Disaggregating Underlying Drivers of Fruit and Vegetables Trade : an HS-level Modelling Analysis of the AfCFTA

Caitlyn Carrico[1], David Cui[2], and Andrzej Tabeau[3]

Abstract

With the introduction of the African Continental Free Trade Area (AfCFTA), there are expectations to boost interregional trade amongst other measures to increase interregional integration. In particular, the agricultural sector is anticipated to be an important beneficiary of the strengthening and development of interregional linkages from the advent of the AfCFTA. In our paper, we focus on the fruit and vegetables sector, and we implement a new extension of the MAGNET model (Modular Applied GeNeral Equilibrium Tool), a global computable general equilibrium (CGE) model, which has theoretical adaptions in order to model trade flows at the disaggregate HS-level. Fruits and vegetables are high-value crops, which many African countries are switching towards, diversifying their agricultural portfolios away from typical cash crops. In addition, while in many current standard CGE frameworks there is a single aggregate commodity "Veg & Fruit", in reality, the composition of the underlying products within this aggregate commodity can vary significantly. For this analysis we compare two scenarios: (1) a simulation of AfCFTA with the standard MAGNET model and (2) a simulation of AfCFTA with the HS-level modelling extension. Preliminary simulation results indicate a high difference between the two scenarios in terms of trade flows originating from Southern Africa which depend on several factors, including the tariff shock at the HS- versus GTAP- level, the underlying value of trade from Southern Africa, and the differing theoretical structure of the HS module.

Introduction

With the introduction of the African Continental Free Trade Area (AfCFTA), there are expectations to boost interregional trade amongst other measures to increase interregional integration. While agriculture remains a very important sector across the continent, employing and providing for over 60 percent of the continental active population (ILO, 2019), agricultural trade today most often occurs within regions. Therefore the agricultural sector is anticipated to be an important beneficiary of the strengthening and development of interregional linkages from the advent of the AfCFTA.

Global computable general equilibrium (CGE) models are uniquely positioned to analyze large, international agreements such as the AfCFTA, due to their ability to account for country and product coverage and to consider economy-wide effects and interlinkages. Over the years, there have been several CGE studies of the AfCFTA, including from the UN (Mevel and Karingi, 2013) and the World Bank (Maliszewska and Ruta, 2020). In our paper, we make two important contributions, topically, we focus on the fruit and vegetables sector, and,

[1] Wageningen Economic Research, The Hague, The Netherlands
[2] Wageningen Economic Research, The Hague, The Netherlands
[3] Wageningen Economic Research, The Hague, The Netherlands

technically, we implement a new extension of the MAGNET model (Modular Applied GeNeral Equilibrium Tool) (Woltjer and Kuiper, 2014) which implements theoretical adaptions in order to model trade flows at the disaggregate HS-level[4].

The HS-level disaggregation of fruits and vegetables is important for several reasons. Fruits and vegetables are high-value crops, which many African countries are switching towards, diversifying their agricultural portfolios away from typical cash crops. In addition, fruits and vegetables are important crops for food security and more particularly for nutrition security. In many current standard CGE frameworks where databases are derived from the GTAP Database (Aguiar et al., 2019), there is a single aggregate commodity "Veg & Fruit". However in reality, the composition of the underlying products within this aggregate commodity can vary significantly. Therefore, by disaggregating trade flows and the modelling at the HS-level, the underlying drivers of changes to trade in Fruit and Vegetables can be better identified.

Methods

Our extension of the MAGNET model to incorporate HS-level modelling is based on the GTAPv7-HS model (Aguiar et al., 2019). The GTAPv7-HS model is a hybrid version of the standard GTAPv7 model (Corong et al., 2017) that enables users to disaggregate the standard GTAP-level commodities into sub-commodities at the HS6 level. In our modified MAGNET model, we make modifications to the MAGNET core theory and adopt new introductions from the GTAPv7-HS model, including, the aggregate GTAP level, turning off the user-specific (top-level) Armington and replacing them with user-generic Armington model for all commodities.

Table 1. African Regions Modelled

Region	Full Title
UMA	Arab Maghreb Union
UEMOA	Union Économique et Monétaire Ouest Africaine
ECOWAS	Rest of Economic Community of West African States
ECCAS	Economic Community of Central African States
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
SADC	Southern African Development Community

For this analysis we run two simulations: (1) a simulation of AfCFTA with the standard MAGNET model and (2) a simulation of AfCFTA with the HS-level modelling extension. We aggregate African countries and regions from the GTAP level to the seven regions, as shown in Table 1. This regional decision was motivated based on existing regional economic communities, and it was additionally motivated by the decision was made to split out UEMOA

[4] Harmonized Commodity Description and Coding Systems (HS). https://unstats.un.org/unsd/tradekb/Knowledgebase/50018/Harmonized-Commodity-Description-and-Coding-Systems-HS

from ECOWAS, due to the high levels of intra-regional trade within ECOWAS and otherwise limited exports to other African regions, as shown in Table 2.

Table 2 shows the intra-continental trade for Fruits and Vegetables. Here we observe that UEMOA exports 4 million USD to UMA, 22 million USD within UEMOA, 29 million USD to Rest of ECOWAS, and only 1 million USD to ECCAS, COMESA, and SADC, each. Therefore it is evident that trade within West Africa far exceeds trade between West Africa and other regional economic communities.

Table 2. Fruit and Vegetable Trade between African Regions, million USD

	UMA	UEMOA	ECOWAS	ECCAS	COMESA	EAC	SADC
UMA	137	9	37	2	2	0	0
UEMOA	4	22	29	1	1	0	1
ECOWAS	3	6	10	1	1	0	1
ECCAS	7	0	1	5	0	0	0
COMESA	182	1	13	14	944	17	27
EAC	4	0	2	5	15	37	8
SADC	1	30	100	131	63	34	238

The implementation of the zero tariff shock differs by scenario. With activation of the HS module, HS-level (referred to as k-level) tariffs (tmsk) are shocked for Fruit and Vegetables, whereas the other aggregate commodities (OthFood, Energy, Mnfcs, Svces) are shocked at the aggregate level (tmsf). Variable tms is endogenous and dependent on these two variables. This differs from the MAGNET core model without the HS module where the shock is implemented entirely at the aggregate level via the tms variable.

Table 3. Variable tms for the Fruit and Vegetable Sector for Simulation without HS module, % change

tms	UMA	UEMOA	ECOWAS	ECCAS	COMESA	EAC	SADC
UMA	-0.46	-13.74	-7.06	-23.00	-5.68	-2.41	-0.77
UEMOA	-13.44	0.00	-3.51	-19.11	-8.80	0.00	-4.26
ECOWAS	-14.76	-3.12	-10.76	-3.47	-0.59	0.00	-1.73
ECCAS	-28.11	-11.14	-14.46	-6.01	-15.53	-9.84	-1.97
COMESA	-0.91	-16.10	-16.29	-21.98	-0.85	-4.01	-2.42
EAC	-5.57	0.00	-3.37	-8.34	-4.77	0.00	-4.22
SADC	-11.97	-16.51	-16.36	-30.55	-1.80	-18.18	-1.86

In Table 3, we see the shocks imposed via variable tms to calculate the zero tariffs in the MAGNETv7 core only. Table 4 shows the k-level shocks imposed via variable tmsk for the first 10 out of 105 HS6 codes over which the Fruit and Vegetables sector is defined, and specifically on imports coming from region SADC. We can compare this to the bottom row in Table 3, which shows the change in aggregate tariff on Fruits and Vegetable imports from SADC. From this comparison, we can see that how the shocks become more precise (and more varying) at the disaggregate HS6 level.

Table 4. Variable tmsk for the Fruit and Vegetable Sector for Simulation with HS module, % change

tmsk	UMA	UEMOA	ECOWAS	ECCAS	COMESA	EAC	SADC
x070110	**-4.09**	**-4.77**	**-5.61**	**-27.85**	**0**	**-19.83**	**-1.14**
x070190	**-16.77**	**-16.7**	**-16.52**	**-32.78**	**-0.08**	**-19.83**	**-4.16**
x070200	**-16.77**	**-16.7**	**-16.52**	**-30.31**	**-5.76**	**-19.83**	**-4.77**
x070310	**-16.77**	**-16.7**	**-16.52**	**-33.14**	**-0.02**	**-19.83**	**-5.55**
x070320	**-16.77**	**-16.7**	**-16.52**	**-32.14**	**-0.02**	**-19.83**	**-1.44**
x070390	**-16.77**	**-16.7**	**-16.52**	**-33.05**	**-2.77**	**-19.83**	**-7.75**
x070410	**-14.73**	**-16.7**	**-16.52**	**-30.06**	**-1.9**	**-19.83**	**-1.8**
x070420	**-14.73**	**-16.7**	**-14.27**	**-29.88**	**-1.38**	**-19.83**	**-2.75**
x070490	**-14.73**	**-16.7**	**-16.52**	**-29.98**	**-13.53**	**-19.83**	**-0.51**
x070511	**-14.73**	**-16.7**	**-16.52**	**-27.14**	**-1.03**	**-19.83**	**-5.18**

Preliminary Results

With the scenario implemented, comparative results can be assessed. We being with macro level results. Table 5 shows the comparative results for GDP growth under each scenario. For both results, GDP gains are small at less than 1%. Comparatively, GDP gains are slightly higher in the simulation without the HS module, with the exception of UMA and SADC.

Table 5. Comparative GDP Results for Simulations with and without the HS module, % change

qgdp	With HS Module	Without HS Module
UMA	0.023	0.008
UEMOA	0.387	0.489
ECOWAS	0.014	0.034
ECCAS	-0.012	-0.008
COMESA	0.006	0.012
EAC	0.012	0.028
SADC	0.106	0.079

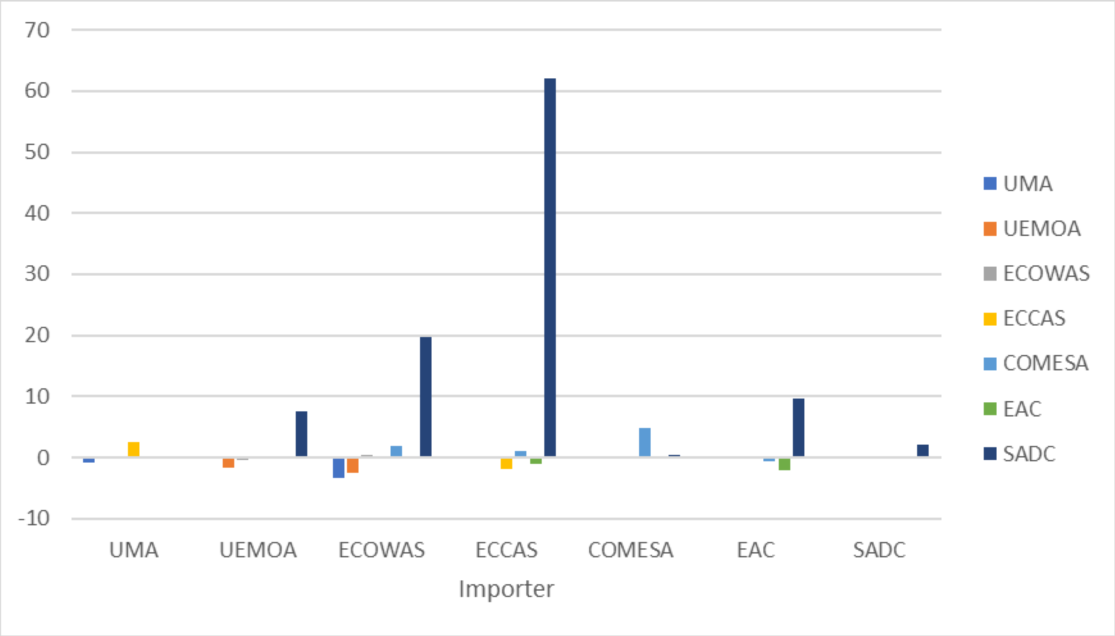
Table 6. Comparative V_F Production Results for Simulations with and without the HS module, % change

qo	With HS Module	Without HS Module
UMA	0.00	-0.06
UEMOA	-0.65	-1.01
ECOWAS	-0.04	-0.04
ECCAS	-1.04	-1.14
COMESA	0.01	0.00
EAC	-0.09	-0.13
SADC	0.93	1.54

We consider the comparative results for Fruit and Vegetable Production in Table 6. Across both scenarios, production tends to decrease slightly, with the exception of COMESA and SADC. Overall, in the simulation with the HS module, these decreases tend to be less than in the simulation without the HS module.

In Figure 1, we look at differences in trade results for the fruit and vegetable sector. In particular, we consider the difference in the change in imports in million real USD. We see that, across all importers, for the simulation without the HS module, Fruit and Vegetable imports from SADC tend to be much higher and from COMESA slightly higher, when compared to the simulation with the HS module. Imports from other destinations tend to be comparatively lower without the HS module. This explains the relative higher production for SADC in the simulation without the HS module (Table 6), as SADC is exporting relatively more and so is also producing relatively more to meet this foreign demand.

Figure 1. Difference in Fruit and Vegetable Imports (without HS module – with HS module), million real USD



The high difference in imports from SADC and, in particular, to ECCAS depends on several factors, including the tariff shock at the HS- versus GTAP- level, the underlying value of trade from SADC, and the differing theoretical structure of the HS module such as the introduction of a super-agent with sourcing decisions made at the HS-level. There is variability of tariff shocks across the HS sectors as opposed to the single shock applied to the aggregate GTAP-level sector. Further, ECCAS is the largest export destination for SADC exports of fruits and vegetables, with 131 million USD traded in the base data (Table 2). Lastly, the HS-level sourcing affects the flexibility of the model, imposing a constraint in comparison with the standard model (without the HS-module), and yet this also presents a higher degree of realism as often the underlying goods aggregated within a GTAP-level commodity are not substitutable.

A clear benefit of the HS module allows users to analyse disaggregate trade results for the Fruit and Vegetable sector across HS6 level disaggregate commodities. We will take the example of imports across destination from source region SADC. We focus on three HS6 disaggregate commodities where there is a relatively large amount of trade: 070190, 070310, and 080810.

Table 7. HS level shocks to tariffs on imports from SADC

tmsk	UMA	UEMOA	ECOWAS	ECCAS	COMESA	EAC	SADC
x070190	-17	-17	-17	-33	0	-20	-4
x070310	-17	-17	-17	-33	0	-20	-6
x080810	-8	-17	-16	-29	-1	-20	-3

In Table 7, the k-level shocks are shown for these three commodities. There appears to be come variation in the shocks, though it is minimal. Table 8 shows the percent changes in imports from SADC, across importers. While there are several large changes, it is important to take this in the context of the relative sizes of trade flows in the HS level data.

Table 8. HS level changes in imports from SADC, % change

qxsk	UMA	UEMOA	ECOWAS	ECCAS	COMESA	EAC	SADC
x070190	87	89	69	101	-4	114	8
x070310	82	86	75	124	-12	103	10
x080810	29	53	40	83	0	50	5

Table 9 shows the underlying HS level data from the base data (header VMSBK). Here, we see that ECCAS is an important importer across these three commodities from SADC. Further, commodity 080810 is an important export good for SADC. Elsewhere, not very high levels of imports from SADC for these three commodities.

Table 9. HS level imports from SADC in the base data, million USD

VMSBK	UMA	UEMOA	ECOWAS	ECCAS	COMESA	EAC	SADC
x070190	0	0	0	23	1	0	33
x070310	0	0	0	29	3	0	15
x080810	0	24	87	46	16	20	23

Taking information in Tables 8 and 9 into account, we compute the import growth at the HS level in million real USD. Therefore, we see that although there are some very high percentage changes in Table 8, this can be contextualized with the information in Table 9, so that Table 10 provides the clear picture of relative import growth at the HS level.

Table 10. HS level changes in imports from SADC, million real USD

	UMA	UEMOA	ECOWAS	ECCAS	COMESA	EAC	SADC
x070190	0	0	0	23	0	0	3
x070310	0	0	0	36	0	0	2
x080810	0	13	35	38	0	10	1

Overall, macro-level GDP and production results from the two simulations do not differ substantially, though this also has to do with the experiment set-up which resulted in low level macro results. Results for alternative scenarios and alternative disaggregate sectors may show more pronounced results. Nonetheless, the benefit of the HS module is the ability to perform analysis at a disaggregate level. While initial results (e.g. changes in trade growth) may appear significant across HS commodities, it is important to bear in mind that the program is spreading trade over a large number of disaggregate commodities which results in many very small numbers, and therefore it is especially important to account for the underlying levels of trade in an HS level analysis.

This illustrative analysis was done with shocks computed to implement zero tariffs between regions. However, another strength of the HS module is that shocks can be completely tailored at the HS6 level. This would facilitate an in-depth analysis of a trade agreement where certain HS6 level commodities may face partial tariff reductions whereas others would face full tariff reductions (detailed changes to the market access schedule).

Preliminary Conclusions

Preliminary simulation results indicate a high difference between the two scenarios in terms of trade flows originating from Southern Africa which depend on several factors, including the tariff shock at the HS- versus GTAP- level, the underlying value of trade from Southern Africa, and the differing theoretical structure of the HS module such as the introduction of a super-agent with sourcing decisions made at the HS-level. In particular, there is variability of tariff shocks across the HS sectors as opposed to the single shock applied to the aggregate GTAP-level sector. Additionally, the HS-level sourcing affects the flexibility of the model, imposing a constraint in comparison with the standard model (without the HS-module), and yet this also presents a higher degree of realism as often the underlying goods aggregated within a GTAP-level commodity are not substitutable.

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