Quantitative Impact of African Continent Free Trade Area (AfCTA) on African Economies

by

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Abstract

We evaluate the impact of African Continent Free Trade Area (AfCTA)agreements on the welfare and terms of trade for African economies. We use a three-region (Two African Economies and the rest of the world) New Keynesian DSGE model to quantify the impact of AfCTA agreements on the welfare and terms of trade. Our results suggest that, in the short run, following elimination of tariffs, output increases, terms of trade ameliorate, consumption increases, trade increases, but most of the impacts vanish very quickly, except for the appreciation of currencies in AfCFTA members.

JEL Classification: F13, F15, F41, E60.
Key words: Tariffs, Terms of Trade Theory, Trade Agreement, Trade Liberalization, AfCTA.

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1 Introduction

While the volume of trade has been increasing over time, the intra-regional trade volume in Africa as a percentage of total trade within Africa and with non-African countries has remained below 10%. To boost the volume of trade among African countries, the African Continent Free Trade Area[4] (AfCFTA) has been implemented in 2018. The AfCFTA aims to eliminate non-tariff and tariff barriers to the trade of goods and liberalize trade in services within African countries. This paper attempt to quantify potential gains from the AfCFTA while accounting that African countries mostly produce and export natural resources or lower values-added goods and import of final goods, mostly from non-African countries (>90%).

Following Eaton and Kortum (2002), who built a new trade model apt to quantify the welfare gains of unilateral and multilateral trade liberalization, numerous scholars have attempted to quantify the benefits of trade liberalization.

However, no consensus has been reached regarding the impact of trade agreements. Dollar (1992), Sachs and Warner (1995), Edwards (1998), Frankel and Romer (1999), Dollar and Kraay (2004), and Ganelli and Tervala (2015) revealed positive impacts of trade agreements on economic growth and/or welfare, while Harrison (1996), Rodriguez and Rodrik (2000), Rodrik, Subramanian, and Trebbi (2004), and Wacziarg and Welch (2008) could not confirm positive impacts of trade agreements. Moreover, Hur and Park (2012) reveal uneven impacts of trade agreements across countries and insignificant economic growth effects until 10 years following the agreements. Caliendo and Parro (2015) propose a new method to estimate sectoral trade elasticities consistent with any trade model that delivers a multiplicative gravity equation. Using their model to estimate the impact of NAFTA, they found that NAFTA triggered an increase in welfare for Mexico (1.31%) and the United States (0.08%), but a decrease in the Canadian welfare (0.06%).

[4]29 African countries have ratified the AfCFTA: Ghana, Kenya, Rwanda, Niger, Chad, Congo Republic, Djibouti, Guinea, eSwatini, Mali, Mauritania, Namibia, South Africa, Uganda, Ivory Coast (Cote d'Ivoire), Senegal, Togo, Egypt, Ethiopia, The Gambia, Sierra Leone, Saharawi Republic, Zimbabwe, Burkina Faso, Sao Tome Prıncipe, Gabon, Equatorial Guinea, Mauritius, and Cameroon.

Numerous factors have been depicted as drivers of the aptitude for trade agreements to enhance welfare. Portugal-Perez and Wilson (2011) revealed that physical infrastructure and regulatory reforms improving business environments are needed for trade reforms to boost international trade. Freund and Bolaky (2008) and Chang, Kaltani, and Loayza (2009) found that trade openness triggered by agreements can boost economic growth only if accompanied by some domestic reforms such as deregulations of business, financial development, better education or the rule of law, and flexibility in labor markets. Caliendo and Parro (2015) found that trade agreements' welfare effects are lower when the production structure does not account for intermediate goods or input-output linkages. Moreover, Dai et al. (2014) revealed that trade agreements could enhance trade between members by diverting trade with non-members and within countries. However, we could not come across a paper analyzing the impacts of lower interconnection between African countries and potential gains from the AfCFTA.In fact, most African countries produce and export almost non-transformed natural resources and import most final goods from non-African countries. This is the gap we intend to fill.

We use a three-country DSGE model that accounts for African households' particularity (real rigidities: two types of households (Ricardian and non-Ricardian)) and the structure of African Economies. We use two African countries and the rest of the world represented by China, India, the European Union, the USA, and other major non-African partners. Our setting maintains the tariff on goods from the rest of the world. Thereafter, we use a small open economy structural panel vector autoregressive (VAR) model to conduct the robust check of our results following Schmitt- Grohe and Uribe (2018) specification, which focuses on terms of trade shocks.

Using quarterly data for 29 African countries that have ratified the AfCFTA from 1962 to 2018, Our results reveal that, in the short run, following the elimination of tariffs, output increases, terms of trade ameliorate, consumption increases, trade increases, but most of the impacts vanish very quickly, except for the appreciation of currencies in AfCFTA members.

Our main results confirm previous findings (Eaton and Kortum (2002), Caliendo and Parro (2015), Ossa (2011, 2014)) on multilateral trade agreement which finds that trade liberation leads to smaller improvements in households' welfare when we consider the value added measure of output. Nevertheless, when we measure outputs by the total value, our results confirm the findings of Ganelli and Tervala (2015) that show a greater welfare gain after an elimination of tariff.

From our results, we recommend the initiative to enhance manufacturing sectors and boost trade between the African countries that relatively depend more on non-African countries. This recommendation aligns with those from Meral (2003), who suggested, for developing countries, first, adopting stronger export promotion strategies and developing infrastructure apt to facilitate exports and provision of uninterrupted energy supplies. Other possible solutions include enhancing the incentives on exports like duty drawback /rebate and refund payments.

The remainder of the paper is organized as follows. Section 2 summarizes some scholarly works related to our topic. Section 3 elaborates on the theoretical model. Our calibration is explained in Section 4. Section 5 provides and comments on our results, and Section 6 concludes the paper.

2 Literature review

This section summarizes some literature related to the focus of this paper.

Frankel and Romer (1999) constructs measures of the geographic component of countries' trade and uses those measures to obtain instrumental variables estimates of the effect of trade on income. The results of the experiment show: trade raises income. The relation between the geographic component of trade and income suggests that a rise of one percentage point in trade ratio to GDP increases income per person by at least one-half percent. Trade appears to raise income by spurring the accumulation of physical and human capital and

increasing output for given capital levels. The results also suggest that within-country trade raises income. Larger countries—and therefore have more opportunities for trade within their borders—have higher incomes. And the estimates suggest that within-country trade, like international trade, raises income through capital accumulation and income for given levels of capital.

Melitz (2003) develops a dynamic industry model with heterogeneous firms to analyze international trade's intra-industry effects. The model shows how the exposure to trade will induce only the more productive firms to enter the export market (while some less productive firms continue to produce only for the domestic market) and simultaneously force the least productive firms to exit. It then shows how further increases in the industry's exposure to trade lead to additional inter-firm reallocations towards more productive firms. The paper also shows how the aggregate industry productivity growth generated by the reallocations contributes to a welfare gain, thus highlighting a benefit from trade that has not been examined theoretically before.

Dollar and Kraay(2004) supports the view that globalization leads to faster growth and poverty reduction in developing countries. Over half of the developing world lives in globalizing economies that have seen large trade increases and significant declines in tariffs. They are catching up with the rich countries while the rest of the developing world is falling farther behind. The increase in growth rates leads, on average, to proportionate increases in incomes of the poor.

Baier and Bergstrand (2007) addressed econometrically the endogeneity of FTAs by using the panel approach. And the endogeneity is the common drawback of the gravity equation. Accounting econometrically for the FTA variable's endogeneity yields striking empirical results: the effect of FTAs on trade flows is quintupled. They find that, on average, an FTA approximately doubles two members' bilateral trade after 10 years.

Sohn and Lee (2006) applied the system GMM method to a dynamic panel of data con-

sisting of major FTAs- European Union, NAFTA, Mercosur, and AFTA, including launching an FTA, expanding membership, or deepening FTA integration. They found considerable evidence for the income convergence effect of FTAs.

Dutt, Mihov, and Zandt (2013) showed that the WTO's impact is concentrated almost exclusively on the extensive product margin of trade, i.e., trade in goods that were not previously traded. WTO membership increases the extensive margin of exports by 25%. At the same time, WTO membership negatively impacts the intensive margin. Based on novel comparative statics results about how fixed and variable trade costs impact the product margins of trade, their results suggest that WTO membership works by reducing primarily the fixed rather than the variable costs of trade.

Goff and Singh (2014) use a panel of African countries over the period 1981-2010 and testing for non-linearities in the trade-poverty relationship and find that trade openness tends to reduce poverty in countries where financial sectors are deep, education levels high and institutions strong.

Bista(2015) find that developing WTO members experience an increase in the extensive margin from industrial member countries. Additionally, the industrial WTO members also experience an increase in the extensive margin from developing WTO members. Results suggest that WTO facilitates the North-South trade relationship, which has been largely absent in trade literature.

In many endogenous growth models, trade leads to the convergence of growth rates across countries. This convergence of growth rate depends crucially on assuming that trade occurs simultaneously with the international diffusion of knowledge. After dropping this assumption, Feenstra 1994 showed that when no diffusion of knowledge occurs, trade in goods can lead to a divergence of growth rates. We also explore how these results are affected by trade in intermediate inputs or by multinational corporations, which may facilitate knowledge diffusion.

Chang, Kaltani, and Loayza (2009) present a theoretical example in which the removal of barriers to trade needs to be accompanied by complementary reforms in non-trade areas to improve productive efficiency and growth. They find that trade openness is associated with faster growth generally but, more importantly, that this positive effect can be significantly enhanced if some complementary reforms are undertaken. And these interactions are economically and statistically significant, and robust to changes in specification, econometric method, and openness measure. These complementary reforms are educational investment, financial depth, inflation stabilization, public infrastructure, strong governance, labor market flexibility, ease of firm entry, and ease of firm exit. The paper concludes that the growth effects of openness may be significantly improved if certain complementary reforms are undertaken.

3 Model

We develop a three-region DSGE model that takes into account not only the particularity of African households (real rigidities: two types of households (Ricardian and non-Ricardian)) but also the structure of African Economies (producers of natural resources (low value-added) and importers of final goods(high value-added)). We consider a three-country model: Two African-countries (Home (H), Foreign (F)), and the rest of the World block (W). The model consists of two types of households: Richardian (entrepreneurs and workers) and non-Ricardian (exclusively workers); Firms producers of three types of goods (Non-tradable goods (N), composite Tradable goods (T), and natural resource goods (D)); a fiscal and monetary authority.

3.1 Household

As mentioned above, our model considers two types of households: Ricardian (R) and non-Ricardian (NR), maximizers of the lifetime utility written as follows:

$$U(C_t, \frac{M_t}{P_t}, N_t) = E_t \sum_{t=0}^{\infty} \beta^t \left[logC_t + log(\frac{Mn_t}{P_t}) - \frac{1}{1-\gamma_N} N_t^{1+\gamma_N} \right] \tag{1}$$

where C_t, $\frac{Mn_t}{P_t}$, and N_t denote consumption, real money balance, and hours of labor respectively. The parameters β and γ_N represent the rate of time preference and the Frisch elasticity of labor supply respectively.

Households maximize (1) subject to the budget constraint that depends on type of households.

3.1.1 Ricardian Households

The Ricardian Households are entrepreneurs and workers. They are subject to the budget constraint

$$\begin{bmatrix} PC_{kt}C_{kt}^R + P_{kt}^I I_{kt} + \left(\frac{Mn_{kt}^R}{P_{kt}}\right) \\ +S_t B_{kt}^W + D_{kt} = W_{kt}N_{kt}^R + \left(\frac{Mn_{kt-1}^R}{P_{kt}}\right) + S_t \varphi_{t-1} R_{t-1}^W B_{kt-1}^W \\ +R_{kt-1}D_{kt-1} + Tr_{kt} + \Omega_{kt}^T + \Omega_{kt}^N - T_{kt} \end{bmatrix} \tag{2}$$

where D_{kt}, B_{kt}^W, I_{kt}, N_{kt}^R, φ_{kt}, W_{kt}, R_t^W, Tr_{kt}, Ω_{kt}^T, Ω_{kt}^N, T_{kt} and R_{kt} denote domestic government bonds, government bonds from the Rest of the world, investment, hours of labor, risk premium, wage, gross interest rate on the rest of the world bonds, government transfers to households, profits from tradable goods sector, profits from the non-tradable goods sector, government revenues, and gross interest rate on domestic government bonds respectively. S_t is the nominal exchange. The subscript k denotes either home or foreign countries. For simplicity, we assume that the gross interest rate and risk premium associated with government bonds from the rest of the world are the same in both home and foreign African countries. PC_{kt} and P_{kt}^I represent the consumption and investment prices respectively.

The second constraint that faces the Ricardian households is the law of motion for productive capital stock where δ denotes the depreciation rate

$$K_{kt} = (1-\delta)K_{kt-1} + I_{kt} \tag{3}$$

The first order conditions associated with the optimization problem of (1) subject to (2) and (3) with respect to domestic bonds, rest of the world bonds, real money balance, hours of labor, and capital stocks are

$$\beta E_t R_{kt} \frac{1}{\pi^C_{kt+1}} \left(\frac{C^R_{kt+1}}{C^R_{kt}} \right) = 1 \tag{4}$$

where $\pi^C_{kt+1} = \frac{PC_{kt+1}}{PC_{kt}}$ is the Consumer Price Index inflation.

$$\beta E_t e_{t+1} \varphi_t R^W_t \frac{1}{\pi^C_{kt+1}} \left(\frac{C^R_{kt+1}}{C^R_{kt}} \right) = 1 \tag{5}$$

where $e_{t+1} = \frac{S_{t+1}}{S_t}$ is the depreciation factor of nominal exchange rate.

$$\frac{Mn^R_{kt}}{P_{kt}} = \frac{R_{kt}-1}{R_{kt}} C^R_{kt} \tag{6}$$

$$W_{kt} = (N^R_{kt})^{\gamma^N} C^R_{kt} \tag{7}$$

$$Q_{kt} = \beta E_t \frac{\pi^I_{t+1} C^R_{kt+1}}{\pi^C_{kt+1} C^R_{kt}} \left[\frac{PC_{kt+1} R^k_{kt+1}}{P^I_{kt+1}} + (1-\delta) Q_{kt+1}) \right]. \tag{8}$$

where Q_{kt} is the Tobin Q's market value of new investment and $\pi^I_{kt+1} = \frac{P^I_{kt+1}}{P^I_{kt}}$.

3.1.2 Non-Ricardian Households

The non-Ricardian households are allowed to work only and do not participate in the financial market. They maximize their lifetime utility (1) subject to the budget constraint

$$PC_{kt} C^{NR}_{kt} + Mn^{NR}_{kt} = W_{kt} N^{NR}_{kt} + Mn^{NR}_{kt-1} - T_{kt} + Tr_{kt}. \tag{9}$$

The first order conditions with respect to hours of labor and real money balance are

$$W_{kt}\frac{1}{C_{kt}^{NR}} = (N_{kt}^{NR})^{\gamma^N} \tag{10}$$

$$\frac{Mn_{kt}^{NR}}{P_{kt}} = C_{kt}^{NR} \tag{11}$$

3.2 Production and Price Index

3.2.1 Final Goods Producing Firms

The final goods are produced by competitive firms with the following technology

$$C_{kt} = \left[(\alpha^C)^{\frac{1}{\nu^c}}(C_{kt}^N)^{\frac{\nu^c-1}{\nu^c}} + (1-\alpha^C)^{\frac{1}{\nu^c}}(C_{kt}^T)^{\frac{\nu^c-1}{\nu^c}}\right] \tag{12}$$

where ν^c denotes the elasticity of substitution between traded (C_{kt}^T) and non-traded goods (C_{kt}^N).

The aggregated final consumption goods is sold in the market at price

$$PC_{kt} = \frac{PC_{kt}^N C_{kt}^N + PC_{kt}^T C_{kt}^T}{C_{kt}} \tag{13}$$

where PC_{kt}^N and PC_{kt}^T denote the consumption price of non-traded and traded goods respectively.

The distribution of the aggregate consumption good, C_t, follows the regular optimization problem in which the retailers maximize their revenues
$Max\{PC_tC_{kt} - PC_{kt}^N C_{kt}^N - PC_{kt}^T C_{kt}^T\}$ subject to (12) yields the following demands for each goods

$$C_{kt}^N = \alpha^c\left(\frac{PC_{kt}^N}{PC_{kt}}\right)C_{kt} \tag{14}$$

$$C_{kt}^{T} = (1-\alpha^{c})\left(\frac{PC_{kt}^{T}}{PC_{kt}}\right)C_{kt}. \tag{15}$$

The traded consumption consists of goods produced domestically (c_H) and imported from a foreign country (c_{Ht}) and from the rest of the world (c_{Wt})

$$\left[C_{kt}^{T} = \left((\alpha^{HC})^{\frac{1}{\nu^{cT}}}(c_{Ht})^{\frac{\nu^{cT}-1}{\nu^{cT}}} + (\alpha^{FC})^{\frac{1}{\nu^{cT}}}(c_{Ft})^{\frac{\nu^{cT}-1}{\nu^{cT}}} + (\alpha^{WC})^{\frac{1}{\nu^{cT}}}(c_{Wt})^{\frac{\nu^{cT}-1}{\nu^{cT}}}\right)\right] \tag{16}$$

where $\alpha^{HC} + \alpha^{FC} + \alpha^{WC} = 1$ and ν^{cT} denotes the elasticity of substitution among home, foreign, and rest of the world traded goods.

As for total consumption goods, traded consumption goods's retailers solve the maximizing profits $Max\{PC_{kt}^{T}C_{kt}^{T} - (P_{kt}^{C}c_{Ht} + S_{kt}PF_{kt}^{C}c_{Ft} + (1+\tau_t^{m})S_{kt}PW^{C}c_{Wt})\}$ subject to (16)yields the order conditions expressed as relative demands are

$$\frac{c_{Ft}}{c_{Ht}} = \frac{\alpha^{FC}}{\alpha^{HC}}\left(\frac{S_{kt}PF_{kt}^{C}}{P_{kt}^{C}}\right)^{-\nu^{cT}} \tag{17}$$

$$\frac{c_{Wt}}{c_{Ht}} = \frac{\alpha^{WC}}{\alpha^{HC}}\left(\frac{(1+\tau_t^{m})S_{kt}PW_{kt}^{C}}{P_{kt}^{C}}\right)^{-\nu^{cT}} \tag{18}$$

where P_{kt}^{C}, PF_{kt}^{C}, PW_{kt}^{C}, S_{kt}, and τ_t^{m} denote respectively price of the home produced traded consumption goods, price of the foreign produced traded consumption goods, price of the rest of the world consumption goods, bilateral nominal exchange rate, and tariff on imported consumption goods from the rest of the world. The latter is consistent with the African Area Trade Agreement which aims to liberalize commercial transition among African countries. The tariff on imported consumption goods will be eliminated or reduced to African countries that have signed the trade agreement. However, it will be maintained on imported goods from the rest of the world. Therefore, our policy instrument (τ_t^{m}) follows an autoregressive process of order 1 (AR(1)). For simplicity, we assume that τ_t^{m} is a shock common to all countries and all goods. The reduction of τ_t^{m} will indicate that the trade agreement is effective.

The aggregate price for consumption goods can be written as

$$PC_{kt} = \left[\alpha^c (PC_{kt}^N)^{1-\nu^c} + (1-\alpha^c)(PC_{kt}^T)^{1-\nu^c}\right]^{\frac{1}{1-\alpha^c}}. \tag{19}$$

The price index of consumption of traded goods is

$$PC_{kt}^T = \left[\alpha^{HC}(P_{kt}^C)^{1-\nu^{cT}} + \alpha^{FC}(PF_{kt}^C)^{1-\nu^{cT}} + \alpha^{WC}(PW_{kt}^C)^{1-\nu^{cT}}\right] \tag{20}$$

3.3 Intermediate goods producing firms

We have a continuum of intermediate goods firms which operate in a monopolistic market. As the firms operate in a monopoly competitive market, they face a two-stage problem: (i) minimization of the cost and (ii) maximization of the discounted real profit. At the first stage, each firm minimizes the real cost of production by taking the prices of factors of production as given. However, at the second stage, each firm maximizes its discounted real profits in Calvo's setting. Therefore, in each period, a fraction of $(1-\lambda)$ of firms can change their prices. Other firms can only report their previous prices.

The economy here consists of three sectors: traded, non-traded, and natural resources. Here, We describe only the cost minimization problem for traded and natural resources sectors. The details for non-traded goods sector are provided in the appendix because traded and non-traded goods sectors' production function constraint depends on three factors: labor (N_{kt}^T), capital (K_{kt}^T), and imported intermediate goods (O_{kt}^T). For simplicity, we assume that the latter is imported from the rest of the world.

The j_{th} traded-goods producer chooses N_{kt}^T, K_{kt}^T, and O_{kt}^T to minimize total costs
$min\{\frac{W_{kt}P_{kt}^T}{N}{}^T{}_{kt} + \frac{PC_{kt}R_{kt}^k}{P_{kt}^T}K_{kt}^T + \frac{(1+\tau_t^m)S_{kt}PO_t}{P_{kt}^T}O_{kt}^T\}$

subject to $y_{kt}^T = \{[A^T(K_{kt}^T)^{\gamma^{KT}}(N_{kt}^T)^{\gamma^{NT}}(O_{kt}^T)^{\gamma^{OT}}]\}$

where A_t^T and PO_t represent the sector specific productivity shock and price of imported intermediate goods.

The cost minimization yields the following first order conditions (factor demands)

$$\frac{W_{kt}}{P_{kt}^T} = \frac{\gamma^{NT} MC^T y_{kt}^T}{N_{kt}^T} \tag{21}$$

$$\frac{PC_{kt}}{P_{kt}^T} R_{kt}^K = \frac{\gamma^{KT} MC^T y_{kt}^T}{K_{kt}^T} \tag{22}$$

$$\frac{(1+\tau_t^m) S_{kt} PO_t}{P_{kt}^T} = \frac{\gamma^{OT} MC^T y_{kt}^T}{O_{kt}^T} \tag{23}$$

where MC_t^T is the real marginal cost of producing an additional unit of traded-good that firms take as given when choosing the output price.

However, the cost minimization problem for the natural resources sector that produces the main exported goods for many African countries and provides more government revenues through taxation and tariff. The sector' production function constraint depends on three factors: imported capital (K_{kt}^D) through direct foreign investment (FDI), imported intermediate goods (O_{kt}^D), and mining/oil stock (L_{kt}). There is no labor employed in this sector since the mining/oil production is capital intensive. For simplicity, we assume that FDI and imported intermediate goods are imported from the rest of the world.

The j_{th} traded-goods producer chooses K_{kt}^D, L_{kt}, and O_{kt}^D to minimize total costs

$$min\{\tfrac{RL_{kt}}{S_t P_t^*} L_{kt} + \tfrac{PC_{kt} R_{kt}^k}{S_t P_t^*} K_{kt}^D + \tfrac{(1+\tau_t^m) S_{kt} PO_t}{S_t P_t^*} O_{kt}^D\}$$

subject to $y_{kt}^D = \{[A^D (K_{kt}^D)^{\gamma^{KD}} (L_{kt})^{\gamma^{LD}} (O_{kt}^D)^{\gamma^{OD}}]\}$

where A_t^D and RL_t represent the sector specific productivity shock and price royalties received by the government on mining/oil stock. The natural resources goods are sold in the

international market represented here by USA at the price (P_t^*).

The cost minimization yields the following first order conditions (factor demands)

$$\frac{RL_{kt}}{S_t P_t^*} = \frac{\gamma^{LD} MC^D y_{kt}^D}{L_{kt}} \tag{24}$$

$$\frac{PC_{kt}}{S_t P_t^*} R_{kt}^K = \frac{\gamma^{KD} MC^D y_{kt}^D}{K_{kt}^D} \tag{25}$$

$$\frac{(1+\tau_t^m) S_{kt} PO_t}{S_t P_t^*} = \frac{\gamma^{OT} MC^D y_{kt}^D}{O_{kt}^D} \tag{26}$$

where MC_t^D is the real marginal cost of producing an additional unit of traded-good that firms take as given when choosing the output price. We assume also that all the production is exported abroad at price (P_t^*).

$$y_{kt}^D = X_{kt}^{DW} \tag{27}$$

where X_{kt}^D is the exported natural resources' goods.

The investment in the natural resources sector in form of FDI is

$$I_{kt}^D = S_t I_{kt}^{WI} \tag{28}$$

where I_{kt}^{WI} is the FDI denominated in US dollar.

3.4 Aggregate Equilibrium

3.4.1 From Production to value added

The main contribution of this paper is to make a distinction between value added and production when we analyze the impact of trade liberation on African welfare. We follow the Andres et all. (2006) procedure for each sector

$$Pv_{kt}^T va_{kt}^T = P_{kt}^T y_{kt}^T - S_{kt} PO_t O^T \tag{29}$$

$$Pv_{kt}^{N} va_{kt}^{N} = P_{kt}^{N} y_{kt}^{N} - S_{kt} PO_t O^{N} \tag{30}$$

$$Pv_{kt}^{D} va_{kt}^{D} = S_t P_t^{*} y_{kt}^{D} - (S_{kt} PO_t O_{kt}^{D} + S_t P_t^{WI} I_{kt}^{WI}) \tag{31}$$

where the Pv's are the sectoral value added deflators. In real terms

$$va_{kt}^{T} = y_{kt}^{T} - O_{kt}^{T} \tag{32}$$

$$va_{kt}^{N} = y_{kt}^{N} - O_{kt}^{N} \tag{33}$$

$$va_{kt}^{D} = y_{kt}^{D} - O_{kt}^{D} - I_{kt}^{IW} \tag{34}$$

Then the real GDP (va_{kt}) is obtained by aggregating across sectors

$$va_{kt} = va_{kt}^{T} + va_{kt}^{N} + va_{kt}^{D} \tag{35}$$

and the GDP deflator is equal to

$$Pv_{kt} = \frac{Pv_{kt}^{T} va_{kt}^{T} + Pv_{kt}^{N} va_{kt}^{N} + Pv_{kt}^{D} va_{kt}^{D}}{va_{kt}} \tag{36}$$

3.4.2 Aggregate Constraints

The equilibrium for factors of production is given by aggregating over the sector

$$K_{kt} = K_{kt}^{T} + K_{kt}^{N} + K_{kt}^{D} \tag{37}$$

$$N_{kt} = N_{kt}^{T} + K_{kt}^{N} \tag{38}$$

and the aggregate prices and resource constraints are

$$P_{kt}^{T} y_{kt}^{T} = P_{kt}^{C}(c_{Ht} + c_{HFt}) + P_{kt}^{IT}(I_{Ht} + I_{HFt}) \tag{39}$$

$$y_{kt}^{T} = (c_{Ht} + c_{HFt} + I_{Ht} + I_{HFt}) \tag{40}$$

$$P_{kt}^N(y_{kt}^N - G_{kt}) = PC_{kt}^N C_{kt}^N + P_{kt}^{IN} I_{kt}^N \tag{41}$$

$$y_{kt}^N = C_{kt}^N + I_{kt}^N + G_{kt} \tag{42}$$

$$y_{kt}^D = X_{kt}^{DW} \tag{43}$$

$$P_{kt} = \frac{P_{kt}^N y_{kt}^N + P_{kt}^T y_{kt}^T + S_t P_t^* y_{kt}^D}{y_{kt}} \tag{44}$$

$$y_{kt} = y_{kt}^N + y_{kt}^T + y_{kt}^D \tag{45}$$

The balance of payments, including the risk premium is given by

$$S_{kt} R_t^W \varphi_{kt-1} b_{kt-1}^W \frac{va_{t-1}}{\pi_{kt}^{VA} va_{kt}} + \frac{P_{kt}^X X_{kt} - P_{kt}^M M_{kt}}{Pv_{kt} va_{kt}} = S_{kt} b_{kt}^W \tag{46}$$

where $b_{kt}^W = \frac{B_{kt}^W}{Pv_{kt} va_{kt}}$ and $\phi_y = \frac{va_{t+1}}{va_t}$.

The import and export deflators are given by

$$\begin{bmatrix} P_{kt}^M M_{kt} = P_{kt}^{FC} c_{Ft} + P_{kt}^{FI} I_{Ft} + S_{kt} P_t^{WC} c_{Wt} \\ + S_{kt} P_t^{WI} I_{Wt} + S_t PO_t (O_{kt}^T + O_{kt}^N + O_{kt}^D) \end{bmatrix} \tag{47}$$

$$P_{kt}^X = \frac{P_t^C c_{FH} + P_{kt}^I I_{FH} + S_t P_t^* X_{kt}^D}{X_{kt}} \tag{48}$$

3.5 Government Sector

The government sector consists of a fiscal authority and monetary one. The central bank for each country conducts the monetary policy according to Fridman's K rule for money growth or the standard Taylor rule for nominal interest rate.

The government budget constraint is given by

$$D_{kt} = R_{kt-1} D_{kt-1} + P_{kt}^N G_{kt} + PC_{kt} Tr_{kt} - T_{kt} \tag{49}$$

where Tax_{kt} is the lamp sum tax and

$$T_{kt} = Tax_{kt} + \tau_t^m (S_{kt} P_t^{WC} c_{Wt} + S_t PO_t (O_{kt}^T + O_{kt}^N + O_{kt}^D) + S_{kt} P_t^{IW} I_{kt}^{IW}) \tag{50}$$

3.6 Rest of the World

The rest of the world bloc consists of a budget constraint for the representative household, demand functions for domestic and imported goods, a production technology (uses labor, capital, domestic intermediate goods, and imported intermediate goods from African countries), a Taylor rule type of monetary policy, and a New Keynesian Phillips curve.

4 Calibration

Most of non-policy parameters are calibrated using quarterly data for 29 African countries that have ratified the AfCFTA from 1962 to 2018. The model is calibrated at quarterly frequency. In order to compute the steady state value of different variables, it is important to choose the steady state values of exogenous variables.

The indexation of prices θ is set to 6 which corresponds with the price-marginal cost steady state markup factor for intermediate goods $\frac{\mu}{(\mu-1)} = 1.2$. This is consistent with Rasaki (2017) for Nigerian economy. The share of domestic export to foreign economy (consumption goods) is set 0.08 or 8% which consists with the data. Moreover, the elasticity of output with respect to capital, α, is set to 0.24 which is consistent also with most of the work on many developing countries (Garcia-Cicco (2011) for Chile; Rasaki (2017) for Nigeria; Steinbach, Mathuloe, and Smit (2009) for South Africa). The depreciation rate of the capital stock, δ, is set to 0.025. Table 3 in appendix shows the value of the remained parameters.

5 Results

This paper examines the quantitative impact of free trade agreement on welfare (consumption) of 29 African countries that have ratified the AfCFTA. We analyze the impact by eliminating the tariff among those countries while maintaining it to other countries. We

Table 1: Calibration

β	$= 0.99$	Discount factor
σ	$= 1.39$	Relative Risk Aversion
δ	$= 0.025$	Depreciation rate of capital stock
γ^{KT}	$= 0.24$	capital share
α_c	$= 0.74$	Share of traded consumption goods in total consumption goods
α^{HC}	$= 0.26$	Share of home produced consumption goods in total traded consumption goods
α^{FC}	$= 0.08$	Share of foreign produced consumption goods in total traded consumption goods
α^{WC}	$= 0.66$	Share of rest of the world produced consumption goods in total traded consumption goods
ν^c	$= 0.74$	Elasticity of substitution between traded and non-traded consumption goods
α_I	$= 0.90$	Import share on investment
θ	$= 6$	Indexation of prices
η_c	$= 11.952$	Elasticity of substitution between import and domestic consumption goods
η_I	$= 2.056$	Elasticity of substitution between import and domestic investment goods
η_f	$= 3.809$	Share of domestic export goods in foreign output
G_{ss}	$= 0.1$	Steady state value of Government spending
L_{ss}	$= 1/3$	Steady state value of hours worked
$\frac{C_{ss}}{Y_{ss}}$	$= 0.60$	Steady state consumption/GDP
$\frac{I_{ss}}{Y_{ss}}$	$= 0.22$	Steady state investment/GDP
$\frac{G_{ss}}{Y_{ss}}$	$= 0.18$	Steady state Government spending/GDP
$\frac{T_{ss}}{Y_{ss}}$	$= 0.19$	Steady state lum sum tax/GDP

solve the model using Sims' (2000) second-order accurate method. The welfare is evaluated through a second-order Taylor expansion of the utility function around the steady state which yields

$$\begin{bmatrix} E(U(C_t, Mn_t, L_t)) \cong U(C_t, Mn_t, L_t) + E(\hat{C}_t) + Mn_{ss}E(\hat{Mn}_t) - L_{ss}E(\hat{L}_t) \\ -Var(\hat{C}_t) \end{bmatrix} \tag{51}$$

where $Var(\hat{C}_t)$ is the variance of $(\hat{C}_t)$.

By expressing the welfare as the permanent relative change in consumption (compared to the steady state), ξ, which gives

$$\begin{bmatrix} E(U(C_t, Mn_t, L_t)) : U((1+\xi)C_t, L_t) \cong U(C_t, Mn_t, L_t) \\ +E(\hat{C}_t) + Mn_{ss}E(\hat{Mn}_t) - L_{ss}E(\hat{L}_t) \\ -Var(\hat{C}_t). \end{bmatrix} \tag{52}$$

Hence, the welfare ξ can be decomposed into two components ξ^m and ξ^v as following:

$$\left[U((1+\xi^m)C_t, Mn_t, L_t) = U(C_t, Mn_tL_t) + E(\hat{C}_t) + Mn_{ss}E(\hat{Mn}_t) - L_{ss}E(\hat{L}_t)\right] \tag{53}$$

$$U((1+\xi^v)C_t, Mn_t, L_t) = U(C_t, Mn_t, L_t) - Var(\hat{C}_t), \tag{54}$$

where ξ^m and ξ^v represent the mean of consumption, real money balance, and hours worked, and variance of consumption. By applying the equation (52) into the previous equations yields

$$\ln(1+\xi) = E(\hat{C}_t) + Mn_{ss}E(\hat{Mn}_t) - L_{ss}E(\hat{L}_t) - Var(\hat{C}_t) \tag{55}$$

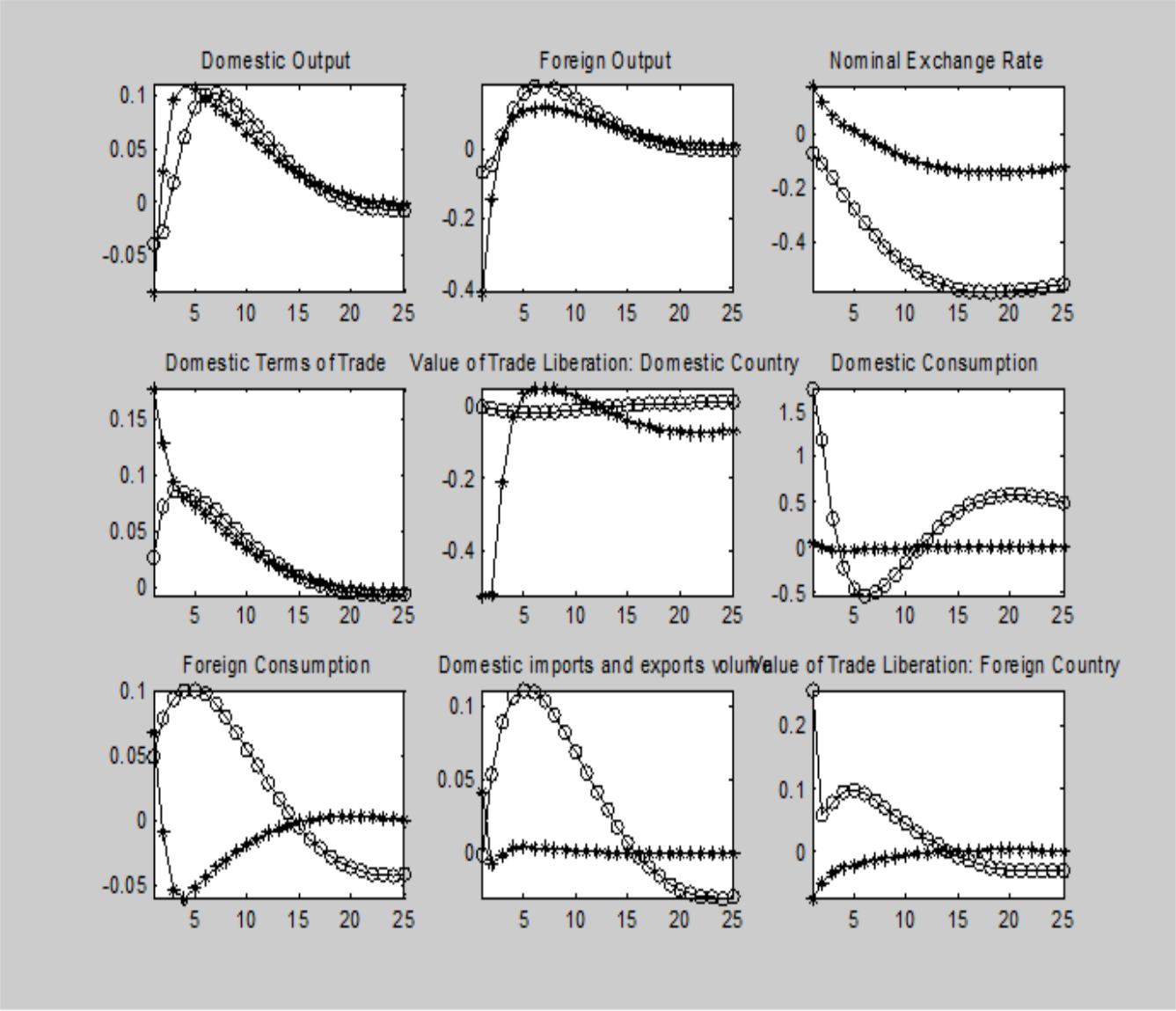
$$\ln(1+\xi^m) = E(\hat{C}_t) + Mn_{ss}E(\hat{Mn}_t) - L_{ss}E(\hat{L}_t) \tag{56}$$

$$\ln(1+\xi^v) = -Var(\hat{C}_t) \tag{57}$$

Therefore,

$$(1+\xi) = (1+\xi^m)(1+\xi^v). \tag{58}$$

We adopt the view of Ganelli and Tervala (2015) and Bagwell and Staiger (1999) that analyze the welfare benefit of a tariff reduction relative to a case with no tariff reduction. The welfare benefit is measured as a percentage of consumption that the household is willing to pay for a tariff reduction in order to render the household indifferent to the two cases (value of trade liberalization).



The horizontal axes our figure 1 indicate time and vertical ones display a percentage deviation from the initial steady state. We analyze the impact by using two measures of output: the value added (-*-*-) and the total value (-o-o-o-).

When we evaluate the output by the total value, the figure 1 indicates that the elimination of tariff among African countries that have ratified the AfCFTA increases the consumption in the home country by 1.5% immediately and 0.5% after ten quarters. For the foreign country, the impact reaches 0.1%. However, the impact is almost null when we use the added value measure for home country and 0.05% for the foreign one. The value of trade liberalization also shows the same pattern as the consumption. Figure 1 shows that the impact of trade liberalization is almost null for both home and foreign when consider the added value or total value measures of output. In fact, only foreign country household benefited from trade liberalization than home country when we use the total value measure of output.

The elimination of tariff among African countries that have ratified the AfCFTA has positive impact on output, terms of the trade, and the volume of domestic imports and exports for any measure of output. The impact of the AfCFTA on nominal exchange rate is contradictory depending on measure of output. When the output is measure by the total value, any tariff elimination appreciates the currencies of those 29 countries. However, when we use the added value measure of output, the elimination of tariff among the AfCFTA countries depreciates immediately their currencies for the first five quarters, then appreciates afterwards.

Our main results confirm previous findings (Eaton and Kortum (2002), Caliendo and Parro (2015), Ossa (2011, 2014)) on multilateral trade agreement which finds that trade liberation leads to smaller improvements in households' welfare when we consider the value added measure of output. Nevertheless, when we measure outputs by the total value, our results confirm the findings of Ganelli and Tervala (2015) that show a greater welfare gain after an elimination of tariff.

Our mixed results may be explained by five reasons. The first main reason is related to measure of output. On the best of our knowledge, this paper considers two measures of output: added and total value. The total value hide the real contribution of domestic production on trade, while the first does the contrary. Most of literature considers the total

value which, in case of Africa, ignores the specificity of African economies and promotes import/export shifts. When we use the added value measure of output, our results are consistent with Eaton and Kortum (2002), Caliendo and Parro (2015), Ossa (2011, 2014). However, when you use the total measure of output, our results are consistent with Ganelli and Tervala (2015). The reason is more on modeling side. In fact, both papers incorporate sticky prices and endogenous wages in their model. This is the second reason.

The third reason is the real rigidities in the model because we distinguish Ricardian households and non-Ricardian households to take into account the reality of most of African countries. The Ricardian-households are allowed to participate in both labor (workers) and financial markets (entrepreneurs). They represent a small fraction of African households. However, the non-Ricardian households who represent the majority of African households are allowed to participate in labor market only. This is the main channel through which trade affects welfare of households in our model.

The fourth reason is related to existence of multi-sectorial setting in our model. The latter consists of traded-goods, non-traded goods, and natural resources goods. We assume here that the entire natural resources sector is mainly export-oriented to the rest of the world and heavily capital intensive from Foreign Direct Investment. This setting plays an important role on explaining the weak impact of intra-african trade volume on households' welfare because labor is not a factor of production of this sector (natural resources).

The last reason is related to the model itself. Our model is based on a three-country DSGE model with a rest of the world block which provides not only the majority of consumption goods in Africa, but also the capital as well as the intermediate goods. This last reason combined with the low intra-African trade volume constitutes the major barriers that should be removed in order to expect a sound impact of the AfCTA on African households. The African Union should propose an agenda to reach the objective of free agreement in long run by implementing a number of reforms as mentioned by Chang, Kaltani, and Loayza (2009).

Chang, Kaltani, and Loayza (2009)present a theoretical example in which the removal of barriers to trade needs to be accompanied by complementary reforms in non-trade areas if it is to improve productivity efficiency and growth. They find that trade openness is is associated with faster growth generally but, more importantly, that this positive effect can be significantly enhanced if some complementary reforms are undertaken. And these interactions are economically and statistically significant and robust to change in specification, econometric method, and openness measure. Those complementary reforms are educational investment, financial depth, inflation stabilization, public infrastructure, strong governance, labor market flexibility, ease of firm entry, and ease of firm exit.

Goff and Singh (2014) use a panel of African Countries over the period of 1981-2010 and testing for non-linearities in the trade-povety relationship find that trade openness tends to reduce poverty in countries where financial sector is deep, educational level high and institution strong.

5.1 Matching moments with data

We use the import tariff shock to generate Table 2 which compares the mean and standard deviation of macroeconomic aggregates of the model with the actual data. Theoretical moments perfectly matches the actual moments. There are some small differences in consumption and investment/GDP ratio, which are usual in DSGE models. However, results show that the model perfectly explains the actual data.

6 Conclusions

This paper attempt to quantify potential gains from the AfCFTA while accounting that African countries mostly produce and export natural resources or lower added values goods and import of final goods, mostly from non-African countries (>90%).

We use a three-country DSGE model that accounts for African households' particularity

Table 2: **Matching Moments**

	Data		**Model**	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
	(1)	(2)	(3)	(4)
GDP	4.560	4.072	4.517	4.070
CPI-Inflation	10.637	9.427	11.026	9.557
Investment	7.998	13.415	8.124	12.869
Investment/GDP	21.835	3.503	18.652	3.863
Real Interest Rate	6.365	6.610	6.352	6.843
Consumption	3.38	8.26	2.42	6.35

(real rigidities: two types of households (Ricardian and non-Ricardian)) and the structure of African Economies. We use two African countries and the rest of the world represented by China, India, the European Union, the USA, and other major non-African partners. Our setting maintains the tariff on goods from the rest of the world. Thereafter, we use a small open economy structural panel vector autoregressive (VAR) model to conduct the robust check of our results following Schmitt- Grohe and Uribe (2018) specification, which focuses on terms of trade shocks.

Our results reveal that, in the short run, following elimination of tariffs, output increases, terms of trade ameliorate, consumption increases, trade increases, but most of the impacts vanish very quickly, except for the appreciation of currencies in AfCFTA members.

Our main results confirm previous findings (Eaton and Kortum (2002), Caliendo and Parro (2015), Ossa (2011, 2014)) on multilateral trade agreement, in the short-run, which finds that trade liberation leads to smaller improvements in households' welfare when we consider the value added measure of output. Nevertheless, when we measure outputs by the total value, our results confirm the findings of Ganelli and Tervala (2015) that show a greater welfare gain after an elimination of tariff.

Because of the vanished impact in the long-run,we recommend the implementation of initiative to enhance manufacturing sectors and boost trade between the African countries that relatively depend more on non-African countries.

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