A Comparative Analysis of the Effects of the African Continental Free Trade Agreement on the Economic Impacts of COVID-19 in North and Southern Africa

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Abstract COVID-19 has forced many governments to take emergency health measures which are undermining productive capacities and disrupting global supply chains. Southern and Northern Africa have been heavily impacted by such measures. According to UNCTAD statistics (2021), the average annual growth rate of exports in Northern and Southern Africa fell by 27.61% and 6.96%, respectively in 2020. Yet, the effective operationalization of the African Continental Free Trade Agreement (AfCFTA) could have limited some of the pandemic's economic impacts. Using a computable general equilibrium model, this paper first analyzes the pandemic's economic impact and then assesses the ability of the AfCFTA to mitigate the economic impacts of COVID-19. The simulation results show that the AfCFTA would mitigate the economic impact in Southern and Northern Africa. It reduces the decline in intra-regional exports by 7.87 percentage points in 2021. The study emphasizes the need to remove non-tariff barriers to amplify potential positive effects.

Keywords: COVID-19, AfCFTA, CGE model, Southern Africa, North Africa

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I. Introduction

As of June 2, 2021, the World Health Organization (WHO)[1)] statistics counted 3,557,586 deaths due to the coronavirus disease (COVID-19) out of 170,812,850 confirmed cases and 1,581,509,628 doses of vaccine administered. Africa recorded its first COVID-19 case on February 14, 2020, in Egypt. Since then, the virus has spread rapidly across the continent, totaling

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4,898,938 confirmed cases. Cumulative cases in Africa represent 3% of the global total and deaths represent 4%. From a regional perspective, Southern Africa accounts for 37% of confirmed cases and is the continent's first most affected area. This is followed by North Africa (30.23%), East Africa (18.40%), West Africa (9.69%), and Central Africa (4.17%).

COVID-19 has forced governments to take emergency health measures, including the closure and strengthening of border controls, export restrictions as remedial measures, lockdowns, and temporary cessation of economic activities to contain the virus (Giammetti et al., 2020). The restrictive measures on exports across Africa represent 11.71% of the measures adopted at the world level (Thiam et al., 2021). These measures affected productive economic units, the labor market, and aggregate demand due to the interdependence of economic agents and sectors. The pandemic has caused a drastic reduction in the aggregate supply of goods and services due to lower productivity and temporary suspensions of business activities. The fall in aggregate demand is linked to reductions in the workforce, particularly through layoffs, but also to losses in income, which affect household consumption patterns and business investment decisions. High investment and raw material supply costs have affected the price levels of food goods (Agyei et al., 2021; Baldwin & Mauro, 2020; Baldwin & Tomiura, 2020; CEDEAO, 2020; Djiofack Zebaze et al., 2020; Rosenberg et al., 2021).

Thus, the health crisis has had a strong negative impact on global economic growth. For example, Fernandes (2020) shows that on average each additional month of crisis costs 2.5-3% of global Gross Domestic Product (GDP). Similarly, the Banque Mondiale (2020) projected a decline in economic growth ranging from -2.1% to -5.1% in 2020 in sub-Saharan Africa compared to the economic growth of +2.4% in 2019. Real GDP fell for the first time in more than 30 years by 2.6% in 2020, and the contraction in GDP per capita was even more marked at 4.7% (Coguic & Osman, 2021). The FMI (2020) shows that resource-rich and tourism-dependent countries are the most affected in sub-Saharan Africa. At the sub-regional level, NUCEA (2020) projects a decline in economic growth in North Africa to -1.8% in 2020 while the loss of full-time equivalent jobs could reach 5 million in 2020. The 50% drop in oil prices and containment will lead to a drop of 4.5% to 5.8% in Algeria's GDP in 2020. Morocco and Tunisia, whose economies have been hit by the fall in tourism and related demand from the European Union, would experience GDP decline by 3.7% and 5%, respectively.

Simultaneously, the response to COVID-19 has particularly affected trade and tourism activities due to their often-transnational nature (Tröster & Küblböck, 2020). Increased trade costs obstruct the supply channel for goods and constitute a key element in the transmission of COVID-19 effects. Debuquet et al. (2020) and UNECA (2020) reported significant harassment on African trade corridors that cause bottlenecks, delays in goods deliveries, and additional costs in the transport sector. Restrictive measures have contributed to increased transport time due to sanitary control

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1)　https://who.maps.arcgis.com/apps/dashboards/0c9b3a8b68d0437a8cf28581e9c063a9

requirements (Bouët & Laborde, 2020). These institutional distortions have sometimes led to corrupt behavior on transnational corridors. Among these measures, the introduction of curfews has complicated night-time freight, where, because of their characteristics, fresh and perishable products are usually transported then.

Additionally, the pandemic has caused an unprecedented collapse of trade in goods and services in Africa due to their high external integration, particularly their dependence on global demand. WTO (2020) estimates indicate that the pandemic's economic shock leads to a net decline in world trade of 13 -32% in 2020 due to uncertainty. In addition, UNCTAD statistics (2021) show a contraction in African exports in 2020 of 2.8% in the first quarter, 21.8% in the second, and 13.65% in the third compared to the same periods in 2019. Along with exports, African imports recorded declines of 1.5%, 16.8%, and 8.47% in the first, second, and third quarters of 2020, respectively, compared to 2019.

Respectively, North and Southern Africa faced a decline in export of 27.61% and 7% in 2020, whereas in 2018, their exports grew by 19.18% and 6%, respectively. The subregions suffered significant losses due to two amplifying effects. First, intra-regional trade in North Africa and Southern Africa is weak. For example, in 2019, intra-area exports accounted for 5.24% of total exports in North Africa and 13.51% in Southern Africa. This poor regional trade integration is partly due to complex tax and customs systems and low transport infrastructure coverage (PNUD, 2017). Second, countries in both subregions are highly dependent on the export of natural (mineral) resources and tourism, which further exposes them to the negative effects of the pandemic. That leads Banque Mondiale (2020) to argue that trade-restrictive measures have significant economic consequences for African countries.

Trade liberalization in goods and services is expected to be integral in mitigating the economic impact of COVID-19. The elimination of intra-African trade barriers would allow firms to have cheaper access to inputs needed for production. The World Bank (2020) and Zidouemba and Jallab (2021) point out that the African Continental Free Trade Agreement (AfCFTA) increases incomes, employment, and exports of industrial and intermediate goods, which is a catalyst for Africa's structural economic transformation. From this perspective, African economies must accelerate the implementation of the AfCFTA[2] and trade liberalization reforms (WTO, 2020). For the WTO, the AfCFTA represents a real trade lever for African countries faced with falling external trade flows. As such, its operationalization when considering COVID-19 can help facilitate the supply of essential goods. The AfCFTA could mitigate Africa's negative economic effects.

As such, it seems clear that COVID-19 and its restrictive measures are causing economic

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2) The AfCFTA, the world's largest free trade area, was launched at the 10th Extraordinary Assembly of Heads of State and Government of the African Union (AU) in March 2018 in Kigali, Rwanda. It now has 54 signatory countries and 36 countries have deposited their instruments of ratification. The AfCFTA was officially launched in January 2021. For the CEA (2017), it aims to further boost intra-African trade and investment, stimulate industrialization and increase employment opportunities, and improve the global competitiveness of African industries.

recessions in Africa. However, among the alternative solutions to enable these economies to be resilient, one can assume that the effects of the implementation of the AfCFTA might be relevant to mitigate the impacts of the crisis. Thus, the main objective of this paper is to assess the mitigating effects of the AfCFTA on the negative economic impacts of COVID-19. To do so, the paper focuses on the following macroeconomic variables: imports, exports, consumption, and the demand for production factors. It also assesses the magnitude of these effects at the sectoral level: industry, services, and agriculture using a dynamic computable general equilibrium model.

The remainder of the article is organized as follows: a brief review of the recent literature in Section 2, the methodology in Section 3, the results in Section 4, and the conclusion and main implications in Section 5.

II. Literature Review

COVID-19 has caused an unprecedented supply and demand shock to the global economy. Governments, to thwart the virus' spread, preserve the health of their populations, and protect their livelihoods, took unilateral measures ranging from restricting travel across land borders to confining populations (BanqueMondiale, 2020; WHO, 2020). Given the virus' rapid spread and its almost unprecedented nature, most containment measures in the early stages were taken unilaterally because of the length of time it often took to make concerted decisions. The reactions of public authorities through measures to contain the virus led to a slowdown in economic activity.

Theoretical literature shows that unilateral trade restrictions have negative impacts on both the preservation of human health and economic activities. According to Aazi et al. (2020), these decisions have had repercussions on the supply of goods and services through the decrease in production of economic units, but also on demand through the decrease in consumption and investment due to economic uncertainty. Thiam et al. (2021) argue that export restrictions in attempting to control COVID-19 have seriously hampered the supply of medical goods to health centers and equate the health crisis with a return to consensual protectionism with export restrictions on medical goods to address the national health emergency. Moreover, Bayham and Fenichel (2020) show that school closures caused a shortage in health centers as health workers were forced to attend to their children at home.

Trade restrictions have negative impacts on economies and people's welfare. Harris (1985) points out that voluntarily imposed restrictive measures on exports when regarding price competition encourage local industries to become the price leader. This induces an increase in prices and profits for firms in the industry at the expense of consumers who will find a decrease in their purchasing power and welfare level. The measures taken to counter COVID-19 would induce macroeconomic costs materialize in supply and demand shocks (Boissay &

Rungcharoenkitkul, 2020). To limit the risks of contagion from COVID-19, workers avoid social interactions by reducing both labor supply (negative supply shock) and consumption (negative demand shock). Theoretically, the analysis of the occurrence of COVID-19 can also be discussed in the framework of the aggregate supply-aggregate demand (AS/AD) model in which AD is a decreasing function of the general price level.

While these measures aim to limit the health and economic impacts of COVID-19, some measures have mixed results. Bayham and Fenichel (2020) show that beyond the economic costs induced by the school closures in the United States, they create involuntary childcare obligations in families, particularly those in the health sector. Emeto et al. (2021) find that the implementation of border closures within African countries (South Africa, Nigeria, Ghana, Egypt, and Kenya) had minimal effect on COVID-19.

Economically, the pandemic has affected all regions of the world, but with varying intensity. Coguic and Osman (2021) show that Africa's real GDP declined for the first time in over thirty years by 2.6% in 2020, and GDP per capita contracted by 4.7% due to the closure of borders, confinements, and dependence on extractive commodities. Also, sub-Saharan Africa experienced an economic decline of -2.5% in 2020, but less severe than Europe (-7.6%), Latin America (-7.6%), and South and Southeast Asia (-6.4%), which recorded the largest declines in national income in 2020. While East Asia, which was the first region affected, has managed to stabilize (Chancel et al., 2021).

Most of the work on the economic consequences from COVID-19 has focused on the immediate effects (Correia et al., 2020). Yet, the effects of a pandemic are not only limited to the short term (Estrada, 2020) because of the irreversibility effects that characterize some decisions. Jordà et al. (2021) argue that the major pandemics of the last millennium have generally been associated with low asset returns for a long period. Similarly, Aazi et al. (2020) observe that the COVID-19 shock tested the different components of the affected economies for a long period, thus jeopardizing the return to normal in the short run.

Coguic and Osman (2021) identify three main channels of transmission of the COVID-19 shock to African economies: (i) the fall in the price of extractive commodities due to Africa's continuous dependence which constitute 55% of total African GDP; (ii) the closure of borders affecting the foreign exchange earnings and supply of countries; and, ultimately, (iii) containment measures in some countries and the lockdown of economic activities combined with weak state response capacities. Figure 1 describes one channel of transmission of the COVID-19 shock to demand through a temporary halt in economic activity that is likely to lead to job losses, a reduction in household purchasing power, and a contraction in investment and consumption, particularly in countries where social protection is almost non-existent.

Figure 1. Mechanisms of transmission of COVID-19 pandemic shock
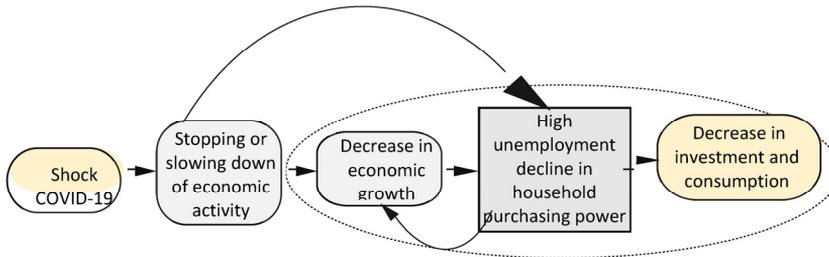
Source: Authors, using Suryahadi et al. (2020)

Boissay and Rungcharoenkitkul (2020) point out that interactions between supply and demand transmission channels are not specific to COVID-19 but rather a general feature of pandemic shocks. Thus, the resulting human losses lead to substantial and persistent economic losses. Consequentially, the significant costs of travel restrictions prove to be economically beneficial for preserving human capital (Baldwin & Mauro, 2020).

The results show that the sectors most affected by COVID-19 are labor-intensive. Thus, non-essential services were more vulnerable to the restriction measures, which were locked down to limit human interaction and the virus' spread (Haddad et al., 2021). These abrupt changes have caused a return to trade protectionism that constitutes bottlenecks in food supply chains (Erokhin & Gao, 2020; Larue, 2021).

However, the magnitude of the pandemic's economic impact on a region depends on the economic structures. It is strongly differentiated according to the sectors of activity (Estrada, 2020; Haddad et al., 2021; Martin et al., 2020). Thus, economies that rely more on the agricultural sector and foreign trade are more affected (Djiofack Zebaze et al., 2020). For Haddad et al. (2021), who discussed the state of São Paulo, non-essential services were more vulnerable than essential services (especially public health), agriculture, and manufacturing industries.

Unilateral containment measures of the pandemic, without cooperation in an ensemble framework and consisting of tightening trade restrictions, worsen the economic effects. The OCDE (2020) report states that world trade collapsed in the first half of 2020, falling by more than 15% from its 2019 level due to trade restrictions. Export restrictions are common factors influencing strategic trade policies. Thiam et al. (2021) show that bilateral restrictions between countries during the pandemic are inappropriate because they lead to a decrease in the total production of medical goods. In contrast, the number of medical goods available in an exporting country increases when restrictions are unilateral, reflecting good management. Also, Coulibaly (2021) supports the thesis of regional cooperation of government measures in containing the pandemic. These results indicate that world food and oil prices positively affect the consumer price index in the WAEMU region.

Alongside African partners' production difficulties, trade barriers have contributed to increasing transport time, which has reduced intra-African trade flows. Moreover, the requirement for more thorough sanitary controls has not been matched by an increase in control staff, resulting in higher transport costs due to the intensive controls imposed at cross-border and the long travel and clearance times (Dicko, 2020).

Some of the empirical work on economic policies to mitigate and/or stimulate the economy following the pandemic's negative economic impacts has focused on the cyclical measures taken by governments at the national level. These economic policies are mainly based on fiscal instruments. This is what Fe and Ahoure (2021) have proposed by showing that the public measures implemented in Côte d'Ivoire have mitigated the impact of COVID-19 on the economy. They point out that these measures included the release of special funds to assist the most affected businesses such as those in tourism, transport, and hospitality, the establishment of moratoriums on the payment of taxes, the creation of special funds for small and medium-sized enterprises, including the informal sector, the purchase of food for emergency food aid, and the provision of cash transfers to the most vulnerable households. As for the policies' effectiveness, the authors find that they are sensitive to the shock on the labor supply of unskilled workers. Therefore, they argued that any policy aimed at reducing the effect of the pandemic on hours worked is more likely to mitigate the negative impact of the pandemic and foster economic resilience (Suryahadi et al., 2020).

Guerrieri et al. (2020) show that in a multi-sector economy with incomplete markets, firm shutdowns, and job losses amplify the negative effect of a Keynesian supply shock on economic activity. The authors examine the effects of various economic policies for economic stimulus and find that conventional fiscal stimulus may be less effective than usual because some sectors, being shut down, reduces the Keynesian multiplier feedback effect. Similarly, Morsy et al. (2021), in a first phase simulating the macroeconomic effects of COVID-19 in Africa, find that the pandemic would lead to an economic recession and widen fiscal deficits due to the contraction in the level of employment in the formal and informal sectors, including household consumption. In a second phase, Morsy et al. (2021) explore the different types of fiscal measures implemented by African countries to limit the economic impacts of the disease. The authors find that all fiscal policy instruments succeed in increasing household consumption and income, thus mitigating the effects of Africa's health crisis.

Figure 2 illustrates the mechanism, by which the pandemic containment measures affect and increase transport margins. It also highlights the relationship between export and import volumes including export taxes or subsidies and import tariffs. AfCFTA represents a removal of tariffs. When authorities take measures that restrict free movement (COVID-19 effects), they contribute to higher transport margins, and hence higher trade costs, because of the resulting rise in export prices. As a result, export demand falls. However, when countries adopt coordinated trade policies, such as the AfCFTA (total elimination of tariffs), this reduces trade costs.

Figure 2. Trade channel of transmission of COVID-19 and AfCFTA measures
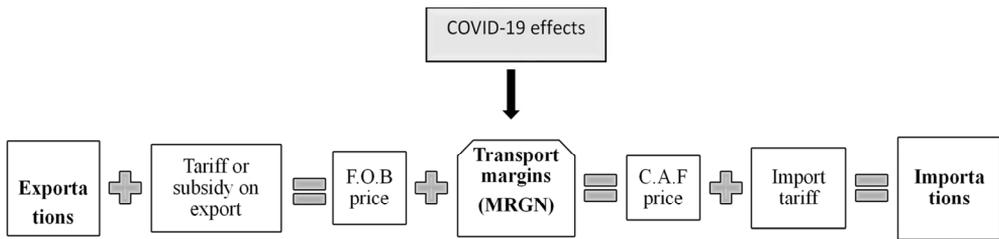
Source: Authors using Aguiar et al. (2016)

Figure 3 describes the interaction between the COVID-19 shock and the implementation of the AfCFTA on African economies. The transmission effects of COVID-19 are mediated by the sanitary measures imposed (red arrow). These measure negative impacts on economic activity. They have had negative economic consequences on economic growth (-2.6% in 2020), incomes, and food supply (Chancel et al., 2021; Coguic & Osman, 2021; Debuquet et al., 2020). The sudden decline in economic growth increases poverty (Suryahadi et al., 2020) due to falling incomes and job losses. This leads to a decline in household consumption and business investment while the AfCFTA reduces the costs of sourcing consumer goods for households and the costs of inputs and capital for firms (green arrow). The AfCFTA stimulates economic activity and growth through an increase of consumption and investment that leads to job creation. Depending on the redistributive impacts, the net effect of COVID-19 combined with implementing the AfCFTA depends on the magnitude of each.

Figure 3. Transmission Mechanism: From COVID-19 shock and the implementation of the AfCFTA to economic growth
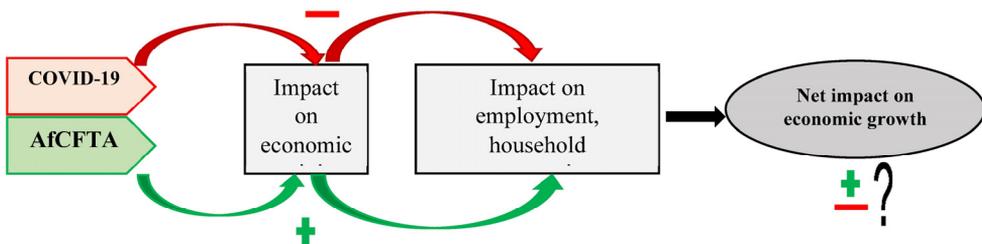
Source: Authors

III. Methodology

A. Data and simulations

This study uses the latest Global Trade Analysis Project database (GTAP, version 10.2; 2014), which describes global bilateral trade patterns, production, consumption, and use of intermediate goods and services. To better understand the structural effects of shocks, the database[3] has been grouped into 33 industry sectors.

Three scenarios were simulated. The first scenario, "COVID-19," assumed increased trade costs due to border controls, personal travel restrictions, and curfews. These measures disrupted logistics and transportation. Following the WTO (2020) assumptions on the aggregation of indirect economic costs due to COVID-19, we assume that in Africa, COVID-19 increases trade costs of goods and services by 20%. Indeed, WTO (2020) calculations show that transportation and service costs, alongside transportation costs for specialized equipment, increased by 22.5% over 12 months.

Additionally, air freight has increased by 70% in 2020 due to reduced air transport capacity. The "COVID-19" scenario captures the impact of COVID-19 in Southern and Northern Africa without mitigation measures.

The second scenario, "COVID-19+AfCFTA," is based on the first scenario and explores the implementation of the AfCFTA. The implementation of the AfCFTA consists of the complete elimination of intra-African tariffs in line with the final objective of the agreement. The results of the two scenarios are compared and analyzed.

The third scenario, "AfCFTA post COVID-19," explores the potential effects of the AfCFTA agreement without the measures (trade restrictions, containment …) taken to protect public health. This scenario begins in 2024 with the complete removal of tariffs on exports and imports to Africa. The disease containment measures are assumed to be temporary.

B. General description

A dynamic multi-sector, multi-regional CGE model is used to assess the economic impact of COVID-19 containment measures on the Southern and Northern African economies. This model is theoretically based on the Partnership for Economic Policy (PEP-w-t) model by Lemelin et al. (2013). It can identify the different economic interactions in a given area and the mainshock transmission chains. The methodology presented here has already been used to assess the economic effects of COVID-19 (Banque Mondiale, 2020; Chitiga-Mabugu et al., 2021; Djiofack Zebaze et al., 2020; Madai Boukar et al., 2021; McKibbin & Fernando, 2021; Zidouemba et

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3) See Badri et al. 2015. for more details on the GTAP database

al., 2020). These authors believe that the CGE model is appropriate for simulating the impact of an economic shock. It allows the direct and indirect effects of the pandemic to be evaluated in the medium term while allowing for both macroeconomic and sectoral effects. Also, this model is suitable for evaluating trade policies (Fouda Ekobena et al., 2021; Hamid & Aslam, 2017; Mold & Mukwaya, 2017; Zidouemba & Jallab, 2021). It implements the interaction between different consumption and production behaviors while ensuring broad macroeconomic equilibria.

In the CGE model, the production structure of a regional economy is illustrated in Figure 4 and the consumption structure in Figure 5. Firms use land, labor, capital, and natural resources as factors of production. They combine these factors with intermediate inputs to produce goods in each region. This output is consumed by households, governments, and private and public sectors for investment. The rest of the output is exported.

Figure 4. Nested production structure
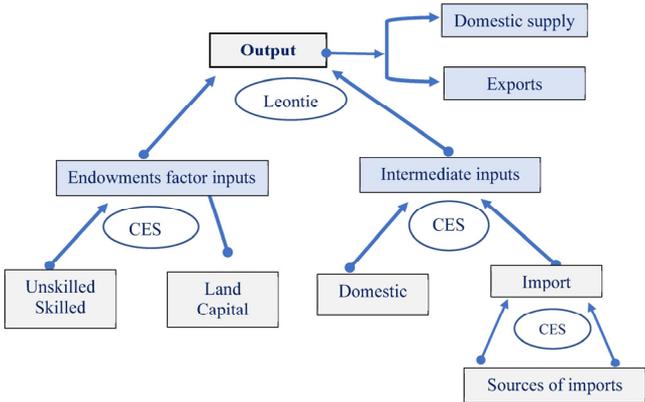
Source: Authors

Figure 5. Consumption structure
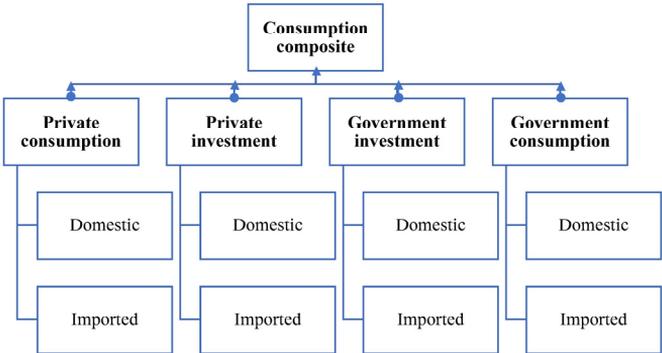
Source: Authors

In this model, firms are assumed to operate in a perfectly competitive environment. Their objective is to maximize profits or minimize production costs regarding the technological constraints of their products but also to the prices of goods and services and factors. The government collects taxes and makes public expenditures. The household agent receives income from labor and capital and makes private expenditures. Taxes on goods and services imports, income, and production constitute the fiscal instruments. Taxes on imports of goods and services are applied to the value of sales, which already includes trade and transport margins, and customs duties. The consumption of households, public administrations, and intermediaries, and investments constitute the domestic demand for imported or domestically produced goods. Producers allocate their products to markets to maximize profits. The behavior of producers follows production functions of constant elasticity.

Three trade outlets contain the overall production in the economy, namely exports, domestic, and international transport margins. Exports are distributed across countries or regions of destination. Under the assumption that goods are heterogeneous (the functional forms are constant elasticity of substitution (CES) production functions), producers and consumers respond to symmetric behavior since it is assumed that imports from one region are imperfectly substitutable to imports from another region and that local products are imperfect substitutes for imported products. The macroeconomic equilibria, closures, and dynamics of the CGE model are in Appendix 1.

The direct effect of an increase in transaction costs (the *tmrg* parameter in equation [1]) is an increase in the price of imports and exports (equation [2]). This could therefore result in a drop in import demand (equation [2]), including for finale consumption, intermediate consumption goods (equation [3a]), and investment demand (equation [3b]) likely have negative effects on domestic production of goods and services (equation [4]). The increase in export prices will have the effect of lowering the price competitiveness of region's exports and could ultimately induce a fall in national production and overall economic growth. Whereas, the tariff dismantling, which consists of the elimination of customs duties (equalization of the parameter *ttim* to zero in equation [1]) will have the effect of producing the opposite effect of reducing the world price of imports, which would benefit private consumption and national production through increased demand for intermediate consumption and investment goods. The final effect can only be measured in a general equilibrium framework, which justifies the relevance of using the multi-region CGE model. Individuals interested in a complete description of the model can refer to Lemelin et al. (2013).

The price paid in region z for imports from region zj is the world price paid by z for imports from zj, translated into region z's currency, plus taxes and duties on imports, margins, and domestic indirect taxes:

$$PM_{i,zj,z} = (1 + ttic_{i,z})(1 + ttim_{i,zj,z})e_z \left[PWM_i + \sum_{ij} PWMG_{ij} ttmrg_{ij,i,zj,z} \right] \qquad [1]$$

$PM_{i,zj,z}$: Price of commodity i imported from region zj by region z (including margins and all taxes and duties); $PWM_{i,zj,z}$: World price of commodity i imported from region zj by region z (expressed in international currency); $PWMG_i$: World price of margin I (expressed in international currency); $ttic_{i,z}$: Tax rate on commodity i in region z; $ttim_{i,zj,z}$: Rate of taxes and duties on imports of commodity i from region zj by region z; $ttix_{i,zj,z}$: Export tax rate on commodity i exported to region zj by region z.

Demand functions of imports from individual regions are derived from the first-order conditions of expenditure minimizing subject to the CES aggregator function. We have:

$$IM_{i,zj,z} = \left[\frac{\beta_{i,zj,z}^{M2} \ PMT_{i,z}}{PM_{i,zj,z}} \right]^{\sigma_{i,z}^{M2}} \frac{IMT_{i,z}}{\left(\beta_{i,z}^{M2}\right)^{1-\sigma_{i,z}^{M2}}} \tag{2}$$

Where $\sigma_{i,z}^{M2}$: Elasticity of substitution (CES - composite import); $PMT_{i,z}$: Price of composite commodity i imported by region z (including all taxes, duties, and margins); $IMT_{i,z}$: Quantity demanded of imports of composite commodity i by region z from all other regions.

$$CI_{j,z} = io_{j,z} XS_{j,z} \tag{3a}$$

Where $CI_{j,z}$: Total intermediate consumption of industry j in region z; $io_{j,z}$: Coefficient (Leontief-intermediate consumption) and $XS_{j,z}$: Total output of industry j in region z.

Investment demand refers to gross fixed capital formation (GFCF), which is distributed among commodities in fixed shares:

$$PC_{i,z} PC_{i,z} = \gamma_{i,z}^{INV} IT_{,z} \tag{3b}$$

Where: $IT_z = PK_z \sum_{k,j} IND_{k,j,z}$ and $PK_z = \frac{1}{A_z^k} \prod i \left(\frac{PC_{i,z}}{\gamma_{i,z}^{INV}} \right)^{\gamma_{i,z}^{INV}}$; $IT_{z,t}$ represents Real GFCF in region z, PK_z: Price of new capital in region z and A_z^k: Scale parameter (price of new capital); $\gamma_{i,z}^{INV}$: Share of commodity i in region z total investment expenditures; $IND_{k,j,z}$ Volume of new type k capital investment to industry j in region z. $PC_{i,z}$ Purchaser price of composite commodity i (including all taxes and margins) in region z.

The section on production describes how, in each region, industries combine inputs to produce total aggregate output $XS_{i,z}$. Producers allocate output to market outlets to maximize sales revenue, given product prices. The total output of industry j in region z $\left(XS_{j,z,t}\right)$:

$$XS_{i,z} = B_{i,z}^{X1} \left[\beta_{i,z}^{EX\_X1} EXT_{i,z}^{\rho_{i,z}^{X1}} + \beta_{i,z}^{D\_X1} DS_{i,z}^{\rho_{i,z}^{X1}} + \left(1 - \beta_{i,z}^{EX_{X1}} - \beta_{i,z}^{D\_X1} \right) MRGN_{i,z}^{-\rho_{i,z}^{X1}} \right]^{-\frac{1}{\rho_{i,z}^{X1}}} \quad [4]$$

Where: $EXT_{i,z}$: Supply of composite commodity i by region z to the export market; $DS_{j,i,z,t}$: Supply of commodity I to the domestic market of region z; $\beta_{i,z}^{X1}$: Scale parameter (CET-composite supply); $\beta_{i,z}^{D_{X1}}$: Domestic market share parameter (CET - composite supply); $\beta_{i,z}^{EX\_X1}$: Export share parameter (CET - composite supply); $\rho_{i,z}^{X1}$: Elasticity parameter (CET - composite supply; $MRGN_{i,z}$: Domestic production of commodity i in region z exported as international margin.

IV. Results and Discussion

A. Descriptive statistics and stylized facts

The IMF's 2020 Regional Economic Outlook for sub-Saharan Africa stated, "Sub-Saharan Africa is facing an unprecedented health and economic crisis, which in just a few months has jeopardized years of hard-won development progress and disrupted the lives and livelihoods of millions." The evidence shows that African countries have beaten the alarmist predictions concerning their ability to cope with COVID-19.

B. Focus only on South and North Africa

Although some countries in Africa are severely affected by the virus, their health situation is not very alarming compared to other global regions. Notably, 76.02% of confirmed cases were in nine African countries including South Africa (34.07%); Morocco (10.61%); Tunisia (7.08%); Ethiopia (5.55%); Egypt (5.38%); Libya (3.80%); Kenya (3.49%); Nigeria (3.40%); and Algeria (2.64%).

Figure 6. Cumulative total cases per 100,000 population in Africa, 2 June 2021

Source : Authors, using WHO COVID19, 02 june 2021

Figure 7. Death cumulative total per 100,000 population in Africa, 2 June 2021

Source : Authors, using WHO COVID19, 02 june 2021

Table 1 illustrates the situation of COVID-19 in North and Southern Africa. In North Africa, the countries most affected are Morocco (10.61%), Tunisia (7.08%), and Egypt (5.38%). While in Southern Africa, more than 92% of COVID-19 cases are in South Africa (Table 1).

Table 1. *African Regional Distribution of Total Confirmed COVID-19 Cases as of 2nd June 2021*

North Africa		Southern Africa	
Country	Proportion (en %) en Afrique	Pays	Proportion (en %) en Afrique
Morocco	10.61	South Africa	34.07
Tunisia	7.08	Botswana	1.17
Egypt	5.38	Namibia	1.14
Libya	3.80	Eswatini	0.38
Algeria	2.64	Lesotho	0.22
Sudan	0.73		
Total	**30.23**		**36.99**

Source: *Authors, using WHO (2021a)* [4]

C. Structure of intra-regional exports in Africa and recent export trends

Table 2 shows that intra-regional trade in Africa remains structurally weak. While intra-Southern African trade was 13.51% in 2019, in North Africa it barely reached 5.25%. Southern Africa has experienced a significant increase in intra-area trade from 2.88% in 2000-2009 to 14.31% in 2010-2019.

Table 3 shows that a significant share of African exports is directed outside the continent. African countries do not trade enough among themselves because of the nature of their exports, which are mainly raw materials and less technological goods. The nature of the products exported (unprocessed and with low added value) would constitute a weakness in economic resilience to COVID-19.

Table 3 shows the average annual rate of change in exports in Africa. Over 2000-2018, the average rate of exports in North Africa (9.82%) was above the African average (9.81%) whereas Southern Africa (7.81%) was below. In 2019, these rates ranged from -5% to -6% for these two subregions. There is a significant drop in African exports of 20.31% in 2020. Consequently, while Southern Africa recorded a slight decline in these exports in 2020 compared to 2019, this decline in North Africa was multiplied by almost five or -27.61%. This can be explained by the uncertainty linked to the coronavirus outbreak in China in December 2019 and by the negative economic consequences due to the containment measures taken by the authorities.

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[4] https://who.maps.arcgis.com/apps/dashboards/0c9b3a8b68d0437a8cf28581e9c063a9

Table 2. *Intra- and Extra-Trade of Country Groups by Product, (% of Total), 2000-2019*

Year	Mean 2000-2009			Mean 2010-2019			2019		
PARTENAIRE	Intra-group	Rest Africa	Rest of the World	Intra-group	Rest Africa	Rest of the World	Intra-group	Rest Africa	Rest of the World
Africa	10.33			15.32			15.51		
Northern Africa	**3.14**	**21.10**	**75.77**	**4.85**	**32.19**	**62.96**	**5.24**	**35.34**	**59.43**
Sub-Saharan Africa	13.57	4.38	82.05	18.06	3.62	78.32	17.79	4.19	78.03
Eastern Africa	13.90	50.23	35.87	13.56	54.54	31.90	13.60	53.51	32.89
Middle Africa	1.22	68.52	30.27	1.96	70.89	27.15	1.38	78.83	19.79
Southern Africa	**2.88**	**84.06**	**13.06**	**14.31**	**50.38**	**35.31**	**13.51**	**51.51**	**34.98**
Western Africa	9.00	34.30	56.70	8.24	44.80	46.96	7.08	47.15	45.77

Source: Authors, using [5]CNUCED 2021

Table 3. *Growth Rates of Comodities Exports in Africa, 2000-2020*

Group	Mean 2000-2018	2018	2019	2020
Africa	9.81	16.04	-5.47	-20.31
Northern Africa	**9.82**	**19.18**	**-5.8**	**-27.61**
Southern Africa	**7.81**	**6.41**	**-5.22**	**-6.96**
Eastern Africa	9.45	6.98	-1.75	-5.87
Middle Africa	13.61	23.22	-19.38	-28.79
Western Africa	10.97	21.81	3.49	-24.58

Source: Authors, using [6]CNUCED, 2021

Additionally, cooperative trade reforms such as the AfCFTA agreement stimulate economic growth, intra-regional trade, and human welfare (Valensisi et al., 2016; World Bank, 2020). The removal of tariff barriers is a crucial response to the crisis. Reducing the fiscal and administrative burdens on commercial actors improves the supply of goods and services (World Bank, 2020). Implementing such dismantling policies at this time, however, will only be effective if their gains outweigh the resultant losses.

D. Results of simulations

1. Macroeconomics effects

Table 4 presents the percentage changes in imports, exports, and total investment expenditures in Southern and Northern Africa over 2021-2023. The results show a significant decline of different magnitudes in imported and exported trade flows. COVID-19 has a greater impact on North Africa's economies than on Southern Africa's regarding foreign trade. Additionally,

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5)   https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en

6)   https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en

the drop in investment spending is higher in Southern Africa. This difference is explained by the structure of the economies of the two subregions (Table 2). It is also explained by the severity of restrictions on population mobility and policy responses to the crisis. On average, over 2010-2019 intra-regional exports accounted for 14.31% of total exports in Southern Africa and 4.85% in North Africa. In addition, 35.31% of Southern Africa's export flows are directed to partners outside Africa who are unable to trade, compared to 62.96% for North Africa. The level of economic integration in Southern Africa is higher. Oil exporters have suffered severe terms of trade shock with the fall in external demand and a decline in world commodity prices, particularly for oil and gas (CEDEAO, 2020).

There has been a drastic decline in the level of investment in both subregions where Southern Africa has had a greater decline. The economic costs associated with restrictive measures to stop COVID-19 combined with the dependence of the supply chains of sub-regional industrial units on imported productive capital goods are at the root of the drop.

Furthermore, the operationalization of the AfCFTA is an instrument for mitigating the economic impacts of COVID-19. Trade liberalization in Africa reduces the negative economic consequences of the health crisis for trade in the two subregions. In contrast to foreign trade, the effectiveness of the AfCFTA amplifies the negative impacts of COVID-19 on investment in both zones, but more so in Southern Africa. Economic recovery in these subregions requires coordinated strategies at the regional level, alongside public support for the private sector that combines supply and demand-side measures.

Table 4. *Estimated Regional Impacts, Variation in %, 2021-2023*

Year	Importations		Exportations		Total investment	
	COVID-19	COVID-19 + ZLECAf	COVID-19	COVID-19 + ZLECAf	COVID-19	COVID-19 + ZLECAf
North Africa						
2021	-1.99	-1.89	-2.93	-2.72	-0.27	-0.50
2022	-4.39	-4.29	-4.41	-4.19	-0.50	-0.73
2023	-7.63	-7.54	-6.24	-6.03	-0.80	-1.03
South Africa						
2021	-0.64	-0.74	-1.64	-1.59	-1.01	-2.38
2022	-2.23	-2.29	-2.41	-2.33	-1.50	-2.89
2023	-4.56	-4.59	-3.37	-3.26	-2.14	-3.54

Source: Authors' simulations, GTAP 10.

Table 5 shows the effects of COVID-19 on intra-African exports by the three major sectors. The values are percentage changes for 2021. The results show that the loss of export volumes suffered by the economies is mainly through a decline of almost 27% in exports of agricultural

products and a decline of about 7% in regional exports of industrial goods. Services activities are affected less. These results corroborate Coguic and Osman (2021), who show that the closure of borders has caused some supply disruptions and severe consequences for the industrial and agricultural sectors that depend on imports of foreign inputs.

Implementing the AfCFTA during COVID-19 mitigates the negative impact of the pandemic on intra-regional trade. The AfCFTA increases exports of goods in the industrial sector by 3.47% and reduces the fall in exports from 27.28% (COVID-19 scenario) to 22.74% (COVID-19+ AfCFTA scenario) (Table 5).

Scenario 3 "AfCFTA post COVID-19" produces significant positive results for intra-African trade flows (Table 5), industrial production, and household consumption (Tables 9 and 10 in appendix). Compared to the COVID-19 context, the simulation results show that without the restrictive measures, the AfCFTA would lead to an increase in exports of 12.87% in the industrial sector and about 5% in agriculture. The positive effects obtained are explained by the facilitation of trade (especially the supply of goods and inputs at lower cost) caused by the removal of tariff barriers in Africa. The border control measures imposed to curb COVID-19 in Africa have interrupted the continent's progress of economic integration (with the entry into force of the AfCFTA on January 1, 2021).

Table 5. *Estimated Impacts of COVID-19 and the AfCFTA on Intra-African Exports by Sectors, Variation (%), 2021 (2024 for AfCFTA post COVID-19)*

Sectors	COVID-19	COVID-19 +AfCFTA	AfCFTA post COVID-19
Agriculture	-27.69	-22.74	5.01
Industry	-7.16	3.47	12.87
Services	-0.518	-0.6	-0.18
Mean Exportations	-10.23	-2.36	5.90

Note. Scenario 3 "AfCFTA post COVID-19" assumes the end of restrictive measures from 2024.
Source: Authors' simulations, GTAP 10.

2. Sectoral impacts of COVID-19 and the AfCFTA

Table 6 shows the sectoral effects of the virus containment measures on production and consumption. Table 7 shows the sectoral effects of COVID-19 on labor demand and capital demand by industry. The results are summarized through agriculture, industrial production, and services. The values are annual percentage changes relative to the baseline scenario over 2021-2023. They are calculated averages expressing annual variations in %.

Tables 6 and 7 show that Southern Africa would be more affected than North Africa in sectoral production, household consumption, and factor demand. Details are presented in Appendix 2, Tables 9 and 10.

Table 6. *Estimated Impacts of COVID-19 and the AfCFTA on Total Output of Industry and Consumption, Variation (%), 2021-2023*

	Total output of industry in region				Consumption of commodity by households			
	South Africa		North Africa		South Africa		North Africa	
	COVID-19 +AfCFTA	COVID-19	COVID-19 +AfCFTA	COVID-19	COVID-19 +AfCFTA	COVID-19	COVID-19 +AfCFTA	COVID-19
Year 2021								
Agriculture	-2.65	-2.90	0.33	0.34	1.57	-3.12	1.47	-2.93
Industry	-0.26	-1.34	-0.12	-0.26	0.82	-4.10	0.81	-3.58
Service	-0.20	-0.24	0.15	0.18	0.44	-1.95	0.62	-1.48
Year 2022								
Agriculture	-4.08	-4.40	0.47	0.48	-7.45	-4.79	-9.07	-4.08
Industry	-0.60	-1.74	-0.29	-0.43	-2.13	-5.80	-3.07	-5.01
Service	-0.37	-0.43	0.05	0.08	0.41	-2.78	0.37	-2.11
Year 2023								
Agriculture	-5.78	-6.15	0.63	0.64	1.78	-6.83	1.70	-5.41
Industry	-0.95	-2.14	-0.50	-0.64	-3.29	-7.82	-3.84	-6.69
Service	-0.63	-0.69	-0.15	-0.12	-4.75	-3.79	-6.33	-2.89

Source: Authors' simulations, GTAP 10.

Table 7. *Estimated Impacts of COVID-19 and the AfCFTA on Demand for Labor and Capital by Industry, Variation (%), 2021-2023*

	Demand for labor by industry				Demand for capital by industry			
	South Africa		North Africa		South Africa		North Africa	
	COVID-19 +AfCFTA	COVID-19	COVID-19 +AfCFTA	COVID-19	COVID-19 +AfCFTA	COVID-19	COVID-19 +AfCFTA	COVID-19
Year 2021								
Agriculture	-4.21	-4.56	0.50	0.51	-1.70	-1.87	0.03	0.04
Industry	-0.96	-2.65	-0.10	-0.31	-0.24	-0.62	-0.36	-0.44
Service	-0.21	-0.27	0.55	0.58	-0.26	-0.29	-0.24	-0.22
Year 2022								
Agriculture	-5.92	-6.33	0.74	0.75	-2.85	-3.08	0.06	0.07
Industry	-1.16	-2.81	-0.04	-0.24	-0.55	-1.07	-0.67	-0.77
Service	-0.31	-0.39	0.68	0.70	-0.55	-0.58	-0.51	-0.48
Year 2023								
Agriculture	-7.84	-8.30	1.02	1.03	-4.24	-4.52	0.08	0.10
Industry	-1.16	-2.80	0.10	-0.08	-0.98	-1.62	-1.10	-1.21
Service	-0.44	-0.52	0.77	0.80	-0.97	-1.01	-0.91	-0.87

Source: Authors' simulations, GTAP 10.

Table 8 reports the simulation results for "AfCFTA post COVID-19." The detailed results are in Table 10 (Appendix).

Table 8. *Estimated Impacts of the AfCFTA post COVID-19 by Sectors, Variation (%), 2024-2026*

Sectors impacts post COVID-19	Total output of industry in region		Consumption of commodity by households		Demand for labor by industry		Demand for capital by industry	
	North Africa	South Africa	North Africa	South Africa	North Africa	South Africa	North Africa	South Africa
Year 2024								
Agriculture	0,00	0,34	0,06	0,35	0,00	0,39	-0,01	0,31
Industry	0,20	1,54	0,13	0,69	0,26	2,01	0,15	0,95
Service	-0,04	-0,09	0,04	0,26	-0,02	-0,15	-0,05	-0,04
Year 2025								
Agriculture	-0,01	0,38	0,06	0,35	0,00	0,43	-0,01	0,35
Industry	0,20	1,59	0,13	0,69	0,26	2,01	0,16	1,07
Service	-0,04	-0,10	0,04	0,25	-0,02	-0,16	-0,06	-0,06
Year 2026								
Agriculture	-0,01	0,41	0,05	0,36	0,00	0,46	-0,02	0,38
Industry	0,20	1,64	0,13	0,69	0,26	2,01	0,16	1,17
Service	-0,05	-0,11	0,04	0,24	-0,02	-0,16	-0,07	-0,08

Source: Authors' simulations, GTAP 10.

These results predict the economic vulnerability of North and Southern African industrial units if appropriate economic stimulus measures are not anticipated. They contradict Haddad et al.'s (2021) findings regarding São Paulo because of differences in economic structures. Six major lessons can be drawn from the results:

1. A drastic decrease in household consumption can be observed in most sectors of activity. This decline is more significant in the industrial sectors due to the high dependence of the supply chains of sub-regional industrial units on imported raw materials. Containment measures are disrupting production value chains, resulting in job losses in labor-intensive sectors and a decline in household purchasing power. This combined effect leads to a decrease in domestic demand for manufactured goods that are already suffering from export constraints. Moreover, the decline in household consumption is also explained by the surge in consumer prices.

2. Demand for labor and capital factors falls significantly over 2021-2023 in Southern Africa and all sectors of activity than in North Africa due to the significant reduction in sectoral output and household consumption. The level of mitigation of the impacts of the crisis through the implementation of the AfCFTA is also lower in North Africa. In North Africa, the agricultural sector increased over the three years, while the industrial and services sectors did not because of the tourism and oil industries. To consolidate the resilience of the economies in the two subregions, it is necessary to implement differentiated support

from the authorities in the medium term, at the national level to protect jobs in agriculture and industries as argued by Madai Boukar et al. (2021). This government support should target businesses and workers in times of confinement to ensure the continuity of economic activities and the restarting of businesses already closed due to COVID-19. Managers may consider paying partial unemployment benefits, which would help reinforce household purchasing power, keeping workers active and reviving household consumption, ultimately remedying the decline in the level of investment and wealth.

3. In Southern Africa, labor demand is falling significantly in rice, vegetables, fruits and nuts, sugar, processing as well as construction, other food, beverages, and tobacco products. While in North Africa, the decline is in fishing, gas distribution, water, meat products and other manufactured goods, vegetable oils and fats, transport equipment, and petrochemicals. However, activities timber, harvesting, and rice processing are experiencing an increase in labor demand. This is because the prices of these goods and the accompanying efforts of the public authorities are increasing. The decline in demand for labor and household consumption are explained by the collapse of economic activity and fear of contamination in marketplaces and containment measures as supported by Langot and Petit (2020).

4. Services have been negatively affected by COVID-19. Disruptions in the supply of services have important economic and trade consequences because the sector provides inputs for other economic activities. The results corroborate Fernandes (2020) who argued that service-based economies are more affected by the crisis and with a greater threat to jobs. As Arturo & Estrada (2020) point out, consumption, retail, and service industries have been more impacted due to changes in consumer behavior.

5. Accounting for AfCFTA helps mitigate the negative economic impacts of COVID-19. Economic costs could be significantly minimized through the facilitation of procurement of capital goods and sanitary products. As such, McKibbin and Fernando (2021) emphasize the need for more investment in public health systems in all economies, especially those with high population density and less developed health care systems. Our results corroborate Djiofack Zebaze et al. (2020) and the World Bank (2020) on the need for regional coordination and cooperation of responses to the negative economic impacts of the health shock. Also, they complement Zidouemba and Jallab (2021) who show that all African regions experience an increase in exports of industrial and intermediate goods through the AfCFTA. For these authors, the AfCFTA is a catalyst for industrialization and structural economic transformation.

6. "AfCFTA post COVID-19" scenario indicates that, in the absence of the trade restrictions triggered by the pandemic, implementing the AfCFTA potentially produces positive effects in North and Southern Africa. Although the effects are mixed for services, the AfCFTA

without restrictive measures produces positive effects for household consumption and input demand in the industrial and agricultural sectors. These results show that stricter sanitary border controls on the transport of goods, confinements, and border closures have contributed to declining economic growth in North and Southern Africa.

V. Conclusion

This paper focused on assessing the macroeconomic and sectoral impacts of COVID-19 on the North and Southern African economies, while analyzing the potential positive impact of the implementation of the AfCFTA on the economic impacts of COVID-19.

We used the PEP-w-t CGE model in the first scenario with the assumption that virus containment measures reduce trade due to increased trade costs. The second scenario assumes that the complete removal of intra-African tariff barriers is a response to mitigate the negative effects of the crisis in North and Southern Africa. The third scenario simulates the impacts of AfCFTA implementation on economic activity without the COVID-19 restrictive measures. The results show that COVID-19 has had and continues to have significant economic and social impacts. According to our results, the COVID-19 pandemic induces a contraction of economic activity in these subregions over 2021-2023 in the absence of coordinated economic recovery measures. Whereas, the AfCFTA mitigates the economic impact of the crisis.

Given the results, it is necessary to take appropriate measures to deal with the collapse of economic activity due to COVID-19. To this end, accelerating the implementation of the AfCFTA, coupled with improvements in trade infrastructure, would amplify the mitigating effects by reducing the economic impacts of the pandemic through the supply of consumer and capital goods. Additionally, policies to remove trade barriers would mitigate the decline in intra-African exports from an average of 10.23% (COVID-19 scenario) in 2021 to 2.36% (AfCFTA+COVID-19 scenario).

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Appendix

Appendix 1. Macroeconomic equilibria, closures, and dynamics of the CGE model

For macroeconomic equilibria in the commodity and factor market, it is assumed that the balance between supply and demand is verified through the flexibility of the respective prices. In the baseline scenario, labor demand is assumed to be equal to labor supply, *i.e.*, full employment in each region.

The CGE model brings together a system of equations that describes the economic links between several regions and sectors of activity at the global level. As for the model's closure rules, the endogenous and exogenous variables are determined. The values of the exogenous variables are fixed at their initial level while the values of the endogenous variables are determined during the resolution of the model. Also, prices and quantities are determined endogenously. The exchange rate of a region chosen as reference is the European region. Since there is no theoretical framework to choose between different closures, the choice of closure must be guided by the structure of the economy under study (Mold & Mukwaya, 2017).

The dynamics of the model are recursive. The calibration of the baseline scenario is done by running a modified version of the model that is constrained to follow Fouré et al.'s (2012) projections of real GDP where total factor productivity (TFP) is endogenous. Aggregate labor supply and domestic savings rates are also fixed according to Fouré et al.'s (2012) projections. The solution value of total factor productivity and other exogenous variables (including savings rates) given by the modified version of the model is the baseline scenario. These variables are then exogenously fixed at their calibrated values.

Capital accumulation is endogenous in the model and thus does not follow the projections (Fouré et al., 2012). Therefore, the sectoral and regional capital stock is equalized to that of the previous period, minus depreciation, plus the volume of new capital investment in the previous period.

The quantity demanded of each type of capital in each region is equal to the quantity supplied. Capital is assumed to be region and sector specific. Total investment expenditure is equal to the sum of agents' savings. Labor is assumed to be mobile only between production sectors in the same region. Thus, labor can move between sectors, but not between regions. It is therefore assumed that the wage rate is defined by region within a geographically segmented labor market.

Appendix 2. Estimated Impacts of COVID-19 and the AfCFTA, Variation (%), 2021-2023

Table 9. *Estimated Impacts of COVID-19 and the AfCFTA on Demand for Labor and Capital by Industry, Variation (%), 2021-2023*

| Sectors | year | Total output of industry | | | | Consumption of commodity by households | | | |
| | | South Africa | | North Africa | | South Africa | | North Africa | |
		Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19
Grains	2021	-1.69	-1.73	4.92	4.88	1.34	-6.11	1.31	-5.34
Grains	2022	-2.42	-2.52	7.5	7.45	-2.4	-8.74	1.31	-7.05
Grains	2023	-3.23	-3.41	10.52	10.5	1.44	-11.79	1.37	-8.95
VegFruitNuts	2021	-8.82	-9.61	-2.91	-2.97	1.42	-0.93	1.38	-1.87
VegFruitNuts	2022	-13.87	-14.8	-4.11	-4.17	-5.3	-2.46	-3.74	-2.95
VegFruitNuts	2023	-19.88	-21	-5.37	-5.44	1.56	-4.62	1.5	-4.23
Crops	2021	-1.74	-1.68	0.3	0.48	1.48	-3.97	1.45	-2.83
Crops	2022	-2.54	-2.51	0.59	0.79	-8.92	-5.84	-7.02	-3.98
Crops	2023	-3.44	-3.45	0.99	1.2	1.69	-8.11	1.63	-5.36
Animals	2021	-1.24	-1.28	2.15	2.12	1.53	-2.77	1.51	-3.98
Animals	2022	-1.88	-1.94	2.58	2.55	-13.05	-4.03	-10.95	-5.15
Animals	2023	-2.7	-2.77	2.81	2.79	1.83	-5.51	1.76	-6.43
Forestry	2021	-0.8	-1.01	-0.51	-0.46	1.58	-2.54	1.56	-1.68
Forestry	2022	-1.31	-1.55	-0.8	-0.74	-17.19	-3.82	-15.15	-2.44
Forestry	2023	-1.96	-2.2	-1.16	-1.1	1.98	-5.37	1.91	-3.35
Fishing	2021	-1.63	-2.11	-1.97	-2.04	2.06	-2.42	1.61	-1.88
Fishing	2022	-2.47	-3.01	-2.92	-2.99	2.14	-3.85	-18.87	-2.92
Fishing	2023	-3.49	-4.07	-3.99	-4.07	2.14	-5.57	2.06	-4.15
Mog	2021	-1.75	-1.18	-0.29	-0.17	0.08	-5.21	0.08	-2.81
Mog	2022	-2.77	-2.04	-0.5	-0.34	-1.47	-7.6	0.08	-4.03
Mog	2023	-3.97	-3.12	-0.73	-0.56	0.08	-10.44	0.08	-5.44

Table 9. *Continued*

| Sectors | year | Total output of industry | | | | Consumption of commodity by households | | | |
| | | South Africa | | North Africa | | South Africa | | North Africa | |
		Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19
Meat	2021	-1.36	-1.58	-0.49	-0.51	0.08	-2.62	0.08	-1.85
Meat	2022	-2.11	-2.35	-0.71	-0.74	-5.71	-3.79	-3.41	-2.65
Meat	2023	-3.03	-3.28	-0.99	-1.01	0.09	-5.17	0.09	-3.63
VegoilsFats	2021	1.62	1.55	3.88	3.16	0.08	-5.96	0.08	-4.99
VegoilsFats	2022	2.3	2.22	5.35	4.62	-11.44	-8.38	-8.37	-6.97
VegoilsFats	2023	3.15	3.04	7.16	6.43	0.1	-11.23	0.09	-9.29
Dairy	2021	-1.14	-1.59	-0.54	-0.67	0.08	-2.4	0.08	-2.83
Dairy	2022	-1.87	-2.34	-0.79	-0.92	-18.57	-3.46	-14.86	-3.94
Dairy	2023	-2.77	-3.25	-1.08	-1.22	0.1	-4.74	0.1	-5.25
Procrice	2021	-35.18	-36	-4.11	-4.14	0.08	-10.8	0.08	-4.75
Procrice	2022	-45.08	-45.7	-5.51	-5.54	-26.51	-14.96	-22.49	-6.39
Procrice	2023	-54.17	-54.7	-7.07	-7.1	0.11	-19.68	0.11	-8.23
Sugar	2021	-1.04	-2.64	-0.65	-1.29	0.11	-3.36	0.07	-4.01
Sugar	2022	-2.15	-3.87	-0.99	-1.63	0.12	-4.88	-34.27	-5.63
Sugar	2023	-3.58	-5.38	-1.28	-1.9	0.12	-6.72	0.11	-7.55
Othfood	2021	-2.04	-2.66	-1.92	-2.19	1.83	-3.55	0	-3.58
Othfood	2022	-3.2	-3.87	-2.83	-3.1	1.82	-5.1	1.74	-5.02
Othfood	2023	-4.63	-5.33	-3.89	-4.15	-0.12	-6.95	1.74	-6.71
BevTobac	2021	-1.16	-2	-0.73	-0.87	2	-2.38	1.92	-2.67
BevTobac	2022	-2.07	-2.97	-1.27	-1.43	1.96	-3.49	1.9	-3.87
BevTobac	2023	-3.23	-4.18	-1.98	-2.13	-1.84	-4.85	-0.91	-5.32
Text	2021	3.65	3.96	1.57	1.57	2.17	-4.11	2.08	-3.64
Text	2022	5.26	5.53	2.1	2.1	2.08	-5.78	2.02	-5.02
Text	2023	7.14	7.36	2.66	2.66	-4.19	-7.73	-2.91	-6.63

Table 9. *Continued*

Sectors	year	Total output of industry				Consumption of commodity by households			
		South Africa		North Africa		South Africa		North Africa	
		Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19
Wearap	2021	1.35	1.71	-1.79	-1.76	2.35	-3.29	2.26	-2.67
Wearap	2022	2.08	2.4	-2.66	-2.64	2.17	-4.64	2.13	-3.8
Wearap	2023	2.92	3.21	-3.74	-3.72	-7.34	-6.26	-5.67	-5.15
Leatherprod	2021	2.9	3.64	2.36	2.31	2.53	-4.09	2.44	-3.43
Leatherprod	2022	4.44	5.14	3.32	3.26	2.25	-5.76	2.21	-4.77
Leatherprod	2023	6.27	6.94	4.48	4.41	-11.16	-7.74	-9.17	-6.36
Wood	2021	-0.23	-0.29	2.35	2.17	2.74	-4.09	2.63	-4.21
Wood	2022	-0.34	-0.44	3.06	2.89	2.74	-5.74	2.33	-5.78
Wood	2023	-0.47	-0.6	3.83	3.68	2.84	-7.68	-11.58	-7.61
Petrochem	2021	3.1	1.91	0.84	0.8	0.1	-5.09	2.84	-4.82
Petrochem	2022	3.71	2.5	0.99	0.95	0.1	-7.22	0.1	-6.73
Petrochem	2023	4.34	3.12	1.14	1.11	0.88	-9.72	0.1	-8.95
Metal	2021	1.26	2.98	4.57	4.49	0.11	-4.59	0.11	-5.31
Metal	2022	2.4	4.34	6.31	6.21	0.11	-6.36	0.11	-7.27
Metal	2023	3.8	5.95	8.31	8.21	-0.71	-8.41	0.27	-9.54
VehiclesParts	2021	0.27	-0.51	-0.59	-1.08	0.12	-4.64	0.12	-4.46
VehiclesParts	2022	0.04	-0.82	-1.2	-1.7	0.11	-6.53	0.11	-6.22
VehiclesParts	2023	-0.34	-1.28	-2	-2.5	-4.27	-8.76	-2.18	-8.3
OthtraEqp	2021	8.95	1.06	-0.78	-0.81	0.13	-4.68	0.12	-3.46
OthtraEqp	2022	9.48	1.28	-1.34	-1.38	0.12	-6.56	0.12	-4.82
OthtraEqp	2023	9.77	1.33	-2.11	-2.16	-10.6	-8.78	-7.06	-6.42
Elctrn	2021	17.79	3.99	-0.01	0.12	0.14	-4.21	0.13	-3.24
Elctrn	2022	20.64	5.82	-0.02	0.11	0.11	-5.96	0.11	-4.55
Elctrn	2023	23.78	8.02	-0.04	0.09	-19.25	-8.04	-14.76	-6.12

Table 9. *Continued*

| Sectors | year | Total output of industry | | | | Consumption of commodity by households | | | |
| | | South Africa | | North Africa | | South Africa | | North Africa | |
		Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19
MachEqp	2021	1.59	1.34	-2.54	-3.12	0.15	-4.11	0.14	-4.88
MachEqp	2022	2.05	1.77	-3.94	-4.55	0.15	-5.77	0.11	-6.79
MachEqp	2023	2.5	2.18	-5.6	-6.22	0.15	-7.73	-21.2	-9.03
OthMan	2021	0.22	0.55	0.09	0.09	0.68	-3.46	0.15	-4.01
OthMan	2022	0.38	0.72	0.07	0.07	0.67	-4.9	0.64	-5.61
OthMan	2023	0.52	0.87	0.03	0.03	-0.78	-6.6	0.64	-7.5
Electricity	2021	0.04	0.21	-0.83	-0.87	0.74	-2.86	0.71	-2.85
Electricity	2022	-0.03	0.18	-1.3	-1.33	0.72	-4.11	0.7	-4.1
Electricity	2023	-0.15	0.12	-1.88	-1.9	-2.66	-5.64	-1.65	-5.6
GasWater	2021	-0.93	-1.02	-0.53	-0.53	0.8	-1.99	0.77	-1.75
GasWater	2022	-1.43	-1.53	-0.89	-0.89	0.76	-2.87	0.74	-2.54
GasWater	2023	-2.08	-2.17	-1.35	-1.35	-5.2	-3.95	-3.82	-3.51
Constr	2021	-3.68	-3.02	-2.47	-2.35	0.87	-2.66	0.84	-2.59
Constr	2022	-4.99	-4.32	-3.57	-3.45	0.79	-3.8	0.78	-3.72
Constr	2023	-6.59	-5.89	-4.91	-4.79	-8.66	-5.19	-6.82	-5.09
Trade	2021	0.78	0.34	-0.7	-0.72	0.94	-1.89	0.91	-1.55
Trade	2022	0.88	0.4	-1.09	-1.1	0.82	-2.69	0.81	-2.22
Trade	2023	0.95	0.43	-1.57	-1.58	-12.98	-3.65	-10.73	-3.06
Transport	2021	-0.37	-0.2	3.17	3.26	1.02	-2.87	0.98	-1.52
Transport	2022	-0.65	-0.47	4	4.1	1.02	-4.1	0.85	-2.16
Transport	2023	-1.04	-0.85	4.72	4.83	1.06	-5.6	-13.6	-2.96
BusServ	2021	-0.47	-0.43	-0.56	-0.5	0.07	-1.57	1.06	-1.49
BusServ	2022	-0.73	-0.69	-0.9	-0.84	0.07	-2.26	0.06	-2.1
BusServ	2023	-1.07	-1.03	-1.35	-1.29	-0.61	-3.11	0.06	-2.83

Table 9. *Continued*

Sectors	year	South Africa		North Africa		South Africa		North Africa	
		Total output of industry				Consumption of commodity by households			
		Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19	Covid-19 +ZLECAf	Covid-19
OthServ	2021	-0.68	-0.71	-0.84	-0.85	0.07	-1.56	0.07	-1.09
OthServ	2022	-1.06	-1.09	-1.35	-1.35	0.07	-2.27	0.07	-1.67
OthServ	2023	-1.55	-1.58	-1.99	-1.99	-3.52	-3.15	-1.93	-2.4
Admin	2021	-0.23	-0.21	-0.3	-0.29	0.08	-1.84	0.07	-1.73
Admin	2022	-0.32	-0.3	-0.42	-0.42	0.07	-2.58	0.07	-2.4
Admin	2023	-0.42	-0.4	-0.58	-0.58	-7.72	-3.46	-5.43	-3.19

Source: Authors' simulations, GTAP 10.

Table 10. *Estimated Impacts of the AfCFTA Post COVID-19 by Sector, Variation (%), 2024-2026*

Sectors	Year	Total output of industry in region		Consumption of commodity by households		Demand for labor by industry		Demand for capital by industry	
		North Africa	South Africa	North Africa	South Africa	North Africa	South Africa	North Africa	South Africa
Grains	2024	0.05	0.02	0.04	0.38	0.05	0.05	0.03	0.00
Grains	2025	0.05	0.04	0.04	0.38	0.05	0.08	0.04	0.02
Grains	2026	0.05	0.06	0.04	0.37	0.06	0.10	0.04	0.04
VegFruitNuts	2024	0.08	1.17	0.03	0.42	0.08	1.38	0.07	1.06
VegFruitNuts	2025	0.08	1.31	0.03	0.47	0.08	1.49	0.07	1.21
VegFruitNuts	2026	0.08	1.44	0.03	0.51	0.08	1.60	0.06	1.34
Crops	2024	-0.17	-0.07	0.15	0.39	-0.17	-0.04	-0.18	-0.09
Crops	2025	-0.18	-0.05	0.15	0.38	-0.17	-0.02	-0.18	-0.07
Crops	2026	-0.18	-0.03	0.15	0.38	-0.17	0.00	-0.19	-0.05
Animals	2024	0.02	0.08	0.04	0.24	0.03	0.09	0.01	0.07
Animals	2025	0.02	0.09	0.04	0.24	0.02	0.10	0.01	0.08
Animals	2026	0.02	0.09	0.04	0.24	0.02	0.10	0.01	0.08

Table 10. *Continued*

Sectors	Year	Total output of industry in region		Consumption of commodity by households		Demand for labor by industry		Demand for capital by industry	
		North Africa	South Africa	North Africa	South Africa	North Africa	South Africa	North Africa	South Africa
Forestry	2024	-0.07	0.25	0.03	0.35	-0.06	0.26	-0.07	0.24
Forestry	2025	-0.07	0.25	0.03	0.35	-0.07	0.27	-0.08	0.25
Forestry	2026	-0.08	0.26	0.02	0.34	-0.07	0.27	-0.08	0.25
Fishing	2024	0.07	0.59	0.04	0.30	0.08	0.62	0.07	0.57
Fishing	2025	0.07	0.61	0.04	0.30	0.08	0.64	0.07	0.60
Fishing	2026	0.07	0.63	0.04	0.31	0.08	0.66	0.07	0.62
Mog	2024	-0.22	-1.18	0.01	0.65	-0.23	-1.44	-0.22	-1.10
Mog	2025	-0.24	-1.34	0.00	0.59	-0.24	-1.57	-0.24	-1.27
Mog	2026	-0.25	-1.49	-0.02	0.54	-0.26	-1.70	-0.25	-1.42
Meat	2024	0.03	0.24	0.03	0.27	0.06	0.28	0.00	0.15
Meat	2025	0.02	0.24	0.03	0.27	0.06	0.28	0.00	0.16
Meat	2026	0.02	0.25	0.03	0.27	0.06	0.28	0.00	0.17
VegoilsFats	2024	0.79	0.08	0.19	0.61	0.90	0.10	0.70	0.06
VegoilsFats	2025	0.80	0.09	0.19	0.60	0.90	0.11	0.72	0.06
VegoilsFats	2026	0.80	0.09	0.19	0.60	0.89	0.12	0.74	0.06
Dairy	2024	0.15	0.50	0.08	0.28	0.18	0.62	0.09	0.33
Dairy	2025	0.15	0.51	0.08	0.28	0.18	0.61	0.10	0.36
Dairy	2026	0.15	0.52	0.08	0.28	0.18	0.61	0.10	0.39
Procrice	2024	0.03	1.13	0.04	0.95	0.08	1.35	0.02	1.03
Procrice	2025	0.03	1.12	0.04	0.94	0.08	1.24	0.02	1.07
Procrice	2026	0.03	1.10	0.04	0.93	0.09	1.14	0.02	1.08
Sugar	2024	0.76	1.96	0.22	0.53	0.89	2.85	0.67	1.57
Sugar	2025	0.77	2.04	0.22	0.56	0.88	2.78	0.70	1.72
Sugar	2026	0.78	2.11	0.22	0.59	0.88	2.75	0.72	1.84

Table 10. *Continued*

Sectors	Year	Total output of industry in region		Consumption of commodity by households		Demand for labor by industry		Demand for capital by industry	
		North Africa	South Africa	North Africa	South Africa	North Africa	South Africa	North Africa	South Africa
Othfood	2024	0.32	0.69	0.17	0.40	0.39	0.91	0.28	0.45
Othfood	2025	0.33	0.72	0.17	0.40	0.39	0.90	0.29	0.50
Othfood	2026	0.33	0.74	0.17	0.41	0.39	0.90	0.29	0.55
BevTobac	2024	0.20	0.97	0.16	0.37	0.30	1.37	0.19	0.78
BevTobac	2025	0.21	1.00	0.17	0.39	0.30	1.33	0.19	0.84
BevTobac	2026	0.21	1.03	0.17	0.40	0.31	1.29	0.20	0.89
Text	2024	-0.02	-0.22	0.08	0.63	0.02	-0.27	-0.03	-0.17
Text	2025	-0.02	-0.20	0.08	0.62	0.03	-0.22	-0.04	-0.19
Text	2026	-0.02	-0.18	0.08	0.62	0.03	-0.19	-0.04	-0.20
Wearap	2024	-0.05	-0.34	0.05	0.44	-0.03	-0.40	-0.06	-0.18
Wearap	2025	-0.05	-0.34	0.05	0.44	-0.02	-0.38	-0.07	-0.21
Wearap	2026	-0.05	-0.33	0.05	0.44	-0.02	-0.37	-0.07	-0.24
Leatherprod	2024	0.04	-0.69	0.11	0.47	0.06	-0.87	0.00	-0.45
Leatherprod	2025	0.03	-0.68	0.11	0.46	0.05	-0.82	-0.01	-0.50
Leatherprod	2026	0.03	-0.68	0.11	0.45	0.05	-0.78	-0.01	-0.54
Wood	2024	0.25	0.10	0.17	0.40	0.32	0.13	0.19	0.03
Wood	2025	0.26	0.11	0.17	0.40	0.32	0.15	0.20	0.04
Wood	2026	0.26	0.12	0.17	0.39	0.31	0.16	0.21	0.05
Petrochem	2024	0.02	1.32	0.12	0.90	0.03	1.81	0.02	0.98
Petrochem	2025	0.01	1.34	0.12	0.90	0.02	1.74	0.00	1.07
Petrochem	2026	0.00	1.36	0.12	0.90	0.02	1.69	-0.01	1.13
Metal	2024	0.11	-2.14	0.15	0.74	0.17	-3.45	0.06	-1.51
Metal	2025	0.12	-2.28	0.15	0.69	0.17	-3.44	0.06	-1.73
Metal	2026	0.12	-2.41	0.15	0.65	0.17	-3.44	0.07	-1.93

A Comparative Analysis of the Effects of the AfCFTA on the Economic Impacts of COVID-19 in North and Southern Africa **155**

Table 10. *Continued*

Sectors	Year	Total output of industry in region		Consumption of commodity by households		Demand for labor by industry		Demand for capital by industry	
		North Africa	South Africa	North Africa	South Africa	North Africa	South Africa	North Africa	South Africa
VehiclesParts	2024	0.65	1.03	0.24	0.92	0.85	1.50	0.53	0.63
VehiclesParts	2025	0.67	1.09	0.25	0.93	0.84	1.54	0.57	0.73
VehiclesParts	2026	0.69	1.16	0.25	0.93	0.84	1.58	0.60	0.81
OthtraEqp	2024	0.07	9.58	0.16	1.39	0.12	11.91	0.02	5.30
OthtraEqp	2025	0.08	9.95	0.16	1.41	0.12	12.05	0.03	6.11
OthtraEqp	2026	0.08	10.30	0.16	1.43	0.13	12.18	0.03	6.84
Elctrn	2024	-0.16	16.22	0.14	1.90	-0.15	21.91	-0.15	10.28
Elctrn	2025	-0.16	16.90	0.14	1.95	-0.15	21.88	-0.17	11.69
Elctrn	2026	-0.17	17.52	0.13	2.01	-0.15	21.88	-0.18	12.94
MachEqp	2024	0.76	0.32	0.23	0.82	0.96	0.41	0.57	0.18
MachEqp	2025	0.79	0.33	0.24	0.82	0.97	0.43	0.62	0.20
MachEqp	2026	0.81	0.35	0.24	0.82	0.97	0.44	0.67	0.22
OthMan	2024	0.01	-0.34	0.14	0.42	0.04	-0.49	-0.01	-0.29
OthMan	2025	0.01	-0.35	0.13	0.40	0.04	-0.44	-0.01	-0.32
OthMan	2026	0.00	-0.35	0.13	0.39	0.05	-0.41	-0.02	-0.34
Electricity	2024	0.03	-0.30	0.05	0.38	0.06	-0.60	0.02	-0.15
Electricity	2025	0.02	-0.34	0.05	0.36	0.06	-0.63	0.02	-0.20
Electricity	2026	0.02	-0.38	0.04	0.34	0.07	-0.66	0.01	-0.25
GasWater	2024	-0.01	0.08	0.02	0.20	0.01	0.08	-0.02	0.07
GasWater	2025	-0.02	0.08	0.01	0.19	0.01	0.07	-0.03	0.07
GasWater	2026	-0.02	0.07	0.01	0.18	0.01	0.06	-0.03	0.06
Constr	2024	-0.15	-0.79	0.08	0.45	-0.16	-1.11	-0.15	-0.42
Constr	2025	-0.16	-0.83	0.08	0.43	-0.15	-1.11	-0.16	-0.50
Constr	2026	-0.17	-0.86	0.08	0.42	-0.14	-1.11	-0.18	-0.57

Table 10. *Continued*

Sectors	Year	Total output of industry in region		Consumption of commodity by households		Demand for labor by industry		Demand for capital by industry	
		North Africa	South Africa	North Africa	South Africa	North Africa	South Africa	North Africa	South Africa
Trade	2024	0.00	0.55	0.04	0.08	0.03	0.83	-0.01	0.29
Trade	2025	0.00	0.58	0.04	0.08	0.04	0.85	-0.02	0.33
Trade	2026	0.00	0.60	0.03	0.08	0.04	0.86	-0.03	0.37
Transport	2024	-0.09	-0.18	0.06	0.48	-0.08	-0.30	-0.09	-0.09
Transport	2025	-0.10	-0.19	0.05	0.47	-0.08	-0.30	-0.10	-0.11
Transport	2026	-0.10	-0.20	0.05	0.47	-0.08	-0.30	-0.12	-0.13
BusServ	2024	-0.08	-0.05	0.04	0.12	-0.07	-0.09	-0.08	-0.03
BusServ	2025	-0.08	-0.05	0.04	0.11	-0.07	-0.09	-0.09	-0.04
BusServ	2026	-0.08	-0.06	0.04	0.11	-0.07	-0.08	-0.11	-0.05
OthServ	2024	-0.01	0.02	0.02	0.17	0.03	0.00	-0.02	0.02
OthServ	2025	-0.01	0.01	0.01	0.17	0.03	0.01	-0.02	0.02
OthServ	2026	-0.02	0.01	0.01	0.16	0.03	0.01	-0.03	0.01
Admin	2024	0.00	-0.02	0.04	0.18	0.00	-0.03		
Admin	2025	0.00	-0.02	0.04	0.17	0.00	-0.03		
Admin	2026	0.00	-0.02	0.04	0.17	0.00	-0.03		

Source: Authors' simulations, GTAP 10.

Table 11. *Sectors Description*

1	Grains	cereal grains	18	Wood	Wood and paper products
2	VegFruitNuts	Vegetables, fruit, nuts (	19	Petrochem	Petroleum and Chemical products
3	Crops	crops	20	Metal	Metal products
4	Animals	Animal products	21	VehiclesParts	Motor vehicles and parts
5	Forestry	Forestry	22	OthtraEqp	Other transport equipment
6	Fishing	Fishing	23	Elctrn	Electronic, computer, optical products
7	Mog	Mineral products, gas and oil	24	MachEqp	Machinery and equipment
8	Meat	Meat products	25	OthMan	Other manufactures
9	VegoilsFats	Vegetable oils and fats	26	Electricity	Electricity
10	Dairy	Dairy products	27	GasWater	Gas and Water
11	Procrice	Processed rice	28	Constr	Construction
12	Sugar	Sugar	29	Trade	Trade services
13	Othfood	Other food products	30	Transport	Transport
14	BevTobac	Beverages and tobacco products	31	BusServ	Business services
15	Text	Textiles	32	OthServ	Other business services
16	Wearap	Wearing apparel	33	Admin	Public administration
17	Leatherprod	Leather products			

Source: Authors, GTAP 10