate policies (prospective trade in the bottom of the figure).

[3] This section draws on Casella and Melo (2022, section 1)

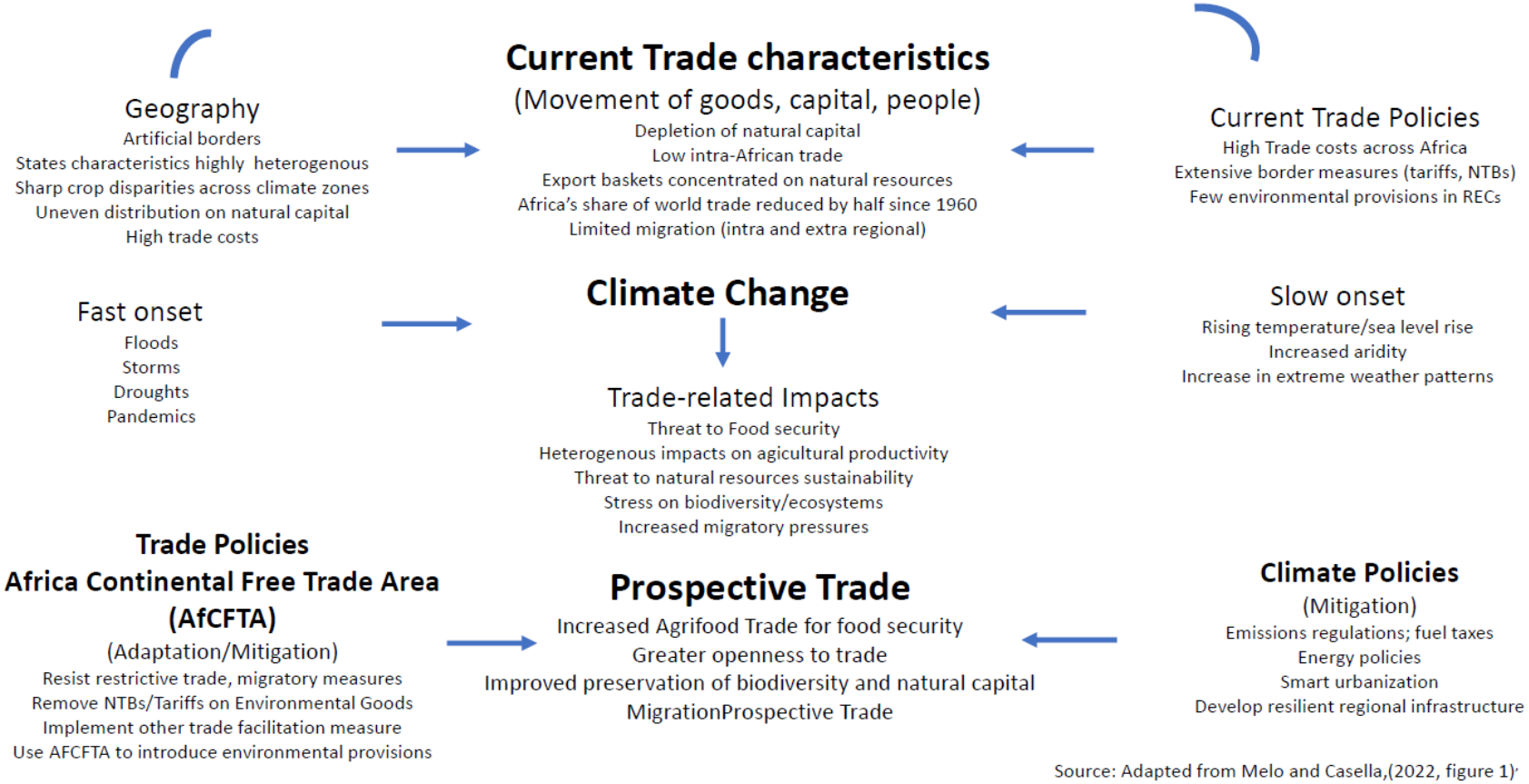
[4] Adjusted net savings (or investment) is increases in physical capital adjusted for changes in human capital and the stock of natural assets which include geology, soil, water and all living things. See estimates in Lange et al. Eds. (2018)

[5] 20% of intra continental trade is agricultural goods, and close to 25% is fuel.

[6] 1.9 percent of Africa's population is residing at less than 5 meters from the sea level (2010 estimate). Corneille and Melo (2015).

[7] According to the UN, climate-related disasters increased by 83 percent in the first two decades of the 21st century compared to the last two decades of the 20th century—from 3,656 to 6,681 events. Major floods have more than doubled, the number of severe storms has increased by 40 percent, and droughts, wildfires, and heatwaves have become much more prevalent. Cited in Brenton and Chermutai (2021)

Figure 1
The Climate Change challenge to African Trade



Source: Adapted from Melo and Casella,(2022, figure 1)

The bottom of figure 1 lists trade (and climate) policies needed for trade to contribute to Africa's adaptation to the CC challenge. If successfully implemented, the Africa Continental Free Trade Area (AfCFTA) will boost 'prospective' trade will contribute to resilience to climate challenge (and to Africa's needed structural transformation). As this paper documents, if widely implemented, the AfCFTA should help Africa adapt to the fast-onset and slow onset events of climate change.

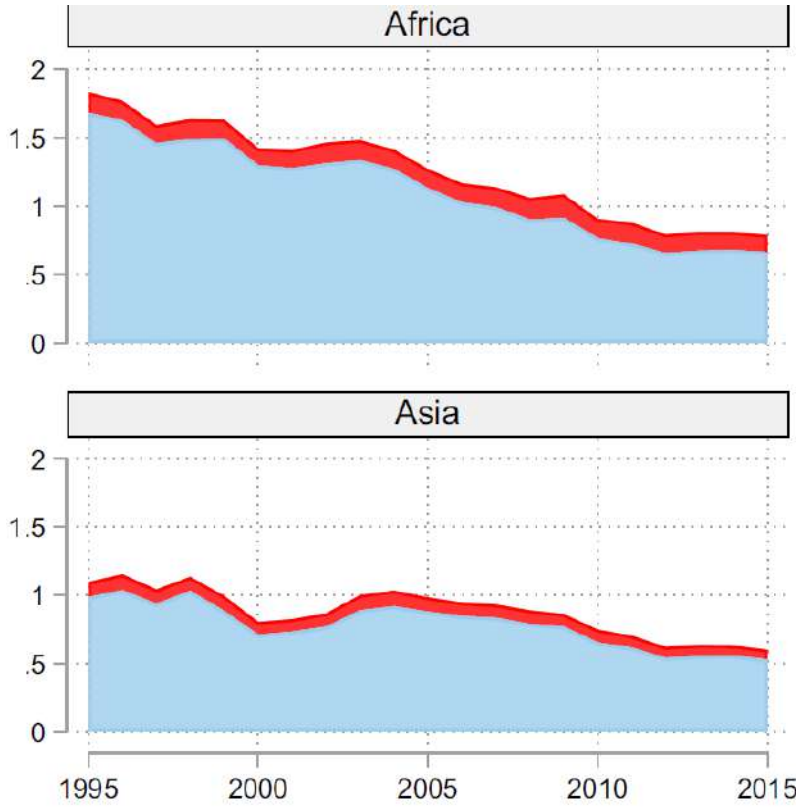
CC presents an additional barrier to Africa's quest towards greater integration in the global economy. Because of its high expected population growth and urbanization, under current IPPC projections, Africa is expected to be the third largest GHG cumulative footprint by the end of the Century and to account for 20 percent of global CO2 emissions (Calvin et al. (2016). While its low per capita income and small footprint amply justify following a 'grow first clean up later' strategy followed across continents so far, the urgency of the CC challenge also calls for efforts at mitigation by all towards a greener development path.[8] This will necessitate lower growth in GHG emissions, principally CO2 emissions, less carbon-intensive growth path by shifting towards a less carbon-intensive growth and by shifting to less carbon-intensive production.

As background, figure 2 shows the carbon-intensity trajectories of the two regions with the highest emission intensities, Africa and Asia. As with other regions, both regions have reduced their CO2e emission intensities over the last decades, yet Africa's emission intensities in 2015 were still 30 percent higher than those in Asia, the second region with the largest CO2 emission intensities. At 3.7%, Africa's exports of CO2 emissions to Europe are low compared to Asia's exports of emissions to Europe of 16.2% (Melo and Solleder 2023, table 3).

For Africa, the role of trade in adaptation to CC is complicated by two other factors. First, the known worldwide distribution of natural assets (renewable like forests, and non-renewable like subsoil) are largely concentrated in Africa. Often, property rights for these assets are poorly defined, making them vulnerable to 'tragedy of the commons' outcomes prone to be exacerbated by international trade. Threats to biodiversity, already present, will increase. Here, under weak governance, increased international trade presents a challenge. Second, net food-importing countries (and continents like Africa) are legitimately concerned about dependence on food imports, especially in the present times of increased geopolitical tensions. Section 3 gives examples of how trade across Africa has alleviated food insecurity in the past and could contribute to attenuating the effects of warming on food security under global warming

[8] Mitigation and adaptation measures often go together so the attribution of climate policies to mitigation is somewhat artificial. Africa's implementation of a low-carbon urbanization strategy would be a major contribution to both mitigation and adaptation. See Bigio (2015).

Figure 2: Trends in emission intensities: Africa and Asia (average emission intensity kg/€)



Notes: Direct emissions in blue, indirect emissions in red. CO2 equivalent ($CO2_e$) of 8 greenhouse gases (GHGs). Excludes transport and methane. Region classification follows UN definition. Total emissions in 1995: Asia: 24.6 billion kg; Africa: 2.18 billion kg. Gross output weighted country average (Africa: 49 countries, Asia 49 countries). To avoid double counting, direct emissions are emissions originating from any production in the region and indirect are emissions embodied in trade from other regions. The higher indirect intensities in Africa reflect the fact that most of Africa's supply chain trade is with countries outside Africa while in Asia supply chain takes place in 'factory Asia'.

Source: Melo and Solleder (2023, figure 2b). Data from the Resolved Multi-Regional Input-Output (RMRIO) data of Cabernard and Pfister (2021) that gives data on emission intensities for 163 sectors (77 classified as tradable) covering 183 countries (51 African) yearly over 1995-2015. Discussion of results reported in section 5 use RMRIO data.

3. The Climate change–food security–trade nexus

Trade has been shown to attenuate the effects of climate shocks (fast-onset shocks like droughts and floods, and slow-onset shocks like warming). The summary below of a review of the literature shows how the bulk of evidence indicates that trade attenuates the two types of shocks related to CC. Measures for safe trade should also be taken.

3.1 Slow-onset events

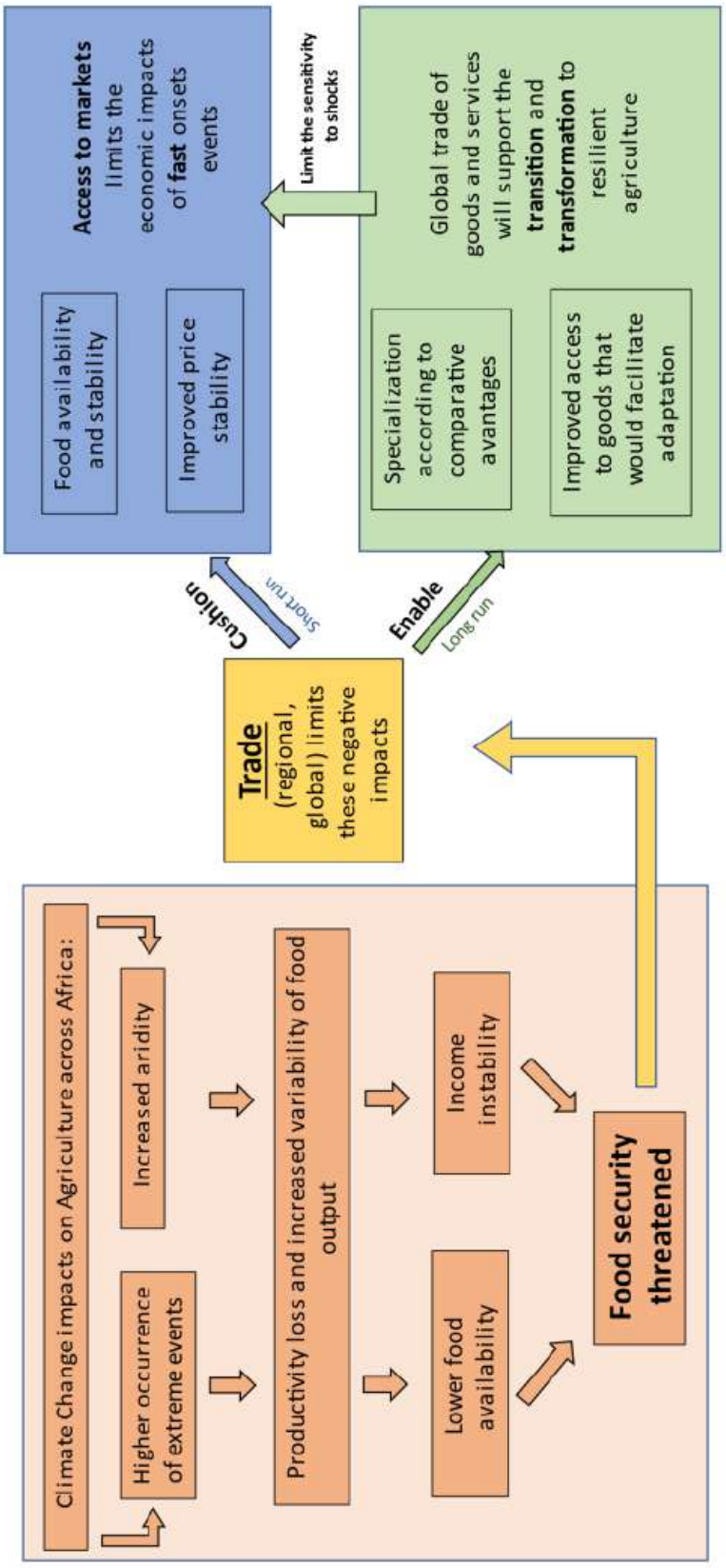
Except for a few regions in East Africa, no benefits are expected from a warmer climate across African agriculture. The leading position of the agricultural sector in Africa (52,9% of employment in SSA) makes the rural sector the main transmitter of climate shocks, threatening food availability and households' livelihoods across the country. Evidence reviewed in Hallegate et al. (2016) and Brenton and Chermutai (2021) shows that the adverse impacts of natural disasters tend to disproportionately affect vulnerable groups of society: the poor and marginalized; women; and micro, small and medium-sized enterprises, many concentrated in rural areas.

The left-hand side of figure 3 identifies the channels through which CC affects food security, and the right-hand side, how trade (the difference between consumption and production in net food importers) contributes to adaptation.[9] The right-hand side of figure 2 identifies two "crucial" roles for trade in supporting Africa's food systems. In the short-run, trade **cushions** the volatility of food markets by reducing the amplitude of a drought or a flood. In the longer run, in addition to the ongoing urbanization, the effects of warming and increased aridity call for changes in crop and livestock patterns. Trade then **enables** changes in comparative advantage helping the transformation of Africa's agriculture sector towards more resilience. In the long run, however, countries also need to adopt policies towards their extent of food self-sufficiency considering their circumstances. During global crises threatening food security, trade barriers are raised in exporting countries and lowered in food importing countries.

Casella and Melo (2022) give two examples. The first is from South Africa. During the acute 2015-6 drought episode in South Africa, the region switched from net food exporter to net food importer. Policy responses to help consumers included the lowering of barriers on food imports. For cattle herders and farmers, support policies included increases in subsidies to key inputs and the temporary removal of the export ban of live cattle in Botswana which aggravated the situation of cattle herders in other countries in the region. This example shows how policy reactions to large shocks generate strong spillovers that require collective action to be controlled. This was also the case with the global crisis of 2008 and the Covid-19 pandemic.

[9] Food security, is a sine qua non to avoid famines. distinguish three pillars to food security: Food availability (the 'supply side of food security'), food access (intra-nation and intra-household) and stability (minimization of price hikes) (Brown et al. 2017).

Figure 3: Agriculture as cushion and enabler towards resilience to climate



The second example are price-hikes during the 2008 food crisis and Covid-19 pandemic. During the 2008 food crisis, major exporters of rice and wheat restricted exports. Restrictions on exports of medical equipment took place during the early phases of the Covid-19 crisis, and of vaccines more recently. Both episodes harmed African countries. Collective action to dampen the crisis failed in both cases. In the case of the price hikes for rice and wheat during 2006-08, Martin and Anderson (2014) attribute 45% of the rise in the price of rice and 30% of the rise in the price of wheat to the insulating behavior by major exporters. [10]

Compared with the 2008 food crisis, export restrictions during the Covid pandemic were less pervasive and short-lived. The goods affected only accounted for 5% of the world market of calories, down from 18% during the previous global food crisis. Critically, all restrictions were short lived as almost all of them were lifted or expired by the end of April 2020. It is encouraging that ASEAN major exporters of rice quickly removed restrictions on exports of rice.

These examples show that in the short-run, for the fast-onset events identified in figure 1, trade reduces the amplitude of a drought. These contemporary fast onset events show that cross-border externalities are prevalent in African CC events implying gains from cooperation across countries. A successful AfCFTA will lower policy-imposed trade barriers, above all tariffs, but also non-tariff barriers (NTBs). Importantly, it would also set up a forum for strengthening cooperation.

3.2 Slow-onset events

For Africa, slow-onset events are captured in forward-looking modelling scenarios, typically up to 2080 with efforts concentrating on agriculture, exploring the 'margins' of adjustment. All derive from a CC shock captured by the Global Agro-Ecological Zones (GAEZ) project which gives potential crop yield at the 1^0 x 1^0 plot level (about 100 km^2 at the equator) for 35 crops at different time scales.[11] Margins of adaptation include to what extent farmers can alter production levels of existing crops (intensive margins); switches in crops (e.g. rice to wheat); changes in land utilization (when included explicitly as a factor of production); labor (relocation across crops, to urban areas or to neighboring countries). For trade, adaptation possibilities are captured by either constraining export shares in output at the crop level of in

[10] Martin and Anderson (2014) note that this collective action problem is akin to a situation when a crowd stands up in a stadium to get a better view. No one gets a better view by standing, but any that remain seated get a worse view. In the case of restrictions on food exports, as net importers, African countries have small shares so reductions on import tariffs would help them individually, but have small effects on world prices.

[11] For reference, GAEZ estimates of the average percentage reductions in potential crop yield across crops for 2080 are: [-13.3% (world)]; [-39.8% (SSA)];-[34.5% (LA)];[-26.0% (MNA)];[-10.7 (Europe)];[-8.8% (Asia)]; [-20.8% (OCEANIA)]; [-16.1% (NA)]; [-2.8% (CIS)]. Time scales include 1975-2000 and predictions over the 21st. C. at 20 year intervals under different IPPC scenarios (as captured in the IPPC SRES (Special report Emissions Sscenarios)). Potential yield is purely form physical Process models of potential yield that include topographic information (altitude, soil characteristics) as well as temperature variation, producing natural or potential yield estimates for each crop.

the volume of trade at different scales (regional or international) or by changes in trade policies and/or trade facilitation.

Casella and Melo review the lessons for trade and migration learned from these forward-looking exercises. Partial Equilibrium (PE) estimates produce the largest losses from reductions in crop yields (Janssens et al. 2020). Doha round tariff reductions, not implemented, would have reduced hunger risk from 43 to 30 million. Estimates appear large since, generally, NTBs were not reduced during the period. However, because often modelling assumptions are not explicitly discussed.[12]

Headline results from GE estimates are easier to compare. All models ask the same question how the economy (modelled at the field level) is likely to adjust to reduction potential crops yields in 2080 predicted by GAEZ fed into the model as the predicted physical outcome of CC. Models differ by their margins of adjustment (trade, labor productivity, migration). All studies report that the losses from global warming are mitigated when the margins of adaptation are increased. Suppressing the trade channel as a tool of adjustment raises the cost of the climate shock. Likewise, suppressing the migration channel raises the estimated costs of the CC shock.[13]

3.3. Harmonize SPS measures for safe trade

As intra and extra-regional trade in agricultural commodities is likely to increase with climate change, national regulatory bodies that set Sanitary and Phytosanitary (SPS) measures will have to be designed to deliver safe trade at least cost. African agriculture needs new technologies to adapt to CC. In Africa fertilizer application rates are substantially lower than elsewhere, especially so in Land-locked countries. SPS measures are needed for safe trade. The WTO SPS Agreement is to ensure that SPS measures are evidence-based and used only to protect against SPS risks. This is particularly important for Environmentally Preferable Products (EPPs). Countries that are unable to provide traceability in the value chain and the necessary trading infrastructure such as certification and inspection services to ensure that the product is genuinely preferable may be excluded from markets overseas. The same issues apply to trade in agricultural products across Africa.

Implementing an SPS strategy faces challenges even when among a small group (e.g. South Africa, Malawi and Zambia) as comprehensive criteria may lead traders into informality (Rathebe 2015) . At the same time, accumulating a comprehensive database on cross-country

[12] Casella and Melo compare the results across PE and GE models. They note that models with greater crop coverage estimate larger welfare losses that suppressing the trade adjustment channel leads to larger welfare losses, especially when demand elasticities are lower

[13] Because climate change is altering the ranking of crop suitabilities, low trade and migration frictions are necessary to mitigate the effects of CC-induced changes in productivity across crops. allow migration policy to adapt to climate change, although this is at the expense of higher regional inequality. Conte (2024) gives ballpark estimates on welfare of policies reducing trade barriers and easing migration frictions across Africa Reducing trade frictions to EU levels reduces climate migration by half and attenuates migration flows. Reducing migration barriers to EU levels increases climate migration, primarily between countries.

equivalences, allow Schmidt and Steingrass (2019) to show that the introduction of harmonized standards increases trade at the intensive and extensive margins. Melo and Solleder (2020) use a structural gravity model show that an increase in regulatory overlap that would result from regulatory harmonization would increase bilateral trade in EGs.

4. AfCFTA negotiations: Schedules, timetables, and CO2 intensity of current African trade

The outcome of the AfCFTA process will depend on the exclusion lists submitted by each one of the 8 participating Regional Economic Communities (RECs). See details in table 1. Permitted exclusions (classified as category A products) are not subject to tariff removal but this list is not to exceed 10% of imports from AfCFTA members in 2018. Products under negotiation are covered in category B list of sensitive products with a longer phase-down period; and in category C list longer time frames for LDCs to accommodate Special and Differential Treatment (SDT) for this group.[14] Thus, because of SDT, all countries will not liberalize intra-African trade at the same speed.

4.1 Products on excluded lists have tariffs twice those on submitted lists

At the time of writing for the phase II of the GVC project, only two RECs, EAC and ECOWAS, had submitted acceptable tariff schedules-- in the sense of lists respecting the conditions in the Treaty-to the AfCFTA secretariat. Figure 4 shows that for both RECs, average MFN tariffs on exclusion list (category 'C') are about twice as high as those on the 'in' categories (A and B).

Membership across other participating RECs is more heterogenous than in the EAC so it is likely that the implementation phase of tariff reductions across RECs will follow more closely the path of ECOWAS than that of EAC, in which case the emission intensity of the current basket of imports might increase during liberalization.

Two related stylized facts on the CO2 emissions stand out across Africa's trade patterns.

4.2 African countries subsidize carbon-intensive industries

First, African countries subsidize carbon intensive industries, a pattern first established by Shapiro (2021) for high-income and emerging countries. Melo and Solleder (2024) confirm this pattern across the 44 African countries with the RMIRO data on CO2 emission intensities. They estimate that a 1% increase in the CO2 emission intensity of imports is associated with

[14] Because of the large disparities across members, the implementation and administration of the AfCFTA relies on Special and Differential Treatment (SDT) for LDCs. Members are yet to adopt a mechanism for the settlement of disputes.

a decrease of about 0.09% in the 2021 applied MFN tariff. They establish that this pattern also holds across sectors within countries.

Table 1: Tariff liberalization under AfCFTA: Schedules and Timetable

	LDCs [1] (SDT)	**Non-LDCs**
Non-sensitive products Category A (IN)	90% of tariff lines	90% of tariff lines
	10-year phase down	5-year phase down
Sensitive products Category B (OUT)	7% of tariff lines	7% of tariff lines
	13-year phase down (current tariffs can be maintained during first 5 years – phase down starting in year 6)	10-year phase down (current tariffs can be maintained during first 5 years – phase down starting in year 6)
Excluded products Category C (OUT)	3% of tariff lines; up to 10% of intra-African imports	3% of tariff lines; up to 10% of intra-African imports
Observations: The tariff phase down will be linear. However, the parties can complement it with a request-offer approach. They can also accelerate tariff cuts on a reciprocal basis.		

Notes: 1/ Special and differential treatment (SDT) for 32 LDCs: Angola, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mozambique, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Sudan, Sudan, Togo, Uganda, United Republic of Tanzania, Zambia.

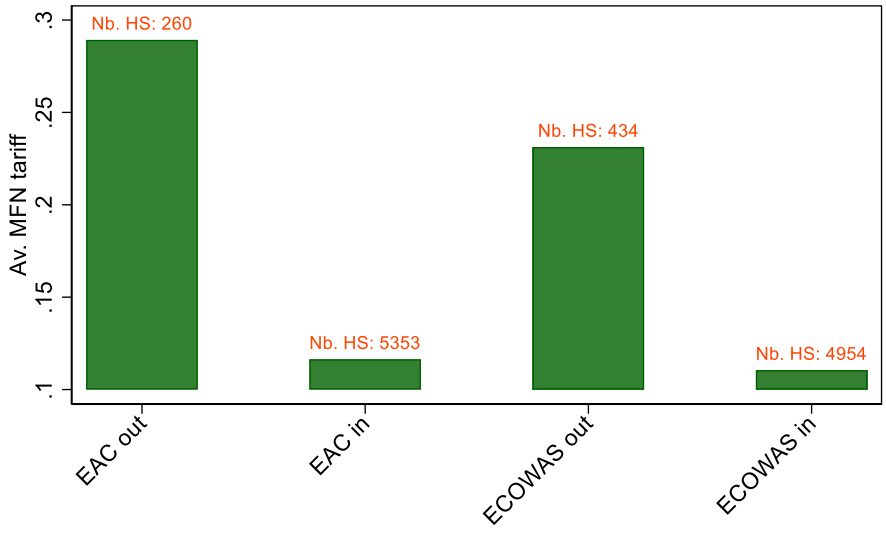
The "non-sensitive" list (category A) is intended for immediate implementation starting from July 2021, is non-negotiable, and has been finalized. The "sensitive" (category B) and "exclusion" (category C) lists are negotiated between parties on a request and offer basis to facilitate the exchange of offers and requests by all parties. As of April 2023, two RECs, EAC and ECOWAS have submitted compliant offers for their exclusion lists

Source: Agreed negotiating modalities of AfCFTA (TI/AfCFTA/AMOT/3/TIG/MOD/FINAL, restricted). ITC https://m.macmap.org/en/learn/afcfta.

Second, Africa also stands out as the only region where export shares and CO2e direct emission intensities are significantly associated positively: an increase in the share of exports of 1% is associated with a 7.2% increase in direct emissions (Melo and Solleder 2023). This pattern is not surprising since African countries mostly export CO2 intensive weight-reducing minerals and other upstream goods.

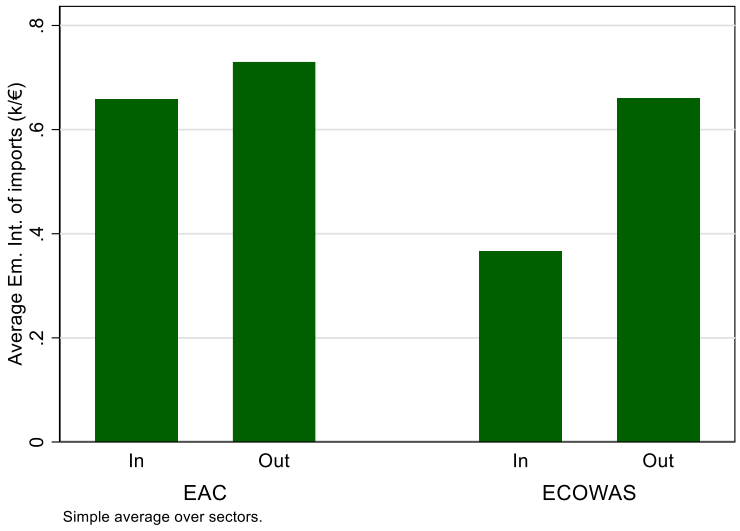
Figure 4: Average tariffs and CO2 intensities by category of AfCFTA goods

4(a): Average tariffs on goods by list: EAC and ECOWAS



EAC average MFN rate: 13.1%
ECOWAS average MFN rate: 12.04%
All averages are simple averages.

4(b): Average imported CO2e emission intensities by category of AcFTA goods:



Notes: 4(a) The tariff reduction schedules are those submitted by EAC and ECOWAS. Number of HS6 goods in each category indicated on each schedule. The schedules do not consider the differences between the LDC and non-LDC countries in each REC. Submitted (category A) and Excluded (categories B and C

4(b) GHG emissions are the CO2 equivalent (CO2e) of the following 8 GHGs: carbon dioxide (CO2), nitric oxide (NO_x), methane (CH4), nitrous oxide (N_2O), carbon monoxide (CO), ammonia (NH_3), sulfur oxides (SO_x), non-methane volatile organic compounds (NMVOCs). Copeland, Shapiro, and Taylor (2021) discuss the merits of using pollution emissions based on end-of-pipe technologies vs. data on ambient pollution. Submitted (category A (IN)) and Excluded (categories B and C(OUT))

Source: Melo and Solleder (2024, figurer 4 and 7). Data for 2015

5. Estimates of tariff removal on CO2 emissions

Two papers in the GVC project (Zgovu and Morrisey (2025) for EAC and Melo and Solleder (2024) for selected AfCFTA members) give estimates of AcFTA- induced changes in intra-African trade on CO2e emissions using the disaggregated RMIRO data on CO2 emissions to estimate used in figure 2. The papers estimate if post-AfCFTA intra-african trade flows are dirtier or cleaner (i.e. changes in the CO2 intensity of trade flows induced by full AfCFTA implementation) than those in the base year (2015). Here I report on Melo and Solleder (2024) focus on the substitution effects across countries and products as tariffs concentrate on the implications of the across-the-board characteristic of FTAs where members are in competition with each other in the newly opened markets.

Melo and Solleder use an extension of the World Bank's WITS partial equilibrium SMART model to include third-country effects. As an example, consider free intra-African trade for plastics produced by African partners. Consider then the implications for Kenya (the same applies to all African countries since each African country consumes plastics). AfCFTA will make it more profitable for Kenya to buy plastics from African partners than from RoW (substitution effect in consumption) and to sell its plastics to African partners rather than to the RoW (substitution effect across destinations as Kenyan goods sold to African partners are no longer subject to import tariffs). If this increased demand for Kenyan plastics cannot be met from plastics previously sold to the RoW, the supply of Kenyan plastics will have to increase via an adjustment in the supply price of plastics.

5.1 CO2 elasticities to imports under full AcFTA implementation are heterogenous

Melo and Solleder estimate CO2 elasticities to imports for 22 countries covering 50 tradable sectors. Those countries with elasticities above (less than) one become dirtier (cleaner) post AfCFTA. Depending on the assumed supply and substitution elasticities, CO2 elasticity estimates range for a full AfCFTA implementation between 0.5. Table 2 and figure 5 reports the headline results.

Table 2 shows that AfCFTA leads to a dirtier mix for Zambia (ZMB) and Botswana (BWA) as the CO2 elasticities to trade are greater than one. This is to be expected since section 3 shows that low CO2e emission intensity sectors are, on average, subject to larger tariffs than dirtier goods. However, this trade policy characteristic phenomenon alone cannot entirely explain the results as, for example, Botswana was showing a statistically significant negative relationship between emission intensities and tariff and, yet its import basket would turn dirtier under the AfCFTA. In the case of Botswana, the sectors "Cultivation of wheat", "Cultivation of cereal grains" that are relatively dirty expand more than other relatively cleaner sectors, such as "Sugar refining" that have originally low tariffs.

Table 2: Country results of AfCFTA full implementation, all imports

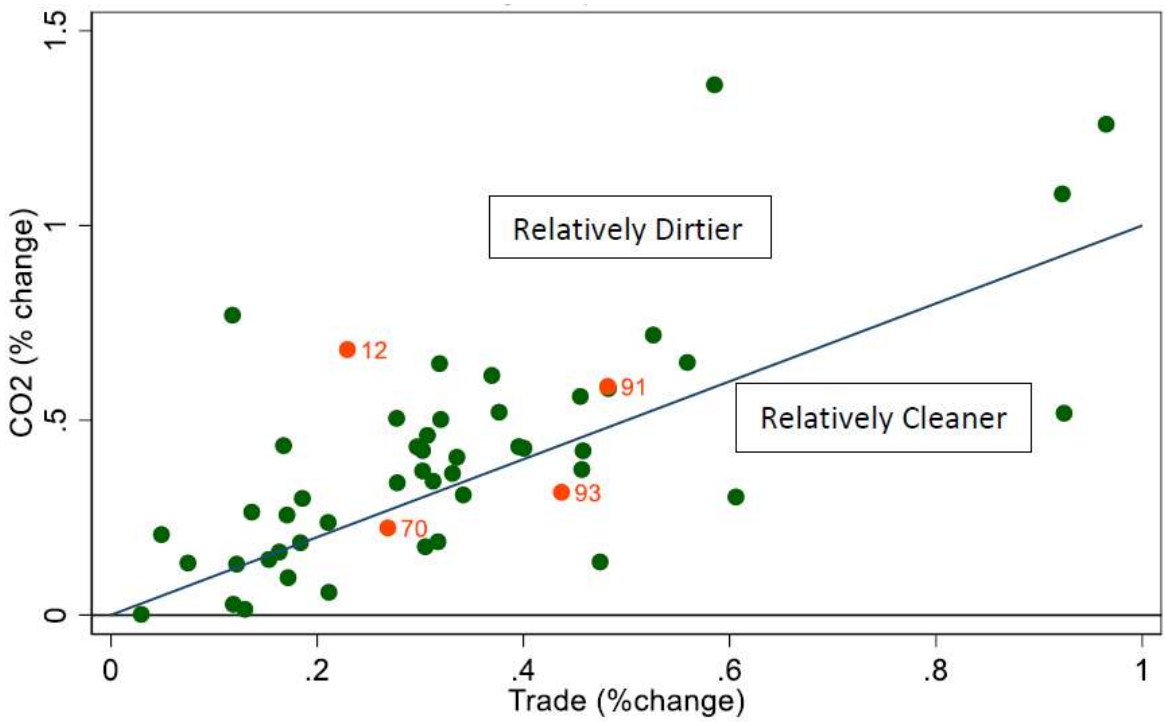
Column	(1)	(2)	(3)	(4)
Country (iso3 code)	CO2 change (%)	Trade change (%)	Average tariff before liberalisation	CO2 elas. (2)/(1)
ZMB	22%	6.1%	0.129	3.610
BWA	20.1%	9.4%	0.075	2.125
ZWE	18.8%	21.9%	0.130	0.858
TZA	4.4%	5.7%	0.129	0.770
RWA	9.5%	14.6%	0.123	0.647
SWZ	17.5%	28.3%	0.075	0.619
KEN	2.6%	6.2%	0.129	0.430
TUN	0.1%	1.5%	0.108	0.087
MDG	0.2%	4.1%	0.117	0.057
ZAF	0.1%	3.6%	0.075	0.040
NGA	0.0%	1.1%	0.121	0.022
TGO	0.1%	7.7%	0.121	0.017
BDI	0.3%	23.1%	0.126	0.012
GMB	0%	3.8%	0.121	0.011
COG	0%	3.3%	0.179	0.004
SEN	0%	3.4%	0.121	0.004
BEN	0%	4.5%	0.121	0.003
MAR	0%	1.4%	0.123	0.003
BFA	0%	2.3%	0.121	0.002
EGY	0%	1.3%	0.190	0.001
MUS	-0.5%	0.9%	0.008	-0.579
Simple average	4.5%	7.3%	0.116	0.619

Notes: Results from removing all tariffs on intra-african trade in a model with 22 countries and 27 sectors. Results listed by descending order of col. (4)

Source: Melo and Solleder (2024, table 4).

Figure 5 plots the average percentage change in CO2 emissions intensities against the associated percentage change in intra-African trade averaged across all countries. About 35% of the sectors exhibit an increase in trade larger than an increase in CO2 emissions embedded in trade (i.e. become 'relatively cleaner' as they are below the 45° line).

Figure 5: Full AfCFTA implementation: CO2 change vs. trade change



Notes: 45^0 separates dirtier and clean sectors. Sector 12 is the sector "Meat animals n.e.c.", 91 the sector "Manufacture of rubber and plastic products", 70 "Manufacture of basic iron and steel and of ferro-alloys and first products thereof", and 93 "Manufacture of furniture; manufacturing n.e.c.". The 4 sectors highlighted in red are the most polluting sectors listed in Melo and Solleder Table 1.

Source: Source: Melo and Solleder (2024, figure 4).

The simulation results show that under all cases, CO2 emissions increase because the AfCFTA involves replacing less CO2 intensive products with more CO2 intensive African products. Their CO2 elasticity estimates to imports range between 0.5. and 0.9. The disaggregated estimates, some reproduced in table 2 and figure 5 show large differences across sectors opening door to more granular investigation through sector studies.

6. Greening supply chain trade across Africa

The fragmentation of production along supply chains has grown continuously for the past 25 years. Africa's average Global Value Chain (GVC) share rose by 13% to reach 44% in 2022. Africa's import content of gross exports is the lowest across regions, standing at around 15% while the share of exports undergoing further processing at destination before reaching the final consumer is among the highest across regions, in the 20-25% range (Melo and Solleder 2025). The low content of imports in Africa's exports suggests a low access to green goods

and technologies that would likely play a role in a green diversification across sectors. As an indication, estimates suggest that, should Africa decrease the CO2e intensity of its 10 most carbon-intensive manufacturing sectors to world average levels, its total CO2e emissions would fall by about 5% (Melo and Solleder 2023).

These estimates are from sector level trade data, but the shift towards green trade takes place at the firm level. Very little is known about African firms trade in 'green' products and what role GVC firms may have in enabling a shift towards greener global trade. In their contribution to the GVC project, Montfaucon and Socrates (2024) contrast the exports and imports of suitably defined GVC firms with those of non-GVC firms by combining customs data on exports and imports over 2013-2020 for each Malawian and Kenyan firm in their sample. The Green Transition Navigator is used to select and classify goods into 19 green good products. The average share of GVC firms in both countries is low, at around 10% with most imports and exports of green goods with countries outside Africa.

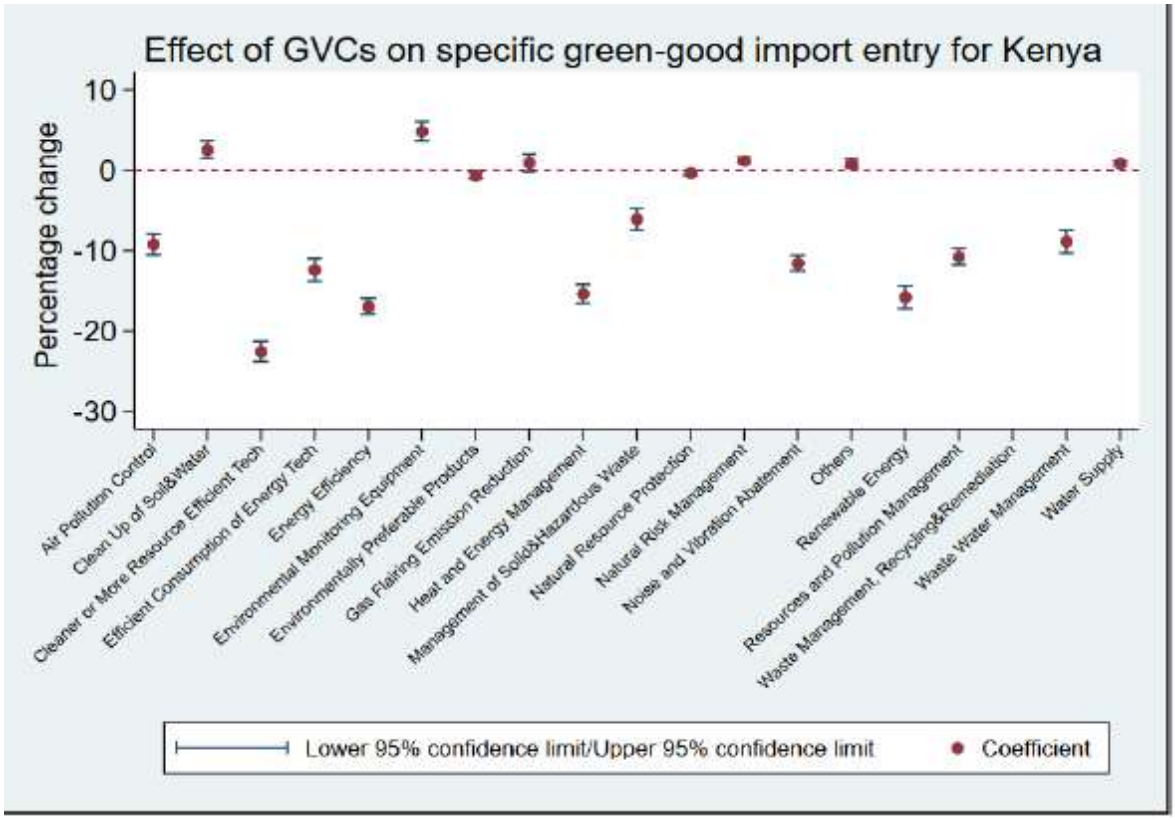
6.1 Imports of green goods exceed exports of green goods

Montfaucon and Socrates ask three questions: do GVC firms (defined as firms that import and export 'green' products, predominantly consisting of multinational firms) trade more in green goods; does shifting from non-GVC to GVC status lead to more imports and exports of green goods; and does importing green goods lead to exporting green goods. [15]Two outcomes are possible under the relocation of firms' operations through GVCs to low-cost destinations: pollution-haven effects could be observed, that is firms producing polluting products could relocate to countries with few environmental regulations (like Kenya and Malawi) or; alternatively, GVC firms could access greener technologies leading to greener trade. In their case study of Kenya and Malawi, imports of green goods far exceed exports of green goods, so supply chain trade is essentially a conduit for access to clean technologies. Increased green exports are not associated with firms that switch to GVC status. In both countries, being a GVC firm increases the probability of starting to import rather than starting to export green goods.

Montfaucon and Socrates estimate that Kenyan GVC firms reduce green good imports by 13.5% and by 12% for Malawi. Similar estimates are obtained for the probability of GVC firms entering green goods exports. Figure 6 reports the more granular estimates for each one of 19 green goods categories. The patterns show that the probabilities of importing clean up or remediation of soil and water technologies go up while the probabilities of importing cleaner or more resource efficient technologies go down.

[15] Panels are unbalanced. For Kenya, the approximate average number of GVC firms each year is 2600, with about 200 firms trading in green goods. This is about 4 times the number of firms in Malawi where approximately 50 firms trade in green goods.

Figure 6: Probability that GVC firms will import green goods

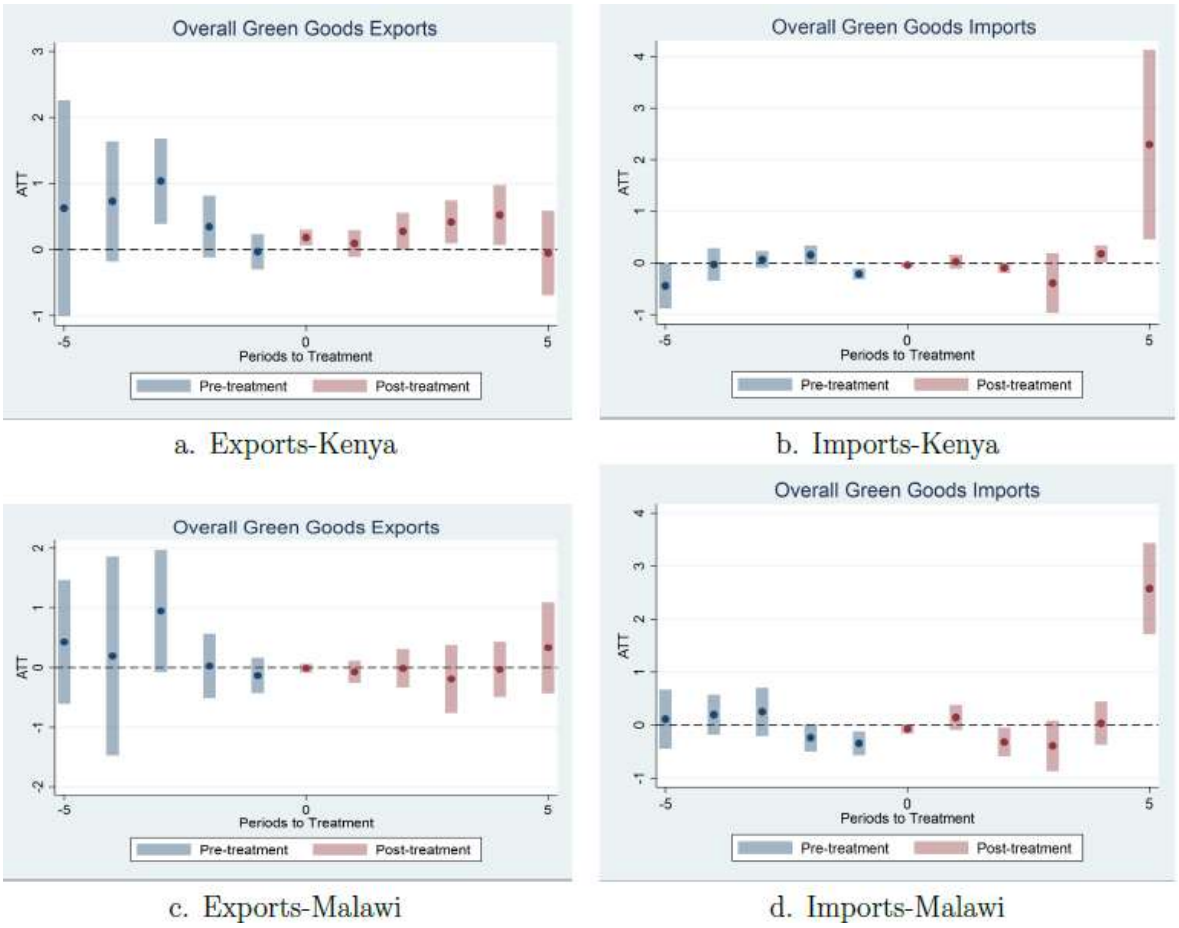


Notes: Probit estimates with firm and year Fixed effects
Source: Montfaucon and Socrates (figure 2)

6.2 Switching to GVC status increases imports of green goods

Figure 7 shows the impact on import and export values of green goods following the switch from non-GVC to GVC status for Kenya and Malawi. Firms had higher export values of green goods when they had a non-GVC status while import values of green goods increased when firms changed their status.

Figure 7: Difference-in-Difference estimates of Green-goods trade after shift to GVC status



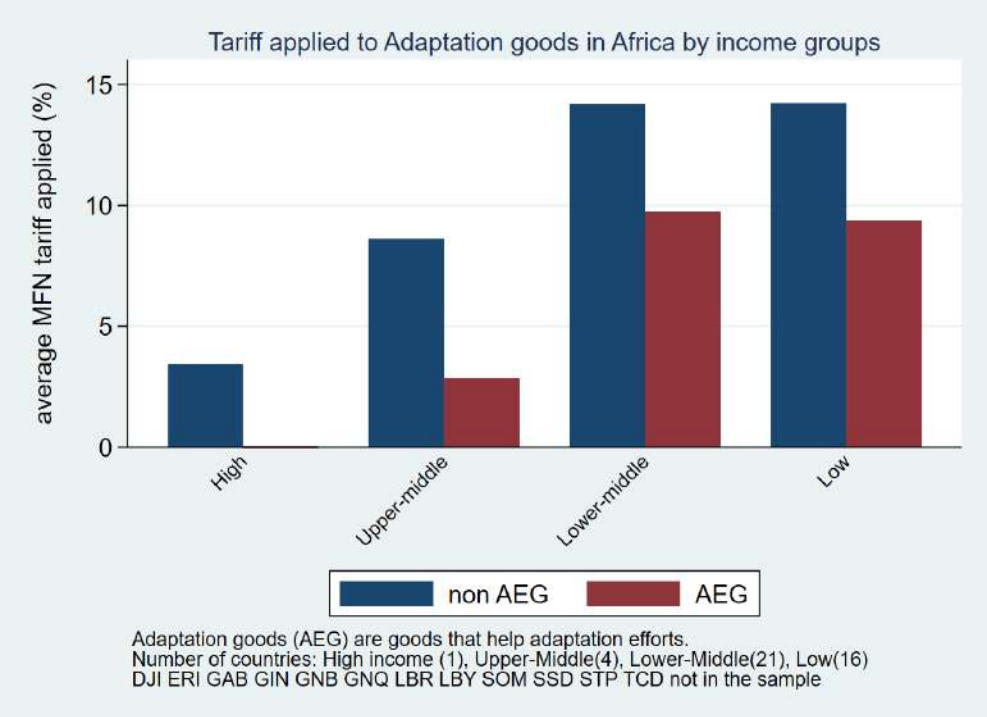
Notes: Probit estimates at the firm-product level. Post-treatment refers to period after change from non-GVC to GVC status. Shaded areas display 95% confidence intervals. Shaded areas overlapping zero indicate non-significant change in imports or exports from change of status.
Source: Montfaucon and Socrates figure 3.

The headline message of their contribution is that trade in green goods is low in both countries with imports far exceeding exports, an indication that trade serves as an access to green technologies. The type of green goods imported is similar between GVC and non-GVC firms while for exports, green goods under the category of environmentally preferable products grows when a firm is a GVC in Kenya or Malawi. Other case studies would help establish the characteristics of firm trade in green goods across Africa, a prerequisite to design supportive policies.

6.3 Use AfCFTA to eliminate tariffs and NTBs on Environmental Goods (EGs)

All countries should reduce tariffs and Non-Tariff Barriers (NTBs) on broad lists of Environmental Goods (EGs) and Environmentally Preferable Products (EPPs), either unilaterally, regionally, or multilaterally. If it is easier to reach agreement on small lists, African countries might first concentrate on reducing their barriers on imports of 'Adaptation-related Environmental goods (AEGs)' starting with a removal of tariffs on intra-African trade while excluding increasing barriers on trade in extra-continental trade.[16]

Figure 8: Average MFN applied tariffs (AEGs vs. non-AEGs) by income group



Notes: Adaptation-related Environmental Goods (AEGs). Simple average of applied MFN tariffs for the two categories of goods. Averages per income group obtained by taking the Simple average applied tariff for all AEGs and countries in the corresponding income group. The list of 57 goods includes goods used for generating renewable energy (biogas stoves, wind-turbine, solar-cells) irrigation, captor and sensor. Seychelles is the high-income group country.

Source: Casella and Melo Figure 6.

[16] Selecting any list of EGs for tariff reductions is difficult. Rather than relying on existing lists, in their background paper for the WTO on adaptation to CC in Africa, under guidance from WTO staff, Melo and Solleder (2022) proposed a list of 56 products they dubbed the Adaptation-related EG (AEG) to distinguish it from other lists derived from negotiations on an Environmental Goods Agreement. The list includes stress-tolerant cultivars, pesticides for weed control, early warning systems, elements of renewable off grid power generation, irrigation technology. The list of 56 products is detailed in an annex to their paper and reproduced here.

Eliminating barriers to trade in AEGs would significantly reduce the cost of acquiring foreign inputs that are critical to carry adaptation measures. For the preservation of the environment and, as first step in the rapprochement of trade and climate policies, AfCFTA members should ban AEGs, then more broadly EGs and EPPs from exclusion lists submitted to the AfCFTA secretariat. Excluding green goods from exception lists would mainstream protection of the environment into the African policy architecture and jump start cooperation across the continent.

7. Policy recommendations

This paper uses several examples of evidence that CC has and will continue to hit hard Africa. Regarding agriculture which will be hardest by CC, this paper has reported on three dimensions along which international trade should help Africa adapt to Climate Change (CC): (i) fast-onset events from short-lived extreme occurrences (floods, extreme temperatures); (ii) slow-onset events (rise in average temperatures and sea-level rise); (iii) greening the AfCFTA to help trade mitigate and adapt to the effects of climate change on African economies.

(i) Fast onset events. Trade reduces the amplitude of extreme events like drought. But policy reactions to large shocks can increase the amplitude of the shock. During the South African drought of 2015-6, policies had spillovers in neighboring countries. Following the 2008-09 financial crisis, export restrictions by major crop exporters and reduction in tariffs by importers amplified the shock. Policy coordination is needed to control spillover effects.

(ii) Slow-onset events. These are to occur over the century. The paper reviews models exploring the 'margins' of adjustment to CC in agriculture: changes in production levels of existing crops; switches in crops; changes in land utilization; labor relocating to urban areas/migration; adjustments in the volume of trade at different scales (regional or international). Enlarging the channels of adjustment mitigates the amplitude of the loss in welfare from expected CC over the 21st Century. Decomposing the welfare changes suggests two conclusions. First adjustments in crop selection and in bilateral trade partners contribute approximately equally to reducing the costs of adjustments. Second, the expected sharp increase in food prices resulting from warming is likely to hit SSA most strongly.

(iii) Greening the AfCFTA. If greening the environment occupies centre stage in recent RTAs, this has not yet happened for the AfcFTA signed in 2018 and operational since January 2021. It is remarkable that the environment appears nowhere in the AfCFTA, not even in the preamble. In short, integration efforts in Africa at the regional and continental level have failed to attract attention on preservation of the environment. As mentioned in the introduction, a first necessary step for AfCFTA is to amend the preamble to mention the environment. [17] The preamble would then recognize the necessity to balance environment and trade (this

[17] Amending the AfCFTA protocol might come at the suggestion of the AfCFTA secretariat, a State Party, or a group of like-minded State Parties.

language is in the preamble for more than 90% of the 280 trade agreements signed since 1956 scrutinized by Monteiro and Trachtman (2020)).

Few studies dealing with the trade-climate nexus is attracting increasing attention on the trade policy cover Africa.[18] Environmental provisions in African Regional Trade Agreements (RTAs) are fewer than those in RTAs in comparable environments. [19] .

As example, measures to protect against deforestation should be a win-win for the AfCFTA as it would minimize spillover effects across countries. A particularly vexing challenge for studies assessing the adverse impact of trade liberalization on the environment is that most use CO2 emissions as measure of environmental damage.[20] But these damages are not easily assigned to countries. Not so with environmental measures limiting deforestation, a challenge across Africa. In an event study comparing RTAs that include provisions to control deforestation with those that do not, Abman et al. (2022) estimate that the inclusion of these provisions almost offset the increase in forest loss observed in similar RTAs without such provisions.[21]

Next, an environmental agenda focused on adaptation to CC would first need to focus on the environmental objectives that are in line with existing Multilateral Environmental Agreements (MEAs) to which African countries are parties (UNFCCC, Aichi Convention on Biodiversity…). This will be a challenge for the many SSA countries with limited implementation capabilities, especially because the measures in this 'positive' trade policy agenda require resources that are also needed for other tasks.

Environment-related provisions should be on the Phase II negotiations agenda. First, the protocol on competition policy could include environmental provisions. Avoiding an environmental race to the bottom should be a top priority. Second, improvements are needed in the application of the SPS agreement so that trade becomes effectively safe by the selection of measures that traders will not seek to avoid because compliance is excessively onerous.

Finally, the National Implementation Strategies for Member States and RECs could be directly included in the AFCTA. For example, the EAC has carried out a Strategic Environmental Assessment (SEA) to this effect, which could serve as an input towards a template. The

[18] An online search of refereed articles across websites over 2010-2020 returned 43 articles of which only one study covered Africa (Balogh and Mizik (2021).

[19] Casella and Melo tabulate environmental provisions across the RECs. Only 4 have environmental provisions. In their tabulation of RTAs across Small Islands Development States (SIDS), they show that African RECs have fewer environmental provisions than those in the Caribbean and the Pacific (table 3.2).

[20] Morin et al. (2018) document environmental provisions in 630 RTAs included in the TRade and ENvironment Database (TREND). They show that North-South RTAs are frontrunners in the inclusion of environmental norms. Democracies, countries that face import competition, and countries that care about the environment (as captured by high values of an Environmental Protection Index) are more likely to include environmental provisions in RTAs.

[21] Controlling for many confounding factors, Abman, Lundberg, and Ruta (2022) show that the inclusion of deforestation provisions in trade agreements in fact reduced forest loss by 7,571 km2 from 1960 to 2020, the effects being most pronounced in ecologically sensitive areas. These provisions limited agricultural land expansion but not total production, indicating that agricultural intensification on existing land may still have occurred.

template would become a flagship on the AU 2063 agenda serving as a continental-level plea to for the include environmental dimensions in the agenda.

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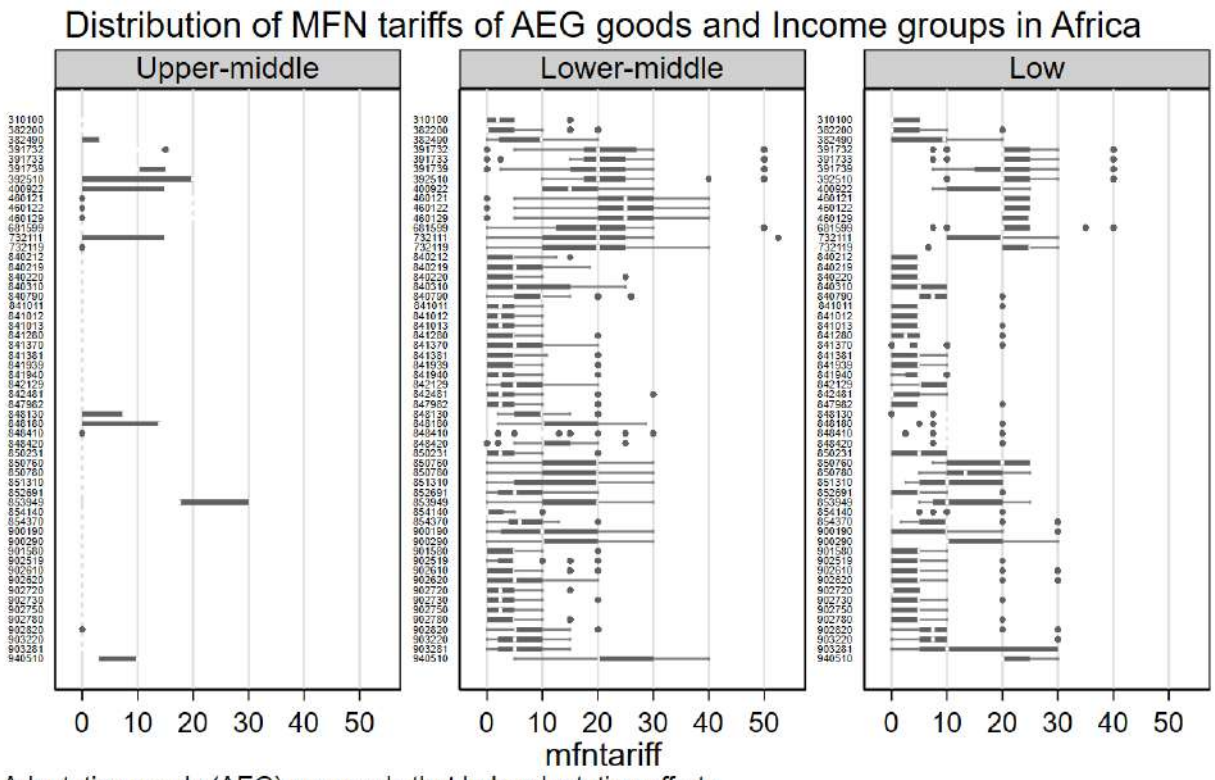
ANNEX: Adaptation-related Environmental Goods (AEG)

Figure A1: Distribution of MFN tariffs on AEG goods in Africa by income group



Source: Casella and Melo (2022) Authors from WITS database. MFN tariffs in %. Boxes represent the interquartile range, whiskers the range of the 1st and 3rdh quartile and dots are outliers observation.

Numbers in left column correspond to the list of 56 AEG products

Table A1: Import values of the most imported AEGs (ranked in descending order)

(1)	(2)	(4)	(5)	(6)
HS6 product code	Averages (million USD)	EG good APEC	avg MFN tariff	Products description
850231	114.6	Yes	3.5%	Electric generating sets and rotary converters: - Other generating sets: wind- powered
854140	54.6	yes	1.6%	Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes; mounted piezo- electric crystals:
382490	48.8	No	6.4%	Prepared binders for foundry molds or cores; chemical products and preparations of the chemical or allied industries (including those consisting of mixtures of natural products), not elsewhere specified or included:
848180	42.3	No	11.5%	Taps, cocks, valves and similar appliances for pipes, boiler shells, tanks, vats or the like, including pressure- reducing valves and thermostatically controlled valves:
382200	34.4	No	2.6%	Diagnostic or laboratory reagents on a backing and prepared diagnostic or laboratory reagents whether or not on a backing, other than those of heading 3002 or 3006; certified reference materials.
841370	34.4	No	4.5%	Pumps for liquids, whether or not fitted with a measuring device; liquid elevators:
840212	29.4	No	3.4%	Steam or other vapor generating boilers (other than central heating hot water boilers capable also of producing low pressure steam); super- heated water boilers: - Steam or other vapor generating boilers: water tube boilers with a steam production not exceeding 45 t per hour
842481	27.0	No	3.0%	Mechanical appliances (whether or not hand- operated) for projecting, dispersing or spraying liquids or powders; fire extinguishers, whether or not charged; spray guns and similar appliances; steam or sand blasting machines and similar jet projecting machines:
840219	18.6	No	4.3%	Centrifuges, including centrifugal dryers; filtering or purifying machinery and apparatus for liquids or gases: §

Source: Authors

Notes: Data used in Casella and Melo figure 4.2. Col. 2: Total imports averaged over 2017-2019. Col. 3: Average Applied MFN tariff over 41 African countries.

"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner ? Sera-ce sur le caprice de chaque particulier ? Quelle confusion ! Sera-ce sur la justice ? Il l'ignore."

Pascal

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