Macro-Economic Effects of COVID-19 on Food Insecurity: Evidence from Select COMESA Countries

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Abstract
Globally, the COVID 19 outbreak and its subsequent containment measures have greatly disrupted regional and global food supply chains posing a big threat to food security. Our study examines the macroeconomic effects of the COVID 19 pandemic on food insecurity in the COMESA region. The study adopted a pooled mean Autoregressive Distributed Lag model (ARDL) to estimate the impact of macro-economic factors on food insecurity in the face of COVID 19 pandemic in the select COMESA countries. Our results reveal a significant long run relationship between food insecurity and food inflation, food trade and COVID 19 registered cases in the COMESA countries. These findings point to the need by governments to; implement standard operating procedures (SOPs), roll out vaccinations to curtail the wide spread of the pandemic while providing safety nets to support the poor vulnerable communities to purchase food. Furthermore, the COMESA members need to pursue a coordinated strategy for food security to enhance intra-regional trade, food distribution and production.

Keywords: Macroeconomic Effect; Food Security; COVID-19; COMESA; Pooled Mean ARDL
JEL Classification Codes: C20, I18, Q18

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1. Background

More than half of Africa's population is food insecure, 90 percent of whom are from Sub-Saharan Africa (SSA) (FAO, 2020a). Worse still, SSA is the only sub-region with a reported rise in the number of stunted children, mostly in rural and poor households *(ibid).* Traditionally, challenges in physical access to and availability of adequate and nutritious food in the region have been attributed to climatic and conflict shocks such as wars, droughts and flooding (FAO, 2020a; FAO, 2006). Since the advent of globalization, food security has increasingly become an economic rather than just an agricultural issue. It is increasingly being influenced by a combination of macroeconomic factors such as food trade policies and international exchange rates (Erokhin & Gao, 2020). Notably, evidence shows that food shortages exist in deficit countries with limited cross-border distribution of food from food surplus regions (World Bank, 2015). This underscores the key role of effective trade and food distribution systems in addressing food security, especially in food importing regions.

Africa is a huge net food importer. She imports 85 percent of her food at an estimated import bill of USD 45 billion (ITC, 2020). This is projected to reach USD 110 billion by 2025 (Purchase, 2017). Conversely, the Common Market for Eastern Southern Africa (COMESA) region's food imports were estimated at USD 14.2 billion while food exports were estimated to be USD 7.2 billion in 2019 (*Ibid)*. Further, COMESA's 17 out of 19 member states are classified as Low-Income Food-Deficit Countries (LIFDCs) based on the Word Bank's eligibility requirement for International Development Assistance (IDA) (FAO & WFP, 2020). Despite her enormous agricultural potential, the region imports basic food stuffs such as cereals, vegetable oils, sugar, meat and dairy products from Europe (45%), Asia (30%) and Latin America (5%) (ITC, 2020). This over-reliance on extra-regional food imports makes the COMESA region vulnerable to disruptions in international food supply and escalates the food insecurity situation in times of crises.

The recent outbreak of the COVID-19 pandemic has exacerbated the food insecurity situation in the COMESA region through several ways; first, transport restrictions imposed to slow the spread of COVID 19 hampered the the movement of food and labour along supply chains, especially during the lock down period between March and June 2020. Consequently, global food prices were driven up to a 6-year high (FAO, 2020b). In the COMESA region, data shows that year on year food prices rose by 38.8 percent in June 2020, with the highest inflation rates recorded in food deficit countries such as Zimbabwe (1,934.5%), Sudan (136.0%) and South Sudan (42.2%) (COMESA, 2020; Trading Economics, 2020). This rise in food prices was attributed to panic buying, transport restrictions and high price for food imports due to depreciation (Blanke, 2020; Cuts international, 2020).

More importantly, evidence shows that the COVID 19 pandemic's most prominent impact on food security has been through the food access dimension (Laborde *et al*., 2020). FAO's price reports[1] show that income declines owing to massive layoffs and agricultural losses have not only reduced demand for food but also induced shifts in the food consumption from high nutrient foods to high calorie staple foods. For instance, the World Bank (2020) estimates show that 276 million people (77 percent) of the total population of 358 million across the 4 countries of Uganda, Ethiopia,

[1] FAO (2020). Regional round ups. http://www.fao.org/giews/food-prices/regional-roundups/detail/en/c/1364061

Malawi and Nigeria suffered income losses as a result of the COVID-19 containment measures. In contrast to developed countries (e.g. UK, Germany and USA), most African and COMESA countries did not provide social safety nets to soften the impact of the pandemic on poor households which spend 70 percent of their income on food consumption (Laborde *et al*., 2020).

Several studies have analyzed the food security implications of the COVID 19 pandemic. Notably, research by Kansiime *et al*. (2020) and World Bank (2020) analyzed the impact of COVID 19 on the household food security in Uganda, Kenya, Nigeria, Uganda, Malawi and Ethiopia. However, these studies largely used micro-level household data, yet, evidence shows that COVID 19 pandemic has had a great impact on the macro-economic parameters such as inflation rate, nominal exchange rate and food trade balance which equally affect food security, especially for net food importers. To the best of our knowledge, no studies have explored how macroeconomic factors interplay with food security particularly in the context of COMESA region. Yet empirical evidence to inform the right policies to address food security challenges is highly imperative at both national level and household levels.

To address these gaps, our study utilized multi-country level data to empirically examine the macro-economic effects of COVID 19 on food insecurity in the COMESA region. Specifically, the study aimed to: first, assess the impact of the COVID 19 prevalence on food insecurity in the COMESA region; second, to investigate the relationship between food trade balance on the food insecurity among the COMESA member states; third, to establish the relationship between nominal exchange rates and food insecurity in the COMESA region; and fourth, to examine the effects of food inflation on food insecurity.

The rest of the paper is organized as follows; Chapter two reviews related literature on the relationship between macro-economic factors, COVID 19 and food insecurity. Chapter three outlines the data and methodology used in the study. Chapter four presents the results and their discussions while chapter five presents the conclusions and policy recommendations from the study.

2. Literature review

In this section, we synthesize the nexus between the macro-economic variables; food inflation, nominal exchange rates, COVID 19 prevalence and food insecurity in the context of COMESA region. Several scholars have examined the relationship between food insecurity and different the macroeconomic variables; inflation, food trade and exchange rate however little is covered on the impact of COVID 19 induced macroeconomic effects on food insecurity.

Regarding trade, past studies have examined the impact of trade on food security by analyzing the effect trade openness in contrast to protectionism pursued by various countries or regional bloc in the quest to remain food secure. For instance, Dorosh *et al*. (2016) using the cointegration analysis explored the role of food imports (maize and sorghum) in mitigating food insecurity in South Sudan. Results from their study revealed that a one-third decline in supply of cereal imports increased food prices by more than 45 percent in the domestic market, hence worsening food insecurity in the country. On the contrary, using the vector error correction model, Khalid et al. (2020) did not find any long run relationship between regional trade and food security in South Asian Association for Regional Cooperation (SAARC). Whereas these studies provide an insight into the relationship between trade and food security, it is not known whether the relationship would be maintained during a global pandemic like COVID 19.

The debate on whether trade protectionism improves food security is still ambiguous. For instance, Morrison and Sarris (2007) argue that agricultural led growth require significant government intervention at early stages of development to alleviate the pervasive nature of market failures such as weak input markets and limited seasonal financing of risk management instruments. On the contrary, Chapoto and Jayne (2009) in their study on the effect of restrictive and trade openness food trade policies in the East and South African countries (ESA) find that protectionism has a destabilizing effect on food prices and market predictability, resulting into a decline in food production which threaten their food security. These results are consistent with findings by Porteous (2017) who found that export ban in ESA drove up food prices by 5 percent hence worsening food insecurity. Further, Doroth *et al*. (2016) argue that export bans cause uncertainty in food markets which deters traders from importing food, leading to price spikes in the long run.

Regarding food inflation, previous studies (Gustafson, 2011; Zezza *et al*., 2008; Mkhawani *et al*., 2015; Julia *et al*., 2015; Stacey and Shahla, 2008) have revealed that food price spikes create winners and losers. Evidence shows that food price volatility can worsen the challenges of food insecurity and poverty. Gustafson (2013) found that food inflation has far reaching impacts on food security but also the extent of this impact varies across socioeconomic groups and countries depending on their degree of vulnerability. Green et al. (2013) adopted systematic review of meta-regression approach to examine the effect of rising food prices on food consumption in 162 countries globally. Their results suggest that a 1 percentage increase in prices of all foods results in greater reductions in food consumption in poor countries (0.61 percent) compared to high income countries (0.43 percent). Furthermore, Zezza *et al.* (2008) assessed impact of rising prices on the poor on a sample of 11 countries in East Asia and Sub-Saharan Africa. Their findings suggest that vulnerable households (especially those headed by children, females and the elderly) are the hardest hit by price shocks given their disproportionate share of food budget. They further found that these vulnerable households change their consumption patterns, sell physical assets to buy food or forego health care and education services as a copying mechanism to the price shocks (*Ibid)*.

Relatedly, Mkhawani *et al*. (2015) assessed the impact of rising prices on female headed households' food security in South Africa. Their study revealed that majority of the female headed households (58 percent) had shifted their consumption patterns from variety of foods to cheaper brands that were less nutritious. Further, Jacobs (2015) in his study on the impact of the 2007-2009 economic slowdown on food security in South Africa found that food inflation increased hunger prevalence by 2-3 percentage points, with female headed households being the most affected. His study further revealed that the affected households substantially increased the proportion of income spent on food as a copying strategy for rising food prices.

Furthermore, rising cereal prices in Ethiopia were associated with decline in the number of household meals per day but price shocks had no significant impact on diet diversity and calorie consumption (Julia *et al*., 2015). Stacey and Shahla (2008) examined the impact of rising food prices on food Insecurity in developing countries. Their findings revealed that high food prices intensify food insecurity especially in import dependent countries although their study also pointed out presence of a silver lining in the food prices rising. More succinctly, in developing countries with supportive economic policies and technological adoption, high food prices could boost domestic production which enhances food security in the long run. In terms of exchange rates, WFP (2019) revealed that exchange rates have influence food prices resulting into changes in access to food. Specifically, depreciation of domestic currency renders food imports expensive, hence affecting the availability of variety of food. This results into substitution of food imports with less expensive ones and shifting consumption patterns. Currency depreciation renders exports more competitive, hence increasing the export demand and driving up domestic prices.

Erokhin & Gao (2020) evaluated the impact of trade aspects and food security in 45 countries in the wake of COVID 19 using the Autoregressive Distributed lag (ARDL) model. Their results show that COVID 19 impact on food insecurity tends to be more significant in low income and middle-income countries than in developed countries despite the high level of prevalence of the pandemic. The study also revealed that the COVID 19 induced inflation worsened food insecurity while trade restrictions and currency depreciation increased food shortages in developed countries. Their results are consistent with findings by Udmale *et al*. (2020) which show that low income African and Asian countries are likely to disproportionately suffer food insecurity compared to developed countries which are resilient to food supply shocks. Borrowing from the previous pandemics, Fan and Youmei (2020) found that the restrictions such as quarantine to curtail the spread of the Ebola in West African countries of Guinea, Liberia and Sierra Leone drove up food prices by 24 percent. In addition, the outbreak worsened individual employment by 24 percent forcing some households to cut food intake (Bowles *et al*., 2016).

This study contributes to the existing literature on food insecurity as follows: First, it employs a pooled mean ARDL model analysis which is suitable for panel data on food insecurity; it accounts for dynamic and heterogeneity features of the data series across the panel of countries. This analysis gives an in-depth perspective on how the COVID 19 pandemic has effected food security across the different COMESA member states. Secondly, given that most food security studies analyses have utilised household level data, the study gives an opportunity to analyse COVID 19 impact from macro-economic lens by assessing direct effect of COVID 19 prevalence and macro-economic variables in COMESA countries on food insecurity.

Whereas there exists some evidence on the link between food insecurity and macro-economic variables such as Erokhin & Gao (2020), their results are general and inconclusive. Specifically, their study gave general results for developed, developing and middle income countries without exploring country specific differences which our study addresses. Moreover, the time series analysis of their study was based on a short time span of 6 months (January-June 2020) which limits the reliability of the long run estimates given. This study covers a longer time span of 12 months, since the onset of the pandemic to give more reliable estimates with respect to the COVID 19 prevalence and its impact on food security status in the COMESA region.

3. Methodology

3.1 Data and sources

The study examines the relationship between food insecurity and macro-economic variables in the 5 selected COMESA countries; DRC, South Sudan, Mozambique, Zambia and Zimbabwe. Whereas, the choice of the countries was informed by data availability, the selection of macro-economic variables draws on the approach by Heseynov (2019) who modelled food security with inflation, exchange rates and food trade balance.

This study used food insecurity as the dependent variable. The World Food Programme Hunger map (WFP, 2021) defines food insecurity as the number of people with poor or borderline consumption. In addition, the COVID-19 prevalence is measured by the number of COVID-19 infection cases registered on a monthly basis in the selected COMESA countries. Food trade balance depicts the level of dependency on food imports in the select countries and shows changes in food supply (availability) in the select countries. Nominal exchange rates and food inflation show changes in food access in the selected country. Table 1 shows the detailed description and definitions of these variables under study.

The study used a panel data across the 5 select countries over the period of 12 months - January 2020 to December 2020. This implies 60 observations which are sufficient to conduct panel data analysis. The period of analysis (January-December 2020) by the fact that the first COVID 19 case was first confirmed outside China in January according to the World Health organization (WHO, 2020). The data used in the study was obtained from different secondary data sources. Data on food insecurity was be extracted from the World Food Programme's Hunger map (WFP, 2021). The nominal exchange rate data was obtained from the IMF website on International Financial statistics while data on food inflation and food trade balance were extracted from Trading Economics and the ITC Trade map websites respectively. Data on COVID 19 prevalence in the select countries was extracted from the Worldometer website that publishes periodic COVID-19 registered cases across all the countries globally.

Table 1: Description of variables

Index	Variable	Unit of measure	Definition	Source
Y	Food insecurity	Millions of people	The number of people with poor or borderline food consumption reported per month	WFP (2021)
X1	COVID 19 prevalence	Number of cases	Number of COVID confirmed cases in a member country reported monthly	Worldometer website
X2	Food trade balance	USD	The value of exports less imports of food reported monthly	ITC (2021)
X3	Food inflation	Percentage	The month on month percentage change in the price of standard basket of commodities calculated from the national consumer price index	Trading Economics (2021)
X4	Nominal exchange rate	Monetary units	Price unit of domestic currency in terms of USD reported per month	IMF (2021)

3.3 Model specification

The econometric model is based on the theoretical framework that assumes a small open economy, true for most COMESA countries. Consider a constant to scale macro-economic production function given by;

$$Y = F(L, K) \quad (1)$$

Where Y is the total food supply/production, K is the inputs of capital, and L is labour employed in the food production. The total cost (TC) function represents the total costs paid for the inputs used in food production

$$TC = wL + rK \quad (2)$$

Where w is the wage paid for the labour in production, r is the rental income for hiring capital

The profit function is derived from the multiplying the price and the production quantity of food.

$$\pi = \mathrm{PY} - (\mathrm{wL} + \mathrm{rK}) \quad (3)$$

Assuming an imperfect market, the profit maximization first order condition is given by;

$$\frac{\delta\pi}{\delta Y} = \frac{\delta P}{\delta Y}Y + \frac{P\delta Y}{\delta Y} - w\frac{\delta L}{\delta Y} + r\frac{\delta K}{\delta Y}$$

$$= -\frac{1}{d_1}Y + P - (w\frac{\delta L}{\delta Y} + r\frac{\delta K}{\delta Y})$$

$$= 0$$

$$P = \frac{1}{d_1}Y + MC \quad (4)$$

The demand for the agricultural food is given by general demand function;

$$Y^d = d_0 - d_1P + d_2Z \quad (5)$$

Where P denotes the agricultural food prices, d_0, d_1 d_2 are the price sensitivities to changes in the total food supply (availability and accessibility) Y^d is the total food supply, Z is the vector of other variables that have an impact on food markets such as the exchange rates, inflation and interest rates and price of substitute products among others.

Following the theoretical framework highlighted above, we estimate the COVID 19 induced effects on food insecurity, Y_t using a panel auto-regressive distributed lag model (ARDL) which takes the form;

$$\Delta Y_{i_t} = \beta_i + \sum_{j=1}^{p} \beta_{1ij} Y_{it-j} + \sum_{j=1}^{q1} \emptyset_{1ij} \Delta X_{it-j} + \sum_{j=1}^{q2} \rho_{1ij} \Delta X_{2t-j} + \sum_{j=1}^{q3} \gamma_{1ij} \Delta X_{3t-j} + \sum_{j=1}^{q4} \pi_{1ij} \Delta X_{4t-1} + \varphi_i Z_{t-1} + \varepsilon_{it-1} \quad [6]$$

Where β_i represents the fixed effects of the model, $\beta_1\emptyset_1\rho_1\gamma_1\pi_1\varphi_1$ are lagged coefficients of the independent variables , Δ is the first difference operator, i represents the different COMESA countries, t is the time period 1, 2, 3…12 and X_s are the different covariates. The values p, q are the lags of the dependent and independent variables respectively, $\varphi_i Z_{t-1}$ is the Error correction term (ECT) of the model, ε_{t-1} is the error disturbance. To estimate the Panel ARDL, we use pooled mean group estimator as recommended by Pesaran and Shin (1999) because it combines the over conventional and pooling of coefficients. The technique is also efficient for cross-sectional data of small sizes (N) just like the case for this study. The model estimation of the study takes three stages as indicated in Table 2

Table 2: Stages of the analysis

Stage	Method	Results
1	The IPS and LLC tests of panel unit root tests by Im, Pesaran and Shin (2003) and Levin, Lin and Chu (2002) to test unit roots	Identify the order of integration of the panel group data
2	Cointegration-Stationarity tests by Pedroni and Kao based cointegration tests	These are used to ascertain possible long run association between Y and Xs
3	Pooled mean estimator ARDL	This estimates the interactions between the dependent variable (food insecurity) and regressors (Xs)

Source: Authors' own construct based on literature review

In the first stage, the variables were subjected to a stationarity test as a pre-condition for establishing the co-integration for each variable in the model. We employed the Im, Pesaran and Shin (IPS) and Levin, Lin and Chu (LLS) tests to establish group stationarity of the series. Noteworthy, these tests take the framework of the ADF Dickey and Fuller unit root analysis (1981) indicated in equation 2.

$$\Delta Y_{it} = \emptyset_i\beta_i Y_{t-1} + \sum_{i=1}^{m}\gamma_i\,\Delta Y_{t-i} + \varepsilon_{it} \qquad [7]$$

Where both tests test the hypothesis the null hypothesis of $\emptyset_i$=0 (m=1) against the alternative that $\emptyset_i$<0 (m<1).

At stage 2 of the analysis, after confirming the order of integration to be both I (0) and I (1) making it suitable for pooled mean ARDL estimation, we apply the long run cointegration tests to establish the long run relationship between food insecurity and other macro-economic variables. Specifically, we use the Pedroni (1999, 2004) and Kao (1999) panel cointegration tests. The alternative cointegration test is the Westerlund (2007) however we opted not to use this test given that it is inappropriate for small samples of less than 100. The Pedroni (1999, 2004) and Kao

(1999) tests are based on the panel-data model for I (1) dependent variable, and tests the null hypothesis of no cointegration against the alternative of cointegration.

4. Results

4.1 Descriptive analysis

In this section, we provide the panel data properties of all the variables used in this study. Table 3 presents the summary statistics for all the variables used in the study. On average, the five selected COMESA countries had an estimated 12.7 million people experiencing food insecurity in the period January-December 2020. Relatedly, the incidence of food insecurity greatly varies among the select countries as shown by a high standard deviation of 12.8 million food insecure people. Specifically, the population of food insecure people ranged from 1.8 million in Zambia to 45.5 million in DRC (Table 3). DRC had the lowest food trade balance with deficit of USD 42.5 million while South Sudan had the largest food balance with a food deficit of USD 3.95 million (Table A3). The high food trade deficit in DRC points to the country's big population estimated at 86 million which pushes up the demand for food imports. Food inflation averaged 157.9 percent with highest rates in Zimbabwe (980.4 percent) and lowest in South Sudan (-4.0 percent) (Table A5). High inflation rates in Zimbabwe can be explained by the unstable macro-economic environment which was further exacerbated with the onset of the pandemic. Regarding the COVID 19 prevalence, the cumulative cases between January- December ranged from 0 to 20,725. More specifically, all countries had no registered COVID 19 cases in January 2020 while Zambia registered the highest COVID- 19 cases (Table A3).

Table 3: Summary statistics of the selected COMESA countries

Variable	Mean	Min	Max	S.D
Food insecurity (Millions of people)	12.7	1.80	45.50	12.87
Food trade Balance (‘000’USD)	-27,799.2	-70,412.0	-91.0	21,728.4
Food inflation (%)	157.9	-4.0	980.4	302.9
COVID19 (No. of active infections)	4,133.0	0.0	20,725.0	5,326.2
Nominal exchange rate (%)	96.8	17.4	177.1	46.0

Source: Authors’ own computation based on data from WFP, IMF and ITC

Table 4: Correlation between food insecurity and different independent variables

Variable	LogFood insecurity	Log food inflation	LogNominal exchange rate	LogCOVID 19	Trade balance
Log Food insecurity	1.000				
Log food inflation	0.405	1.000			
Log nominal exchange rate	-0.461	-0.464	1.000		
LogCOVID 19	0.123	0.004	0.221	1.000	
Food Trade balance	-0.578	0.472	0.047	0.069	1.000

Source: Authors' own computation

4.2 COVID 19 prevalence, macro-economic indicators and food insecurity

To establish the causal association between any two variables in the analysis, but also examine the possibility of multi-collinearity to avoid inconsistent and inefficient estimators, we employ the pairwise correlation test. The results presented in Table 4 reveal a linear relationship between the variables. More precisely, food insecurity has a positive relationship with food inflation, nominal exchange rate and COVID 19 prevalence. On the contrary, food trade balance is negatively related to food insecurity. Noteworthy, the degree of association between any two variables is less than 0.8 in absolute terms which is a requirement for no multicollinearity (Studemund, 2001). Consequently, all the variables are considered for other tests of stationarity and regression analysis.

4.3 Stationarity and cointegration tests

Prior to estimating the model, we assessed the stationarity properties of all the variables as a pre-condition for estimation of the model. We test for unit root in the group of panel series using the IPS and LLC tests panel unit root tests proposed by Im, Pesaran and Shin (2003) and Levin and Chu (2002), respectively to establish the stationarity of the data series. Table 5 shows results from the stationarity test across the 5 countries. The results suggest presence of stationarity of I (0) or I (1) of all the variables, confirming appropriateness for the panel ARDL estimation to establish for co-integration.

Table 5: Panel Unit Root tests

	Level I(0)		First difference I(1)		
Variable	**IPS**	**LLC**	**IPS**	**LLC**	**Order**
Log Food insecurity	-1.886	-0.0877	-14.087***	-10.001***	I(1)
Log COVID 19	-5.6382***	-2.8954***	-14.855***	-0.9733***	I(0)
Log Nominal exchange	-1.7153	-0.0943	-4.86***	-0.9311***	I(1)
Food inflation	-1.7153	-0.087	-101***	-0.9312***	I(1)
Food trade balance	-2.161	-0.1299	-9.41***	-1.133***	I(1)

Note: *, ** and *** indicate significant at the 1%, 5% and 10% level of statistical significance

Further, we apply the Kao and Pedroni cointegration tests to examine the long run cointegration between the food insecurity and the independent variables. Table 6 shows the results from the two tests that confirm presence of a long run relationship between food insecurity and macro-economic variable and COVID 19 prevalence.

Table 6: The Pedroni cointegration test

Pedroni test	t Statistic
Modified Phillips-Perron	2.5404***
Augmented Dickey-Fuller	-1.918***
Phillips-Perron	-1.4237**

Note: *, **, and *** significant at the 1%, 5% and 10% level of statistical significance

Table 7: The Kao cointegration test

Kao test	t Statistic
Modified Dickey-Fuller	-2.2401***
Augmented Dickey-Fuller	2.195**
Dickey Fuller test	3.2456**

Note: *, **, and *** significant at the 1%, 5% and 10% level of statistical significance

4.4 Model estimation

The results in Table 8 are estimates for the short run and long run relationships between food insecurity and the independent variables. In order to select the best model that fits the data series, the three possible models - the pooled mean group (PGM), the mean group (MG) estimator, and the dynamic fixed effects estimator (DFE), were compared using the Hausman test. Specifically, the null hypothesis states that there is no systematic difference between the model estimates and the parameters. Accordingly, the results from the Hausman tests fail to reject the null hypothesis and to select PGM (model 1) as a better estimator. Following these test results, we discuss the results from the study based on the pooled mean group (Model 1). Specifically, the results suggest a statistically significant relationship between food insecurity and the variables of prevalence of COVID 19, nominal exchange rate, trade balance and inflation in the period of January - December 2020.

Variable	PMG (Model 1)	MG (Model 2)	DFE(Model 3)
Long run			
Log Covid19	0.0003***	-0.0008	-0.0002
	(-0.0006)	(-0.0005)	(-0.0001)
Log Nominal exchange	-0.0015	0.0892	0.0310***
	(-0.0005)	(-0.3512)	(-0.0109)
Trade balance	-7.4826***	18.8253	-7.8360*
	(-1.8497)	(-13.8282)	(-4.7412)
Log Food Inflation	0.0107***	0.7949	-0.0006
	(-0.0001)	(-0.0005)	(-0.006)
Short run			
D. Log COVID 19	0.0001	-1.2887	-0.0002
	(-0.0002)	(-0.4099)	(-0.0001)
D. Log Nominal exchange	0.7133***	-2.6408	0.0052
	(-0.2894)	(-2.5997)	(-0.0067)
D. Trade balance	-0.3164	-1.35041	-2.2251
	(-2.1988)	(-1.552)	(-1.4541)
D. Log Food Inflation	-0.0432	0.6312	0.0027
	(-0.42)	(-0.6502)	(-0.0036)
Constant	4.0896	33.9358*	0.1624*
	(-2.694)	(-17.8584)	(-1.9303)
Error correction term(ECT)	-0.4401***	-1.2887	-0.4362***
	(-0.1501)	(-0.4099)	(-0.1306)
N(Obs)	55	55	55
Hausman statistic	PMG Versus MG		PMG Versus DFE
Chi 2(4)	0.49		0.87
Probability	0.9216		0.8316

Table 8: Regression Analysis (Dependent variable: Log food insecurity)

PGM (Pooled mean group estimator), MG (Mean group estimator), DFE (Dynamic Fixed effects model. Standard errors are reported in the parentheses.

4.5 Discussion of results

The results (Model 1) indicate the presence of a long run relationship between food insecurity and food inflation and COVID 19 prevalence in the five COMESA countries. Specifically, across all the five COMESA countries, the study finds a positive relationship between the number of COVID 19 cases and the food insecurity. Averagely, a 10 percentage increase in COVID 19 new infections induces a 3 percent increase in food insecurity in the selected countries. More importantly, the results suggest that this impact on food insecurity is worse in the long run, it increases from 1 percent in the short run to 3 percent in the long run (Table 8). These findings collaborate with the study by FAO & WFP (2020) that projected that pandemic is likely to worsen food insecurity situation in the long run due to sustained adverse effect of the pandemic on the household incomes. Torero (2020) estimated that an additional 38 - 80 million people in low income countries suffer food insecurity as a result of the implemented COVID 19 containment measures. Moreover, most COMESA countries had pre-existing calamities before the pandemic. For instance, Mozambique, South Sudan, Zambia and Zimbabwe had suffered the adverse effect of the African migratory locust outbreaks in 2019 and early 2020. In addition, South Sudan, Mozambique are still grappling with political and civil unrests that worsened the food insecurity crisis among the vulnerable households. Mozambique is still suffering the effects of the cyclones.

Contrary to findings by Omer *et al*. (2012), our study results suggest that exchange rate has no significant relationship with the food insecurity in the long run. These results could possibly be explained by the fact that most developing countries (except South Sudan) do not heavily depend on the global food markets for high value added foods such as wheat, tinned meat, and wheat flour whose prices are grossly affected by exchange rate fluctuations (Erokhin & Gao, 2020). This does not suggest that the low COMESA developed countries do not import foods stuffs. In fact, they are largely food importers but their food imports are mostly low value whose prices are not significantly affected by nominal exchange rates. On the contrary, their most household consumption was locally sourced especially during the COVID 19 pandemic.

The study results show that food insecurity is associated with increase in the domestic food inflation. More succinctly, a 10 percent increase in inflation, induces a 1 percentage growth in the prevalence of food insecurity in the selected COMESA countries. Noteworthy, the adverse impact of inflation on food security was more prominent in poorer countries. Put differently, poorer COMESA countries, the impact of high food prices on food insecurity was more severe than richer ones. For instance, considering the World Bank GDP per capita estimates as an indicator of poverty, DRC (USD 1,220) and South Sudan (USD 1,119) with the lowest per capita incomes experienced the most notable rise in number of people suffering food insecurity (Table A1). On the contrary, whereas Zimbabwe and Zambia experienced high inflation rates in the COVID 19 era, their pre-existing poverty rates were lower compared to DRC implying that the household food consumption patterns in these countries was not greatly affected by the hike in food prices. These results allude to the fact that massive layoffs especially in the informal sector coupled with price hikes due to limited food supply and panic buying limited vulnerable households from accessing food that meets their dietary needs.

We found a negative relationship between food trade balance and food insecurity. This confirms the fact the highly food import reliant countries in the COMESA region suffered high levels of food insecurity during the COVID 19 pandemic crisis. Specifically, these results suggest that countries with higher levels of cereal import dependence ratio (CIDR) according to WFP hunger map (2021); Mozambique (CIDR-50%) and DRC (CIDR- 40%) suffered higher levels of food insecurity (Table 1) compared to other less import reliant ones such as Zambia (Table A2-A6). This could be explained by trade barriers in agricultural products presented by the COVID 19. Notably, many countries instituted tight restrictions such as border closures and strict sanitary and phytosanitary standards (SPS) standards to mitigate the spread of COVID 19, however, these affected agricultural trade inflows in the food deficit countries, worsening food insecurity. For instance, South Africa which is one of the major sources for COMESA's food imports experienced a sharp decline in agri-food exports owing to a tight lockdown especially between April - May 2020 (Ngcakani, 2020; Philip, 2020).

5. Conclusion and policy recommendations

The study set out to establish the effect of COVID 19 pandemic and its induced macro-economic effects (food inflation, foreign exchange rates, and food trade balance) on food insecurity in five selected countries in the COMESA region. Results show that in the long run, food insecurity is significantly affected by food inflation, food trade balance and COVID 19 prevalence. On the other hand, the study finds no long run relationship between food insecurity and nominal exchange rates. In other words, findings suggest that households in COMESA mainly relied on locally available staple foods in the wake of the COVID 19 pandemic. Therefore, food price shocks were mostly due to domestic food inflation than exchange rate fluctuations tagged on food imports abroad. This situation made it extremely difficult for vulnerable households to access food that meets their dietary needs.

To mitigate the adverse the impact COVID spread on the food security, there is need to promote adherence to the standard operating procedures (SOPs). This will limit the further spread of the pandemic that is likely to hurt the economy and exacerbate food insecurity. More importantly, governments in the COMESA region need to fast-track vaccination programmes to all their citizens to minimise the severity of COVID 19 pandemic on their citizens but also prevent more severe lockdowns that further worsen food insecurity. In the short run, to mitigate the immediate effect of high food prices on food security on households, governments in the COMESA region need to provide safety nets targeting poor households to purchase food that meets their dietary needs. Specifically, cash and in-kind transfer programmes should be prioritized to prevent more households from falling into severe food insecurity

Additionally, there is need to strengthen data collection and early warning systems to inform on food prices and food security in the region. Timely collection and dissemination of data on food prices and stocks across border and inland points is critical for the real time response by governments to prevent food crises in deficit areas. Moreover, these systems can also address cases of panic buying in some areas where sellers hoard food commodities in anticipation of higher prices in the near future. We also recommend that governments boost their domestic agricultural production to stabilize food prices especially in the face of the shocks such as COVID 19. Strategies such as irrigation, improved seed multiplication and fertilizer usage will help to close the food supply gaps and reduce import dependency. At storage and distribution stages, the governments can pursue public-private partnerships (PPPs) in establishing grain warehouses, strategic food reserves to address the high postharvest losses estimated at 30-50% of the total harvest in the region. This infrastructure will also help to stabilize domestic food prices and render food more affordable for the poor households. Relatedly, COMESA region needs to pursue a coordinated approach to food security. This could entail the removal of food trade tariffs and non-trade barriers (NTBs) to promote intra-regional food trade. This would facilitate easy agri-trade among food deficit countries. Relatedly, relaxing of very strict sanitary and phytosanitary requirements (SPS) without compromising the food safety is also critical to ensure the distribution of food to food import dependent countries in the COMESA region. The coordination approach can also bar members from pursuing self-sufficient policies such as export bans that undermine food security in other member countries in the region.

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APPENDICES

Table A1: Country specific regression results based on PGM model **(Dependent variable: Food insecurity)**

Variable	**DRC**	**South Sudan**	**Zambia**	**Zimbabwe**	**Mozambique**
D. log Covid_19	0.0002	-0.0012	0.0986***	-0.0002***	-0.0002
	(0.0004)	*(0.2415)*	*(0.0645)*	*(0.0001)*	*(0.0005)*
D. log. Nominal	-0.0188	0.0009	0.1317	0.0533	3.4034***
exchange	*(0.0247)*	*(0.0006)*	*(0.1244)*	(0.0045)	*(0.1175)*
D. log Trade	-3.7342	-2.1134	8.3557***	-2.5939***	-1.4964
balance	*(2.5377)*	*(2.1076)*	*(2.5877)*	*(0.6478)*	*(1.3088)*
D. log Food	1.3223***	0.0098	-0.2348***	0.0032***	-1.3167
Inflation	*(0.6429)*	*(0.0072)*	*(0.0853)*	*(0.0006)*	*(1.0301)*
	-0.4033	-0.4915***	-0.0986	-0.8001***	-1.496***
Error correction term	*(0.2206)*	*(0.2415)*	*(0.0645)*	*(0.0984)*	*1.3088)*
N (observations)	55	55	55	55	55

Source: Authors' own computation

Table A2: Summary statistics of the selected variables; Democratic Republic of Congo

Variable	Obs	Mean	Std. Dev.	Min	Max
Trade balance (USD)	12	-42505.8	12225.4	-66961.6	-27413
Food inflation (%)	12	9.9	5.2	2.6	16
Nominal exchange rate (%)	12	1851.1	125	1680	1969
COVID 19 (infections)	12	6751.3	5979.4	0	17375
Food insecurity (Millions of people)	12	38.7	3.4	34.1	45.5

Source: Authors' own computation

Table A3: Summary statistics of the selected variables; South Sudan

Variable	Obs	Mean	Std. Dev.	Min	Max
Trade balance (USD)	12	-3,958.90	5,238.80	-13279.2	-91
Food inflation (%)	12	27.6	20.9	-4.0	65.8
Nominal exchange rate (%)	12	153.8	43.4	17.0	177
COVID 19 (infections)	12	1678	1378.5	0	3534
Food insecurity (Millions of people)	12	6.4	0.4	5.5	7.1

Source: Authors' own computation

Table A4: Summary statistics of the selected variables; Zambia

Variable	Obs	Mean	Std. Dev.	Min	Max
Trade balance (USD)	12	-13952.8	2298	-17019.2	-10406
Food inflation (%)	12	16.2	1.6	14.0	20.2
Nominal exchange rate (%)	12	18.4	2.2	14.0	21
COVID 19 (infections)	12	6945.5	7619.2	0.0	20725
Food insecurity (Millions of people)	12	2.9	0.8	1.8	4.3

Source: Authors' own computation

Table A5: Summary statistics of the selected variables; Zimbabwe

Variable	Obs	Mean	Std. Dev.	Min	Max
Trade balance (USD)	12	-19629.8	5561.8	-27746.1	-9470.0
Food inflation (%)	12	728.6	222.4	346.0	980.4
Nominal exchange rate (%)	12	51.3	30.0	17.0	82.0
COVID 19 (infections)	12	4200.8	4895.5	0.0	13867
Food insecurity (Millions of people)	12	5.2	1.1	3.5	7.0

Source: Authors' own computation

Table A6: Summary statistics of the selected variables; Mozambique

Variable	Obs	Mean	Std. Dev.	Min	Max
Trade balance (USD)	12	-58949.4	9974.4	-70412	-34456
Food inflation (%)	12	7.6	0.5	6.6	8.2
Nominal exchange rate (%)	12	69.6	3.7	63.0	75.0
COVID 19 (infections)	12	1089.8	1130.1	0.0	3435
Food insecurity (Millions of people)	12	10.4	2.6	7.4	16.0

Source: Authors' own computation