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**ACADEMIC PAPER**

Potential trade, welfare and revenue implications of the African Continental Free Trade Area (AfCFTA) for Ghana: An application of partial equilibrium model

Nimonka Bayale^{1,2} | Muazu Ibrahim^{1,3} | Joseph Atta-Mensah¹¹Macroeconomic and Governance Division (MGD), United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia²Department of Economics, University of Kara, Kara, Togo³School of Business and Law, Department of Banking and Finance, University for Development Studies, Wa, Upper West Region, Ghana**Correspondence**Muazu Ibrahim, Macroeconomic and Governance Division (MGD), United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia.
Email: imuazu@uds.edu.gh, muazu.ibrahim@un.org

This study estimates the potential implications of the implementation of African Continental Free Trade Area (AfCFTA) Agreement for Ghana in terms of trade, welfare and revenue effects. By applying the WITS-SMART simulation model on 2018 disaggregated international trade data, the paper finds that total trade effects in Ghana are likely to surge by US\$ 148.3 million while promoting consumers' welfare by US\$ 8.597 million. However, revenue losses are imminent as the country might experience a drop in tariff revenue of US\$ 8.604 million. Overall, the free trade area is expected to improve on the country's trade balance as exports are envisaged to outweigh imports. In order to mitigate the revenue losses, the paper recommends that the country keep substantial portion of tariff lines for sensitive and excluded products over a longer period during the liberalization.

1 | INTRODUCTION

"We need to talk about Africa and the AfCFTA. Our Marshall Plan is the AfCFTA. The AfCFTA is our plan so let us take it and run with it [Dr. Vera Songwe, Executive Secretary, United Nations Economic Commission for Africa]"

In March 2018, representatives of member states of the African Union (AU) signed the African Continental Free Trade Area (AfCFTA) agreement. This agreement, which provides a charter for trade liberalization in goods and services, is expected to cover all the 55 African countries. Indeed, the AfCFTA leverages on negotiations of the tripartite free-trade area comprising (a) the Southern African Development Community (SADC); (b) the Common Market for Eastern and Southern Africa (COMESA); and (c) the East African Community (EAC). The implementation of the AfCFTA within the framework is expected to achieve the following broad objectives: (a) deepen economic integration in Africa consistent with Agenda 2063; (b) support future creation of a continental customs union (c) reduce the challenges of overlapping memberships in Regional Economic Communities (RECs); (d) liberalize intra-African trade (e) enhance competitiveness; (f) promote sustainable and inclusive socio-economic development, gender equality and structural transformation; (g) deepen the movement of capital and natural persons and facilitating investment; and

(g) promote industrialization. To achieve these objectives, the AfCFTA aims to progressively eliminate tariffs and non-tariff barriers to trade in goods and to liberalize trade in services. Through this, the AfCFTA aims to establish a single continental market for goods and services, hence providing larger market access. By providing freer markets, the AfCFTA is also expected to promote competitiveness at all value chains in production processes at the industry and enterprise levels through exploitation of opportunities for scale production and improved resource reallocation (Arizala, Bellon, & MacDonald, 2019).

In addition, the call for the liberalized trade also has implications for the prices of traded goods. For instance, Schiff and Winters (2002) opine that free-trade areas alter the prices of imports for partner countries on account of the removal of the tariffs. Thus, the effective reduction in the price changes the composition and pattern of demand, resulting in adjustment of output and trade flows. Othieno and Shinyekwa (2011) also argue that, since tariffs are removed for countries participating in the free-trade area, it permits the entry of relatively efficient producers into domestic economies where prices of goods are artificially high. To the extent that AfCFTA ensures lower trade costs and enhanced access to well-diversified products, the free-trade area is envisaged to improve the competitiveness of downstream industries through access to cheaper raw materials for production. Abrego, Amado, Gursoy, Nicholls, and Perez-Saiz (2019)

argue that, by increasing productivity and investment, AfCFTA is envisaged to raise Africa's income levels and reduce poverty. Obeng-Odoom (2020), however, argues that, by exclusively focusing on continental Africa, its disinterest in systemic redistribution, and encouragement of the private appropriation of socially created land rents might prevent AfCFTA from reducing poverty and inequality, which defeats the very purpose of the free-trade regime.

Indeed, to the extent that tariff revenues comprise a major source of domestic revenue for countries in Africa, while the implementation of the AfCFTA comes with removal of tariffs, there are concerns that such liberalization of tariffs will have far-reaching negative impact on tariff revenues (see Kassim, 2016). Theoretically, trade liberalization is envisaged to have a dampening effect on customs revenue on the back of lower tariffs stemming from the liberalization (Matlanyane & Harmse, 2002). Conversely, Epaphra (2014) argues that, because trade liberalization results in lower tariffs, imports become cheaper, driving up import volumes and a corresponding increase in tax revenue. Furthermore, the liberalization of trade may also result in reduction in tariff evasion by decreasing the marginal benefit stemming from taxation avoidance, hence a surge in import tax revenues (Matlanyane & Harmse, 2002). Therefore, theoretically, the precise effect of trade liberalization is not straightforward.

Empirically, Matlanyane and Harmse's (2002) study based on their annual time series data spanning 1974–2000 suggests that, while volume and value of imports increased owing to liberalization in South Africa, import tax revenue reduced on account to the lower tariffs. Relying on co-integration approach, consistent with Matlanyane and Harmse (2002), Epaphra (2014) finds that a reduction in the tariff rates results in a significant loss of import duty revenue. The reduction in revenue has also been confirmed in some existing studies (see Khattry & Rao, 2002; UNECA, 2004). Lang (2006) assesses the impact of liberalization under the Economic Partnership Agreement (EPA) with the assumption of full liberalization of imports from the European Union (EU) into the Economic Community of West African States (ECOWAS). The author finds that the removal of tariffs on all EU goods would result in net trade creation, which is beneficial to consumers although tariff revenue losses are eminent. Further evidence suggests that regional producers are likely to experience a trade diversion as 6.7% of the trade diverted from ECOWAS countries.

Beyond examining the revenue effects of the trade regime, empirical research efforts have moved to examine the implications of free trade agreements in relation to regional blocs. Since majority of African economies are largely agrarian, Korinek and Melatos (2009) examine the impact of selected regional trade agreements on agriculture. The authors find increased trade in agriculture for COMESA member states with evidence of trade diversion for imports from outside the regional bloc. In the case of sub-Saharan Africa (SSA), Darku and Appau (2015) assess the effect of the regional trade agreements by employing the dynamic gravity model. Findings from their study show that the creation of such regional blocs, notably COMESA, ECOWAS and SADC, have resulted in significant surge in trade among the member states while they led to a significant increase in trade among member states while formation of Economic Community of

Central African States (ECCAS) have led to lower intra-ECCAS and inter-ECCAS bilateral trade flows. By investigating the effect of the liberalization of trade between European Union (EU) and South Africa, Guei, Mugano, and Le Roux (2017) observe that trade creation and revenue loss are potential threats to South Africa, and the free trade agreement between EU and South Africa have resulted in higher trade expansion.

Measured as a share of total exports, SSA exhibits the highest share of intra-regional trade integration among emerging and developing economies with the sub-regional trade agreements—particularly SADC and the EAC—playing a major role in strengthening bilateral trade in the region (Arizala et al., 2019). Thus, for most part, while evidence abounds on the sub-regional trade agreements spurring trade, empirical studies on the trade effects of a continental-wide trade agreement, such as AfCFTA, is dearth although few studies are notable. For instance, Masiya (2019) examines the short-run revenue implications of AfCFTA for Malawi and finds that, while the country stands to benefit from ratifying the AfCFTA agreement through improved trade creation, the country will undoubtedly lose tax revenue with more marked effects stemming from the elimination of tariffs on capital goods. More recently, Abrego et al. (2019) estimate the welfare effects of the AfCFTA for 45 countries in Africa and find significant potential welfare gains from trade liberalization. They note that, as intra-regional import tariffs in the continent are already low, majority of these gains come from reducing non-tariff barriers.

At the 12th AU Extraordinary Summit on July 2019 in Niger, Ghana was selected to host the AfCFTA Secretariat. The announcement was met with joy with the belief that by hosting the Secretariat the country will not only experience higher trade flows but will also record improved welfare gains. However, the potential welfare gains and trade patterns are largely gleaned from public discourses with no or little theoretical and empirical backing. More so, the precise welfare and trade changes, so far, are unknown, making policy taking difficult. Indeed, given Ghana's position in the AfCFTA framework, the implications of the free trade for Ghana needs far more nuanced and in-depth analysis. Unfortunately, studies pertaining to Ghana are non-existent. The main focus of this paper is, therefore, to draw on the extensive literature to empirically and theoretically examine the impact of the AfCFTA on Ghana. More specifically, the paper estimates the potential effect of the continental free-trade agreement on Ghana's revenue, welfare gains and more generally on the country's trade. In this endeavour, the paper contributes significantly to the existing literature in so many ways. For instance, the paper provides a pioneering empirical estimates of the potential welfare effect and trade changes of AfCFTA for Ghana. Indeed, such estimates permit the determination of the absolute potential welfare and trade changes, as well as their sources, in order to better situate the expectations of the country. Second, beyond providing the estimates, this study also unearths the products that contribute more to trade creation and diversion, in addition, to revealing Ghana's trade (export and import) changes with the rest of the African countries.

By applying the World Integrated Trade Solution-Single Market Partial Equilibrium Simulation Tool (WITS-SMART) based on 2018

disaggregated international trade data, the study finds that total trade effects in Ghana are likely to surge by US\$ 148.3 million while increasing consumers' welfare by US\$ 8.6 million. While the country might experience a revenue loss following the removal of tariffs, Ghana's exports and imports to the other African countries are expected to increase by 12.9 and 0.7%, respectively. This implies that Ghana's net trade balance position is expected to improve since the country's exports will sufficiently exceed her imports after the implementation of free-trade area. This notwithstanding, following from the revenue loss associated with free trade, the paper recommends that the country may consider keeping a substantial portion of its tariff lines for sensitive and excluded products over a longer period of liberalization.

The rest of the study is organized as follows: the next section outlines the empirical strategy of the study while Section 3 discusses the findings. Section 4 concludes with some implications for the policy.

2 | METHODOLOGY

2.1 | Data

This study relies on the 2018 World Integrated Trade Solution-Single Market Partial Equilibrium Simulation Tool (WITS-SMART) dataset for Ghana as it harmonizes the schedule nomenclature. Our choice for 2018 is based on the fact that it is the most recent period where data are available. The trade data are the actual reported figures (in US \$) as captured at customs, given the different product levels. These data, which have information on various merchandise trade and tariffs, are compiled by the World Bank in collaboration with; (a) the United Nations Conference on Trade and Development (UNCTAD) through the Trade Analysis Information System (TRAINS); (b) International Trade Center (ITC), United Nations Statistical Division (UNSD) and (c) World Trade Organization (WTO) through the Integrated Data Base (IDB), provide data on the consolidated tariff schedule. To the extent that the AfCFTA aims to fully liberalize the African market, the study invokes a 100% tariff reduction for all products at the HS-6 level.

2.2 | Empirical strategy

The study employs the WITS-SMART model within the context of a partial equilibrium framework. The choice for using the SMART is because it contains an in-built analytical technique that allows detailed trade analysis involving multilateral tariff changes and preferential trade liberalization. The study applies a static partial equilibrium framework, which permits the analysis of the trade effects to be conducted for a single country. Thus, given the interest in Ghana, the use of this tool is particularly apt. The paper follows the approach of Jallab, Abdelmalki, and Sandretto (2007) who used the WITS-SMART in examining trade effects in free-trade area agreement between Morocco and the United States.

It is assumed that, when tariffs are eliminated in post-AfCFTA implementation, there will be a full transmission of price changes, which leads to trade creation. Trade creation entails increasing trade volumes following the liberalization that results in the displacement of inefficient producers of a given preferential trade area. The paper also follows Laird and Yeats (1986) in deriving the trade creation, which begins with the specification of simplified demand and supply functions and an equilibrating identity. For instance, a simplified import demand function for country j from country k of commodity i is given as follows:

$$M_{ijk} = f(Y_j, P_{ij}, P_{ik}). \quad (1)$$

Similarly, the export supply function of commodity i of country k is specified as follows:

$$X_{ijk} = f(P_{ikj}). \quad (2)$$

Thus, from Equations (1) and (2), the equilibrating identity in trade between countries j and k in standard partial equilibrium equation can be given as follows:

$$M_{ijk} = X_{ijk}. \quad (3)$$

It is imperative to note that, given the free-trade area, the domestic price of commodity i in country j from country k would vary with changes in ad valorem tariff as follows:

$$P_{ijk} = P_{ikj}(1 + t_{ijk}). \quad (4)$$

Following Laird and Yeats (1986), totally differentiate Equation (4) as:

$$dP_{ijk} = P_{ikj} dt_{ijk} (1 + t_{ijk}) dP_{ikj}. \quad (5)$$

From the import demand function in Equation (1), the elasticity is derived as $\frac{\Delta M_{ijk}}{M_{ijk}} = \epsilon_i^m \frac{\Delta P_{ijk}}{P_{ijk}}$. Substituting Equations (4) and (5) into the elasticity of import demand function produces Equation (6) below:

$$\frac{dM_{ijk}}{M_{ijk}} = \epsilon_i^m \left[\frac{dt_{ijk}}{1 + t_{ijk}} + \frac{dP_{ijk}}{P_{ijk}} \right]. \quad (6)$$

Thus, from the equilibrium identity in Equation (3), $\frac{dM_{ijk}}{M_{ijk}} = \frac{dX_{ijk}}{X_{ijk}}$ is used to derive the equation for the elasticity of export supply as $\frac{dP_{ijk}}{P_{ikj}} = \frac{1}{\gamma_i^e} \frac{dM_{ijk}}{M_{ijk}}$.

Thus, using Equation (3), our trade creation effect is equivalent to the exporting country k 's rise in exports of commodity i to country j as follow:

$$TC_{ijk} = M_{ijk} \epsilon_i^m \frac{dt_{ijk}}{[(1 + t_{ijk})((1 - \epsilon_i^m)/\gamma_i^e)]}. \quad (7)$$

It is imperative to note that, once $\gamma_i^e \rightarrow \infty$, the trade creation equation in (7) above becomes:

$$TC_{ijk} = \varepsilon_i^m M_{ijk} \frac{(1 + t_{ijk}^1) - (1 + t_{ijk}^0)}{(1 + t_{ijk}^0)}, \quad (8)$$

where TC_{ijk} is the sum of trade created regarding commodity i , resulting from the tariff change; ε_i^m is the elasticity of import demand for commodity i in the importing country from the trading partner; M_{ijk} is the current level of import demand of commodity i while t_{ijk}^0 and t_{ijk}^1 , respectively, denote tariff rates for commodity i at the beginning and end periods.

Beyond the ability of the free-trade area to create trade, trade diversion is also eminent. Jallab et al. (2007) refer to trade diversion as a phenomenon where efficient producers who are outside the free-trade area are displaced by less efficient producers in the preferential area. Laird and Yeats (1986) rely on the elasticity of substitution to derive such diversion. The authors show that the elasticity of substitution, which is given as the percentage change, in the relative shares of imports from two different sources to a 1% change in the relative prices of the same product from these two sources. Mathematically, the elasticity of substitution (σ_m) can be expressed as follows:

$$\sigma_m = \frac{\Delta \left(\frac{\sum_k M_{ijk} / \sum_K M_{ijk}}{\sum_k P_{ijk} / P_{ijkK}} \right) / \left(\frac{\sum_k M_{ijk} / \sum_K M_{ijkK}}{\sum_k P_{ijk} / P_{ijkK}} \right)}{\Delta (P_{ijk} / P_{ijkK}) / (P_{ijk} / P_{ijkK})}, \quad (9)$$

where k represents imports from the other African countries within the free-trade area; K denotes imports from the rest of the world (ROTW). Following Laird and Yeats (1986), Equation (9) can be expanded and rearranged to produce the trade diversion equation as follows:

$$TD_{ijk} = \frac{M_{ijk} \sum_k M_{ijk} \sum_K M_{ijk} \frac{\Delta (P_{ijk} / P_{ijkK})}{P_{ijk} / P_{ijkK}} \sigma_m}{\sum_k M_{ijk} \sum_K M_{ijk} + \sum_k M_{ijk} \frac{\Delta (P_{ijk} / P_{ijkK})}{P_{ijk} / P_{ijkK}} \sigma_m}. \quad (10)$$

Therefore, from Equation (10), the trade diverted to other African countries within the free-trade area (FTA) can be expressed as follows:

$$TD^{FTA} = \frac{M^{AFR} M^{ROTW} \left(\frac{1 + t_{AFR}^1}{1 + t_{AFR}^0} - 1 \right) \sigma_m}{M^{AFR} + M^{ROTW} + M^{AFR} \left(\frac{1 + t_{AFR}^1}{1 + t_{AFR}^0} - 1 \right) \sigma_m}, \quad (11)$$

where M^{AFR} denotes the current imports into Ghana from other African countries within the free-trade area; M^{ROTW} represents imports from the rest of the world; t_{AFR}^0 and t_{AFR}^1 , respectively, denote the initial and end periods import tariffs levied on imports from other African countries destined to Ghana with $t_{AFR}^0 > t_{AFR}^1$. Notice that TD^{FTA}

increases with the value of σ_m . Thus, the total trade effect is obtained by adding trade creation and trade diversion together.

Undoubtedly, the implementation of the AfCFTA will have revenue effects where the tariff revenue is obtained by multiplying the tax/tariff rate by the tax base, which is the value of the imports. Thus, the tariff revenue in pre-AfCFTA implementation is given as $R_0 = \sum_i t_{ijk}^0 \sum_k P_{ijk} M_{ijk}$ while the new revenue after the tariff change in post-AfCFTA is $R_1 = \sum_i t_{ijk}^1 \sum_k P_{ijk} M_{ijk}$. Given this understanding, the revenue loss to Ghana, following the AfCFTA implementation, will then be $RL = \sum_i \Delta t_{ijk} \sum_k P_{ijk} M_{ijk}$. Indeed, beyond the trade and revenue effects, the coming into force of AfCFTA is also expected to have welfare gains where consumers in Ghana enjoy as a result of lower import prices. In particular, the free-trade area allows consumers to substitute relatively expensive domestic or imported commodities with cheaper ones that are affected by tariff reductions. Thus, higher imports potentially lead to a gain in consumer welfare, which can be summarized as follows:

$$w_{ijk} = 0.5 (\Delta t_{ijk} \Delta M_{ijk}), \quad (12)$$

where w_{ijk} is the consumer welfare while 0.5 measures the average difference of the tariff before and after their elimination. By assuming an infinite elasticity of export supply, import prices in Ghana will fall by less than that of the full liberalization of the markets. The next section discusses the empirical findings of the paper.

3 | FINDINGS AND DISCUSSIONS

This section presents and discusses the findings from the study based on the SMART model. The paper examines the economic impact of the AfCFTA on trade in Ghana. More specifically, it focuses on the determination of trade creation, trade diversion, imports, exports, revenue and welfare effects of the implementation of the AfCFTA. Table A1 shows the results on trade creation, trade diversion and total trade effects of the AfCFTA on Ghana.

Table A1 indicates that, following the implementation of AfCFTA, trade creation and trade diversion in Ghana are expected to be \$82.3 million and \$65.9 million, respectively, with a total trade effect of \$148.3 million. Interestingly, trade creation exceeds trade diversion and measures about 1.25 times higher than trade diversion. With regard to their respective shares in total trade, our study finds that trade creation and trade diversion, respectively, comprise of 55.5 and 44.5% of total trade effects. For most part, the free-trade agreement will result in a positive total trade effect, which is welfare-enhancing for Ghana. This welfare effect occurs as consumers in Ghana will enjoy imported goods at a lower cost, especially for those products whose prices will fall after AfCFTA. Given the size of Ghana's market, the paper presents 20 top products with the highest trade creation potential effects in Table A2 below:

Indeed, for most part, trade creation is distributed along tariff lines with each product revealing its trade creation potential. Table A3

shows that cereals and maize have greater trade creation potential. The higher trade creation potential of cereals is not surprising given that the country's agricultural production is declining over time. In this endeavour, the less efficient agricultural products will be replaced by imports. For instance, there is evidence that, prior to the AfCFTA, majority of Ghana's consumption of rice are imported from foreign markets since foreign rice is often preferred to the local rice. Tanko, Deng, and Dossou (2017) argue that Ghana engaged in the importation of four major cereals, namely rice, maize, wheat and sorghum. While the importation of maize and sorghum to argument domestic production, that of rice and wheat continue to increase, resulting in the imposition of protectionary policy of import duties on rice and wheat importation. To the extent that the implementation of the AfCFTA will provide a complete liberalized markets on imports from Africa, it is, therefore, not surprising that cereals come as the major products with the highest trade creation potential. Apart from cereals, vehicles also have a high potential trade creation estimated at US\$3.8 million. While this holds, the paper finds that the trade creation potential of cereals and maize measure about 1.36 times higher than that of vehicles. Our findings are consistent with Lang (2006) and Guei et al. (2017) whose studies highlight vehicles as one of the top products with the highest trade creation potential among ECOWAS countries and South Africa, respectively. Beyond the individual trade creation of the products, our overall evidence shows that the 20 top products as listed in Table A3, which have the highest trade creation, comprise 30.62% of the total trade creation.

The paper now discusses trade diversion, which details with substitution of goods from countries outside the African continent but is more efficient than goods from countries in AfCFTA. Table A3 presents the top 20 vulnerable products with the potential of trade diversion. For most part, unearthing those sensitive products prone to trade diversion is crucial to Ghana with regard to negotiations of their partners. From Table A3, our findings show that the most sensitive product to trade diversion is vehicles, followed by cement clinkers, electricity supply and fish products. Thus, following from the removal of tariffs, these products are more likely to be substituted by products from other countries that are not part of AfCFTA but are more efficient relative to those products from countries that for the AfCFTA. The paper observes that the top five products contribute to 13.25% of the country's total potential trade diversion.

Indeed, given the import-dependent nature of Ghana, import tariffs constitute a major source of government revenue. In addition to discouraging excessive imports, which heightens the depreciation of the currency (Ghana Cedi), the import tariffs also play a key role in government domestic revenue mobilization. However, the implementation of the AfCFTA implies the removal of import tariffs as countries aim for full liberalization of their markets. Thus, while the free-trade area promises to create trade, there are also potential revenue losses. Table A4 presents the top 20 largest potential revenue losses for each product for Ghana.

Our findings show that, following the removal of tariffs in the aftermath of AfCFTA, Ghana is likely to lose US\$ 8.604 million in

revenues from import tariffs. Cement clinkers, vehicles, sugars, electricity meters, odoriferous substances and cereals are the top seven products that would account for the majority of the revenue loss if there is full tariff removal. This evidence is consistent with existing studies (see, for instance, Epaphra, 2014; Matlanyane & Harmse, 2002). Similar findings are also observed in Mugano's (2013) study using Zimbabwe as a case. Following the country's and EU's free-trade agreement, the author notes vehicles as one of the products that account for a significant portion of the revenue lost. Our finding is also consistent with Guei et al. (2017) in the case of South Africa. Beyond the impact on revenue, what are the possible effects of the AfCFTA on consumer welfare? The next section tackles this question (Table A5).

Indeed, one of the key arguments of the proponents of AfCFTA is that, by removing tariff as a barrier to free trade, the free flow of goods results in lower prices, which is welfare enhancing. However, the AfCFTA as a free-trade area spurs welfare if trade creation is sufficiently higher than trade diversion. Results based on Table A1 show a higher trade creation relative to trade diversion, suggesting that implementation of the AfCFTA will potentially improve consumer welfare. Table A4 presents the 20 specific products with the highest consumer welfare in post-AfCFTA. The table indicates that the total consumer surplus that will accrue to Ghana is estimated at \$8.6 million. The highest product that will trigger this consumer welfare is cereals, followed by sugar/sucrose, cement clinkers, fish/sardines and vehicles. Notice that the welfare-enhancing effect of cereals is higher and weighs about 2.13 times higher than sugar/sucrose. Indeed, the exceedingly higher welfare effect of cereals is not surprising since cereals comprise a substantial portion of Ghana's imports. Thus, the elimination of tariffs will lower the prices of cereals hence increasing the purchasing power of consumers, potentially improving the standard of living.

Beyond its effect on improving consumer welfare, the paper examines the impact of AfCFTA on Ghana's export of goods. Indeed, to the extent that the free-trade agreement calls for liberalization of markets allows cross-border between and among countries in the free-trade area. Thus, the larger market access is expected to increase exports. In this endeavour, the paper examines the effect of the free trade on exports, and the results are presented in Table A6 below. Our findings show that Ghana's export is expected to increase by \$148.3 million (representing 12.92% over the pre-AfCFTA exports) after the implementation of the free-trade agreement.

With regard to Ghana's export relations with the specific countries, the positive effect from increased exports will not necessarily be experienced for all the countries. For most part, out of the 47 countries, Ghana's exports to 12 countries will reduce in post-AfCFTA implementation.¹ Interestingly, all these countries are from West Africa where the regional bloc already enjoys less restriction in terms of movement of goods. This implies that the full implementation of the AfCFTA will result in Ghana exploring other markets outside the West Africa regional bloc as the free-trade area provides wider market access. In this endeavour, Ghana diverts exports, which hitherto were exported to West African countries to other

regional blocs such as the Southern and Northern Africa countries. Indeed, these reduced exports imply that the country will be losing export revenues. The combined export reduction from these countries amount to US\$ 4.6 million. However, such loss will be compensated by the increase in exports in other countries. For the remaining 35 countries where Ghana's export will increase in post-AfCFTA implementation, exports to South Africa will be the highest followed by Egypt, Morocco and Mauritania. Notice, from Table A6, that the increase in exports to South Africa alone is exceedingly higher than the combined export loss emanating from the 12 countries.

The study also finds that while imports in pre-AfCFTA were measured at US\$ 11.2 billion, the liberalization of the African markets owing to the AfCFTA will lead to an increase in imports of about US\$ 11.3 billion—a surge of US\$ 82.3 million over the pre-AfCFTA period. For most part, the increase in imports is a result of trade creation. By juxtaposing the changes in exports and imports, on account of the free trade, it is observed that the value of exports is sufficiently higher than that of imports and measures of 1.8 times higher. Thus, the implementation of the AfCFTA will, by far, improve Ghana's trade balance. While Table A7 presents evidence on the potential changes in imports, Table A8 below presents Ghana's top 20 import products. From the table, it is observed that imports of vehicles will be the top import products followed by cereals. Cement clinkers and medicaments are also major import commodities. However, insecticides, fertilizers and tractors will contribute less to the import bill of Ghana.

3.1 | Sensibility analyses and robustness tests

This section focuses on sensitivity analysis conducted using the elasticity of substitution in gauging the pattern of trade. Following Mc Daniel and Balistreri (2003), the analysis is carried out under the assumption that the elasticity of supply is infinite as much as the market partners are price-takers, and that changes in demand are met with adjustments in quantities. The value considered for the elasticity of substitution, which determines the degree of substitution between different varieties of goods, according to the export partner, is 1.5 for each product. The supply elasticities are deemed to be infinite because Ghana is considered a small market and some of the African exporters consist of little more industrialized economies (Bayale, Nagou, Nendobe Dobah, & Ngaba, 2020; Suranovic, 2010). Thus, an increase in demand for a given good will always be matched by the producers and exporters of that good without any impact on the price of the good. However, Stern, Francis, and Bruce (1976) revealed that, in WITS-SMART analysis, the import demand elasticity can vary at the HS-6 level. It is for this reason we evaluate the robustness of the results by using the lower bound, upper bound and worst-case scenarios. In this study, we modify the parameter values (substitution and export supply elasticities) as suggested by existing studies (see Bayale et al., 2020; Guei et al., 2017; Mugano, 2013; Wonyra & Bayale, 2020). A base case simulation is first carried out using elasticities from Bayale et al. (2020). The simulation is repeated under varying assumptions.

For this purpose, the lower and upper bound limits were established for different elasticities as shown in Table A9.

The results of these robustness and sensitivity analyses are presented in Table A10. By reducing the elasticity of substitution to 0.5, changes occur in the trade creation from the base case. For instance, trade creation increases by 19.22%.² However, when elasticity of substitution is increased to 2 and 6, trade creation reduces by 90.78 and 69.95%, respectively (see Table A10). Interestingly, Ghana's total imports do not change significantly given the 0.91% change. What is observed is that composition of imports changes as economic agents are substituted across various imports. It is imperative to note that the reduction of trade elasticity value to 0.5 has a positive effect on revenue as revenue loss reduces by 8.02%. On the contrary, if the elasticity of substitution is increased to 2 and 6, revenue losses would increase by 20.45 and 41.66%, respectively, showing that the deviations from the middle ground are important. Thus, the middle ground estimates seem to be very close to the potential sizes.

If the substitution and export supply elasticities are reduced to 0.5 and 94, respectively, welfare increased by 3.27%. By fixing that elasticity to 2 and 6, welfare would reduce by 3.99 and 4.51%. Moreover, under these conditions, exports are expected to increase by 2.96% from the base case. In the upper bound, exports would decrease by 14.08% and, in the worst case, exports would increase by 71.21% (see Table A10). Accordingly, the middle ground estimates are again closer to their potential sizes. However, our import sensibility analysis shows no change in imports from the base case. Similar to the earlier finding, Ghana's total change in imports remains almost the same in value as it only changed from 0.73 to 0.99%.

4 | CONCLUSION AND POLICY RECOMMENDATION

Undoubtedly, improving trade and welfare is one of the major reasons for countries participating in free-trade area, such as the AfCFTA. This is because by liberalizing markets and eliminating barriers to trade, import prices are expected to fall hence spurring welfare gains and increased trade. The study examines the potential trade, welfare and revenue implications of AfCFTA for Ghana by applying the partial equilibrium technique on 2018 disaggregated data. The study shows that total trade effects in Ghana are likely to increase by US\$ 148.3 million while enhancing consumers' welfare by US\$ 8.597 million. Thus, the elimination of tariffs on all other African countries' products would be beneficial to consumers through net trade creation. This notwithstanding, Ghana is likely to experience a revenue loss of US\$ 8.604 million.

Indeed, while the country desires to mobilize domestic revenue to finance the needed infrastructure and other social protection schemes, the loss in revenue might be a concern. However, following the removal of tariffs, both exports and imports to the other African countries will, respectively, increase by 12.9 and 0.7%. Thus, Ghana's net trade balance position is expected to improve since the country's exports will exceed her imports in post-AfCFTA. The findings of the

paper can be used by Ghana when formulating tariff offers while negotiating with her trading partners. To the extent this study unearth the sources of revenue loss, the paper recommends that the country keep a substantial portion of tariff lines for sensitive and excluded products over a longer period of liberalization. In order to mitigate the revenue loss, the exclusion list should contain significant number of products such as cement clinkers, vehicles, sugars, odoriferous substances and mixtures, paper and paperboard, aluminium, and odoriferous substances and mixtures, iron or steel and paper articles.

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ORCID

Nimonka Bayale  <https://orcid.org/0000-0003-1631-0081>

Muazu Ibrahim  <https://orcid.org/0000-0002-4053-9006>

ENDNOTES

¹ These countries are Benin, Burkina Faso, Cote d'Ivoire, The Gambia, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

² The changes are calculated with reference to the base case simulation results. For instance, this change in trade creation is computed as $\frac{98,148,524 - 82,325,553}{82,325,553} \times 100$.

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AUTHOR BIOGRAPHIES

Nimonka Bayale (Ph.D) is currently a Research Fellow with the Macroeconomic and Governance Division (MGD), United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia. He was previously a Research Assistant with the West African Economic and Monetary Union (WAEMU) Commission in Ouagadougou (Burkina Faso) and with the International Food Policy Research Institute (IFPRI) in Dakar (Senegal) under the WAEMU

Commission Research Fellowship Program. He is a Researcher and Lecturer of Economics at the University of Kara, Togo. His research interests are in the fields of development economics, international economics, regional integration and economic policy modelling.

Muazu Ibrahim holds Ph.D in Economics and Finance from University of The Witwatersrand, Johannesburg, South Africa. He is a Lecturer at the Department of Banking and Finance, School of Business and Law, University for Development Studies, Wa, Ghana. He is a Research Fellow with the Macroeconomic and Governance Division, United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia. Muazu is also a Research Fellow with the Institute of Business Research, University of Economics Ho Chi Minh City, Vietnam, and the Centre on African Philanthropy and Social Investment (CAPSI), Wits Business School, University of The Witwatersrand, Johannesburg, South Africa. His research focuses on development and international finance/economics where he has extensively published in these areas.

Joseph Atta-Mensah is a Principal Policy Adviser with the Macroeconomic and Governance Division (MGD), United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia. He previously served as a Senior Economist at the Bank of Canada. He holds Ph.D in Financial Economics from Simon Fraser University, Canada. He has published extensively in the field of macroeconomics, finance and international trade.

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APPENDIX

TABLE A1 Potential trade creation and trade diversion effects of African Continental Free Trade Area (AfCFTA) (US\$ 000)

Trading partner	Trade creation	Trade diversion	Total trade effects
African countries	82,325.553	65,972.583	148,298.137

TABLE A2 Top 20 products with highest potential trade creation effects (US\$ 000)

Number	HS-6	Product description	Total trade effects	Trade creation
1	100590	Cereals; maize (corn), other than seed	6,272.201	5,263.648
2	870421	Vehicles; compression-ignition internal combustion	7,669.625	3,858.837
3	160413	Fish preparations; sardines	3,165.706	1,825.861
4	252310	Cement clinkers (whether or not coloured)	3,517.304	1,625.407
5	902830	Meters; electricity supply or production meters	3,127.395	1,430.072
6	210390	Sauces and preparations therefor	2,332.322	1,420.698
7	330210	Odoriferous substances and mixtures	2,285.122	1,221.402
8	530890	Yarn; of vegetable textile fibres	1,102.206	1,100.057
9	730890	Iron or steel; structures and parts thereof	2,010.763	969.304
10	870333	Vehicles; cylinder capacity over 2,500 cc	2,163.496	954.225
11	170199	Sugars; sucrose, chemically pure, in solid form	2,088.546	862.063
12	200969	Juice; grape, of a Brix value exceeding 30	764.481	745.477
13	220600	Beverages, fermented	762.274	619.491
14	730729	Steel, stainless; tube or pipe fittings	1,193.212	593.587
15	720928	Iron or non-alloy steel; flat-rolled	483.288	475.211
16	854370	Electrical machines and apparatus	538.658	463.38
17	852872	Reception apparatus for television	1,041.618	461.989
18	630222	Bed linen; of man-made fibres	466.584	451.186
19	854790	Insulating fittings; for electrical machines	549.026	446.861
20	847490	Machines, for sorting, screening, separating, washing	949.415	415.478

TABLE A3 Top 20 most vulnerable products to potential trade diversion (US\$ 000)

Number	HS-6	Product description	Total trade effects	Trade diversion
1	870421	Vehicles; compression-ignition internal combustion piston	7,669.625	3,810.788
2	252310	Cement clinkers (whether or not coloured)	3,517.304	1,891.897
3	902830	Meters; electricity supply or production meters	3,127.395	1,697.322
4	160413	Fish preparations; sardines	3,165.706	1,339.845
5	870323	Vehicles; with only spark-ignition internal combustion	2,098.745	1,242.763
6	170199	Sugars; sucrose, chemically pure, in solid form	2,088.546	1,226.483
7	330210	Odoriferous substances and mixtures	2,285.122	1,063.72
8	730890	Iron or steel; structures and parts thereof	2,010.763	1,041.459
9	100590	Cereals; maize (corn), other than seed	6,272.2	1,008.552
10	210390	Sauces and preparations therefor	2,332.322	911.625
11	730799	Iron or steel; tube or pipe fittings	1,584.766	801.141
12	730729	Steel, stainless; tube or pipe fittings	1,193.212	599.625
13	852872	Reception apparatus for television	1,041.618	579.629
14	847490	Machines, for sorting, screening, separating, washing	949.415	533.937
15	220210	Waters; including mineral and aerated	805.14	527.357
16	481930	Paper and paperboard; sacks and bags of paper	891.163	485.671
17	220710	Undenatured ethyl alcohol	800.042	465.742
18	940540	Lamps and light fittings; electric	674.577	397.131
19	200990	Juices; mixtures of fruits or vegetables	460.127	373.208
20	210690	Food preparations; n.e.c. in item no. 2106.10	546.471	335.525

TABLE A4 Top 20 largest potential losses in products revenue after the AfCFTA (US\$ 000)

Number	HS-6	Product description	Revenue loss	Percentage of total loss
1	252310	Cement clinkers (whether or not coloured)	-4,324.733	5.026
2	870421	Vehicles; compression-ignition internal combustion	-4,274.501	4.968
3	170199	Sugars; sucrose, chemically pure, in solid form	-2,905.211	3.376
4	160413	Fish preparations; sardines	-2,368.553	2.753
5	902830	Meters; electricity supply or production meters	-1,721.005	2.001
6	330210	Odoriferous substances and mixtures	-1,487.298	1.729
7	100590	Cereals; maize (corn), other than seed	-1,316.374	1.529
8	730890	Iron or steel; structures and parts thereof	-1,286.971	1.495
9	870333	Vehicles; with only compression-ignition	-1,222.273	1.421
10	210390	Sauces and preparations therefor	-1,222.088	1.420
11	730729	Steel, stainless; tube or pipe fittings	-1,038.89	1.207
12	220210	Waters; including mineral and aerated	-835.568	0.971
13	220600	Beverages, fermented; (e.g., cider, perry, mead, sake)	-741.352	0.861
14	852872	Reception apparatus for television	-723.901	0.841
15	252020	Plasters, whether or not coloured	-566.665	0.658
16	481810	Paper articles; toilet paper	-550.759	0.641
17	854790	Insulating fittings; for electrical machines	-510.494	0.593
18	847490	Machines, for sorting, screening, separating, washing	-468.239	0.544
19	340220	Washing and cleaning preparations; surface-active	-460.449	0.535
20	481930	Paper and paperboard; sacks and bags of paper	-458.079	0.532
	Others	Other products not specified above	-57,557.704	66.896
	Total		-86,041.107	100

TABLE A5 Top 20 products with largest potential consumer welfare after AfCFTA (US\$000)

Number	HS-6	Product description	Welfare	Percentage of total welfare
1	100590	Cereals; maize (corn), other than seed	776.809	9.036
2	170199	Sugars; sucrose, chemically pure, in solid form	364.798	4.243
3	252310	Cement clinkers (whether or not coloured)	308.724	3.591
4	160413	Fish preparations; sardines	247.641	2.881
5	870421	Vehicles; compression-ignition internal combustion	158.836	1.847
6	210390	Sauces and preparations therefor	149.73	1.742
7	730799	Iron or steel; tube or pipe fittings	139.736	1.625
8	870333	Vehicles; with only compression-ignition internal...	137.539	1.599
9	902830	Meters; electricity supply or production meters	124.781	1.451
10	730729	Steel, stainless; tube or pipe fittings	95.896	1.115
11	530890	Yarn; of vegetable textile fibres	95.78	1.114
12	330210	Odoriferous substances and mixtures	91.839	1.068
13	761090	Aluminium; structures and parts of structures	71.339	0.829
14	680911	Plaster, or plaster compositions; boards, sheets	65.835	0.765
15	852872	Reception apparatus for television	64.712	0.753
16	220600	Beverages, fermented	64.266	0.747
17	392690	Plastics; other articles n.e.c. in chapter 39	61.311	0.7132
18	481810	Paper articles; toilet paper	59.723	0.695
19	200969	Juice; grape, of a Brix value exceeding 30	59.51	0.692
20	961900	Sanitary towels (pads) and tampons	57.52	0.669
	Others	Other products not specified above	5,400.521	62.819
	Total		8,596.846	100

TABLE A6 Potential increase in exports of individual countries after AfCFTA (US\$000)

Partner	Exports before AfCFTA	Exports after AfCFTA	Export change in revenue
African countries	1,147,751.89	1,296,050.004	148,298.137
Individual countries:			
Algeria	15,192.145	19,950.153	4,758.004
Angola	42,834.429	49,430.101	6,595.666
Benin	1,893.644	1,888.704	-4.938
Botswana	37.051	50.956	13.905
Burkina Faso	7,193.881	7,169.282	-24.605
Burundi	0.329	0.329	0.00
Cameroon	1,251.312	1,472.747	221.436
Cape Verde	23,049.783	33,565.469	10,515.691
Central African Republic	136.446	182.987	46.541
Chad	2.362	2.597	0.235
Comoros	6.418	7.184	0.766
Congo. Rep.	1,817.821	2,091.057	273.245
Cote d'Ivoire	118,328.873	117,362.925	-965.967
Djibouti	778.47	973.617	195.15
Egypt. Arab Rep.	88,573.212	107,243.658	18,670.453
Equatorial Guinea	2,736.041	3,105.886	369.843
Ethiopia	1,292.997	1,751.402	458.404
Gabon	8,077.256	9,132.675	1,055.423
Gambia	157.81	155.8	-2.009
Guinea	1,553.203	1,548.456	-4.742
Guinea-Bissau	3,377.684	3,181.554	-196.128
Kenya	8,796.567	11,924.262	3,127.694
Lesotho	1.267	1.734	0.467
Liberia	13,233.862	13,201.083	-32.769
Libya	4,007.028	4,151.632	144.604
Madagascar	3,109.019	3,451.347	342.33
Malawi	154.345	217.774	63.432
Mali	2,491.083	2,473.682	-17.393
Mauritania	75,985.27	87,303.379	11,318.11
Mauritius	10,097.794	11,865.497	1,767.697
Morocco	76,474.999	91,733.835	15,258.834
Mozambique	939.527	1,109.599	170.071
Namibia	1,061.401	1,241.855	180.441
Niger	9,252.618	9,128.482	-124.134
Nigeria	144,629.663	143,158.65	-1,471.001
Rwanda	39.683	51.211	11.524
Senegal	8,747.636	8,633.009	-114.625
Seychelles	397.682	498.491	100.803
Sierra Leone	19,105.733	18,287.163	-818.564
South Africa	369,445.48	440,771.176	71,325.689
Sudan	13.029	18.915	5.885
Tanzania	4,501.283	6,162.17	1,660.887
Togo	55,162.039	54,342.123	-819.905
Tunisia	21,532.076	25,709.421	4,177.35

TABLE A6 (Continued)

Partner	Exports before AfCFTA	Exports after AfCFTA	Export change in revenue
Uganda	116.168	126.697	10.534
Zambia	152.107	203.257	51.148
Zimbabwe	13.366	16.02	2.654

Note: Trade data that quantify 2018 trade relations between Ghana and countries like DR Congo, Eritrea, Eswatini, Sahrawi Republic, Sao Tomé and Príncipe, Somalia and South Sudan are unavailable.

TABLE A7 The potential impact of AfCFTA on Ghana's imports (US\$ 000)

Trading partner	Imports before AfCFTA	Imports after AfCFTA	Change in imports
African countries	11,246,590.32	11,328,915.813	82,325.493

TABLE A8 Ghana's top 20 potential imports from the AfCFTA (US\$ 000)

Number	HS-6	Product description	Imports value
1	870323	Vehicles; with only spark-ignition internal combustion	515,839.625
2	100640	Cereals; rice, broken	247,605.141
3	870421	Vehicles; compression-ignition internal combustion...	241,725.469
4	252310	Cement clinkers (whether or not coloured)	218,603.188
5	300490	Medicaments; consisting of mixed or unmixed products	208,901.859
6	100630	Cereals; rice, semi-milled or wholly milled	200,569.25
7	100199	Cereals; wheat and meslin, other than durum wheat	161,369.828
8	170199	Sugars; sucrose, chemically pure, in solid form	157,144.969
9	151110	Vegetable oils; palm oil and its fractions	153,350.203
10	390120	Ethylene polymers; in primary forms	145,192.25
11	110429	Cereal grains; worked, other than rolled or flaked of cereals	135,942.078
12	721391	Iron or non-alloy steel; bars and rods, hot-rolled	108,217.813
13	380893	Herbicides, anti-sprouting products and plant-growth regulators	101,385.594
14	252329	Cement; portland, other than white	96,706.172
15	630900	Clothing; worn, and other worn articles	90,375.469
16	848180	Taps, cocks, valves and similar appliances	84,272.133
17	902830	Meters; electricity supply or production meters	70,566.266
18	380891	Insecticides	68,487.367
19	310520	Fertilizers, mineral or chemical	62,631.008
20	870120	Tractors; road, for semi-trailers	62,117.449
	Other	Other products not specified above	81,15,587.189
	Ghana	Imports	11,246,590.32

Elasticities	Base case	Worst case	Lower bound	Upper bound
Substitution	1.5	6	0.5	2
Export supply	99	99	94	99

TABLE A9 Elasticities used in sensitivity analysis

Note: Import demand elasticity values used by default in SMART are the same for all reporters but may vary according to the product. The current set includes over 100 distinct values but the elasticity value is unique for a given product of import demand elasticity is irrespective of the partner.

Effects	Base case	Worst case	Lower bound	Upper bound
Trade creation	82,325.553	7,590.416	98,148.524	24,738.829
Revenue loss	-86,041.107	-121,885.832	-79,140.611	-103,636.513
Welfare	8,596.846	8,209.128	8,877.963	8,253.574
Exports (%)	12.921	71.209	2.959	-14.008
Imports (%)	0.732	0.906	0.725	0.997

TABLE A10 Robustness and sensitivity analysis of trade creation, revenue, welfare, exports and imports (US\$ 000 and percentage of change)