

SPECIAL ISSUE ARTICLE

COVID-19 and food prices in sub-Saharan Africa

Samuel Kwaku Agyei  | Zangina Isshaq | Siaw Frimpong |
Anokye Mohammed Adam  | Ahmed Bossman | Oliver Asiamah

Department of Finance, School of
Business, University of Cape Coast,
Cape Coast, Ghana

Correspondence

Samuel Kwaku Agyei, Department of
Finance, School of Business, 3rd Floor,
School of Business Building, New Site,
University of Cape Coast, Cape Coast -
Central Region, Ghana. +233
Email: sagyei@ucc.edu.gh

Abstract

This study investigated the impact of the novel coronavirus disease 2019 (COVID-19) outbreak on prices of maize, sorghum, imported rice and local rice in sub-Saharan Africa (SSA). We estimated dynamic panel data models with controls for macroeconomic setting using general method of moments estimation. The study found that the COVID-19 outbreak led to increases in food prices of the sampled countries. Restrictions on movements or lockdowns in the wake of COVID-19 was associated with an increase in the price of maize only. We also found that exchange rate, inflation and crude oil prices exerted a detrimental effect on food prices. We recommend that governments of SSA countries invest in infrastructure that improves efficiencies in the food supply chain during pandemics. Providing adequate support to industries in the value chain will also improve food availability and food price stability post-COVID-19.

1 | INTRODUCTION

Africa may have survived the projected deadly health effects of the novel coronavirus disease 2019 (COVID-19) but the pandemic may have lasting socioeconomic implications for the continent. COVID-19 effects on the global economy could be far-reaching and deep seated (Bitler et al., 2020; Njatang, 2021). Teachout and Zipfel (2020), in their simulations of the impact of COVID-19, found that 80.4 million people (9.1%) would have been added to the poverty list as a result of the pandemic. About 65% of the newly poor would have suffered this fate due to the lockdowns (Teachout & Zipfel, 2020). This has exacerbated Africa's poverty and hunger situation since the region has been the hotspot of hunger and given that Africa is home to about 39% of the world's population who are classified as food insecure people even before the evolution of the novel coronavirus disease (FAO, 2019).

Africa recorded its first case of COVID-19 in Cairo, Egypt on 14 February 2020. Following the example of China where the virus originated, many governments around the world resorted to restrictions on movement of people to combat the spread of the disease. African governments, like governments in Europe, Asia and America adopted similar restrictions on movements of people with varying levels of stringency and duration. Restriction on movements include a ban on international and cross-border travels, social distancing, lockdowns, closure of schools and places of worship To curb the spread of the virus (Mehtar et al., 2020). The enforcement of these stringent measures impeded the way of life of citizens in Africa and also curtailed economic activities with major implications for food security (Kansiime et al., 2020). Food security and human development are intricately linked (Conceição et al., 2011), which shows potential human development implications as the lasting effect on the pandemic in Africa. It is not surprising, therefore, to notice increased concerns for food security on the continent (Hirvonen et al., 2020) because of the disruption to the trade of staple foods (Laborde et al., 2020) due to the enforcement measures to combat COVID-19.

Food insecurity has been of grave concern to policy makers in the wake of COVID-19 because food insecurity is connected with key sustainable development goals such as ending poverty in all its forms, ending hunger, achieving improved nutrition, promoting sustainable agriculture as well as ensuring healthy lives and well-being for all at all ages. Fei et al. (2020) argue that the global economy must brace itself for a persistent food crisis induced by COVID-19. Laborde et al. (2020) observe that all four pillars of food security (availability, access, utilization, stability) are experiencing the brunt of COVID-19 on both the supply and demand side of the global food market. Indeed, many studies anticipated the effect of the pandemic on food security (Espitia et al., 2020; Lawson-Lartego et al., 2020; Paslakis et al., 2020; Pulighe & Lupia, 2020).

Espitia et al. (2020) predict a fall in global food export and a rise in food prices especially for developing economies that are predominantly food-import dependent. Sub-Saharan Africa (SSA) is likely to witness a deeper effect of the pandemic on food prices because of its import dependence on food items such as rice and the labour-intensive nature of its production-distribution system. Reardon et al. (2019) contend that only about 20% of the food systems in Africa and Asia could be considered as modern food supply chains that are dominated by large processing firms and supermarkets, are capital-intensive, and with relatively low labour-intensity of operations. This implies that food supply chains are more likely to have been disrupted by the outbreak. This view is in line with Paslakis et al. (2020), who observe that food price increases, food shortages and income losses cannot be disassociated from the COVID-19 pandemic. Other studies like Moseley and Battersby (2020), however, expect that African food systems would be relatively less vulnerable to disruption by the COVID-19 outbreak due to fewer large-scale commercial farms that would have been disrupted with restrictions on movements. The above studies suggest the effect of COVID-19 on food prices in Africa is an empirical question, which we seek to answer in this study.

The focus of existing studies on food security effects of COVID-19 has largely been on policy opinions on the smooth flow of food assistance (Cardwell & Ghazalian, 2020), how to ensure food security (Kathiresan et al., 2020) and how to deal with food shortages (Farias & Gomes, 2020). These opinions would be better supported with empirical evidence on effects and likely factors producing the effects. Our study fills the evidence-based policy recommendation gap in the literature. In this study, we examine the direct and indirect effects of the COVID-19 outbreak on food prices in SSA. We believe our study facilitates evidence-based policy recommendations. There are existing studies on the impact of COVID-19 on food prices in Europe (Akter, 2020) and China (Yu et al., 2020). We believe SSA's food supply chain has unique features that are different from food systems studied in Akter (2020) and Yu et al. (2020). Our empirical framework also deals with issues of endogeneity and macroeconomic shocks that may bias the results if not accounted for. Also, the kind of food sample in our study is yet to receive empirical attention. To the best of our knowledge this study is the first that attempts to assess the effect of COVID-19 on food prices in SSA.

The rest of the paper is organized as follows. A review of related literature is presented in Section 2, we describe our data and empirical models in Section 3, we present and discuss our results in Section 4 and we present our conclusions and policy recommendations in Section 5.

2 | LITERATURE REVIEW

Fundamental economic intuition tells us that equilibrium price changes result from changes in supply and demand. The restrictions introduced in the wake of the COVID-19 outbreak have battered both the supply and demand sides of the food market. Demand and supply forces in the food market are influenced by both COVID-19 infection cases and the consequential lockdowns instituted as a measure to curtail the infection rate in the absence of a vaccine. Improvement in welfare conditions in the form of a reduction in COVID-19 infection and mortality rates are likely to be associated with lockdown measures but would also increase recession (Eichenbaum et al., 2020). Given the necessity of food commodities, the demand for food may not be affected greatly when compared with the supply for food. Reduction in household demand for food as a result of reduction in purchasing power of households is likely to be made up by a surge in demand by governments, philanthropists and other donor organizations. Food supply, however, may reduce because of COVID-19 induced reduction in labour supply and increase in input prices.

This argument sits well with similar arguments in the SIR-Macro Model propounded by Eichenbaum et al. (2020). In this model, labour supply during a pandemic is curtailed by individuals as a protective mechanism to guard against the risk of infection through exposure. Similarly, consumption is likely to plummet in a pandemic because of individuals' conscious effort to manage their exposure by limiting their contacts with others. Thus, voluntary or self-imposed lockdowns as well as mandatory lockdowns may trigger or sustain a recession during a pandemic such as COVID-19.

The channels through which COVID-19 could influence food prices are varied and could be direct and/or indirect. The direct effect covers how COVID-19 disrupts food systems whereas the indirect effect captures the effect of lockdowns on household income and physical access to food (Devereux et al., 2020). Reduction in production as a result of limited labour supply to support the production-distribution value chain (Fosso Djoumessi, 2021; Pu & Zhong, 2020), changes in food consumption pattern (Bracale & Vaccaro, 2020; Eftimov et al., 2020), raw material price hikes (Ejeromedoghene et al., 2020; Tamru et al., 2020) and dynamics in input cost emanating from exchange rate, inflation and crude oil price response to the pandemic (Arouna et al., 2020; Cullen, 2020) culminating into increased food prices (Bitler et al., 2020; Wegerif, 2020) are likely direct consequences of COVID-19. FAO (2020) postulates that COVID-19 threatens the survival of agricultural companies, traders, food manufacturers, distributors and retailers in the food chain because of their probable inability to pursue growth and survival strategies fit for the pandemic era. Thus, food prices could be harmed through the weakening of the supply side of food markets and the effect of macroeconomic variables on food production and distribution cost. Food price increases have already been documented for staple foods in Rwanda and Kinshasa (Resnick, 2019). Indeed, the evidence of the negative effect of the 2007–2008 food crises on some commodity prices (FAO, 2011; Farias & Gomes, 2020; Headey et al., 2010) suggests that an empirical analysis of the potential effect of COVID-19 on food prices, especially to the vulnerable, is paramount to informing policy recommendations.

Workers' morbidity and containment policies are advanced as some of the key channels through which the pandemic may influence global food markets indirectly (Espitia et al., 2020). Béné (2020) argues that socioeconomic consequences of the lockdown and mobility restrictions are only second to COVID-19 deaths, in terms of the magnitude of the negative consequences of the pandemic. Lockdown measures meant to reduce the spread of COVID-19 potentially stifled household income, production, transportation and distribution of food items such as rice (Sers & Mughal, 2020). COVID-19 lockdowns are likely to lead to frequent increases in food prices, food crises and food insecurity (Arndt et al., 2020; Yu et al., 2020). Thus, the effect of lockdowns must be measured as the trade-off between its health benefits in reducing the spread of COVID-19 and the negative economic ramifications on food-insecure households and other vulnerable groups in society (Arndt et al., 2020). Lockdown in Africa is likely to exacerbate food security issues because it led to a reduction in food supply from peasant farmers and a cut in labour supply to the food production-distribution chain. Furthermore, the labour-intensive nature of the production-distribution system in SSA and the coincidence of the lockdown with planting seasons of most of the staple foods on the continent (Ayanlade & Radeny, 2020) will accentuate the lockdown effect on food prices and food security. In view of this, the study hypothesizes:

H1: *There is a significant relationship between COVID-19 and food prices in SSA.*

H2: *There is no significant relationship between COVID-19 related lockdown and food prices in SSA.*

Prior empirical results generally point to a likely positive relationship between COVID-19 and food prices in both developed and developing economies with very few exceptions. Śmiech et al. (2019) observed that food crises in 2008, and between 2011 and 2012 increased food price volatility. Ahn and Norwood (2020) assert that unemployment, rising food prices and sales downturn could be linked to the COVID-19 pandemic in the United States. Akter (2020) makes similar observations in Europe. Akter (2020) concludes from a study of 31 European countries that a 1% increase in overall food prices could be associated with stay-at-home restrictions in March 2020, compared to January and February 2020. Farias and Araujo (2020) concluded that price variations for products were high for regions in Brazil that were affected by COVID-19. On the other hand, Laborde et al. (2020) argue that food prices may reduce globally because of the decrease in demand as a result of the anticipated COVID-19 global recession. Other studies suggest that the effect of COVID-19 on food prices is food-type dependent. Yu et al. (2020) found that COVID-19 did not have any effect on rice and wheat flour prices but exhibited a significant positive effect on vegetable prices and with mixed results on pork prices in China.

There is a general paucity of studies on the economic ramifications of COVID-19 in SSA but findings from the few existing ones do not deviate significantly from the early global picture. Boukar et al. (2021) suggest that construction, education, hotels and restaurants and commerce sectors in Cameroon need special attention because of COVID-19 induced job losses. In Ethiopia, Tamru et al. (2020) report of early signs of farm losses, shortage of farm inputs, increase in prices of farm inputs, and a gradual scarcity of labour in the vegetable production and distribution chain. Hirvonen et al. (2020) report similar observations from the vegetables market in Ethiopia. Ibukun and Adebayo (2021) assert that the majority of Nigerians faced food insecurity threats during COVID-19.

Managing the potential effect of a pandemic like COVID-19 on food crisis and food prices must not be done to the neglect of the macroeconomic setting (Arouna et al., 2020; Cullen, 2020). Food price volatility is associated with changes in exchange rate, lending rate, money supply, real GDP and crude oil prices (Ahmadi et al., 2016; Nwoko et al., 2016). Other empirical studies have observed a link between food prices and crude oil prices (Baffes & Dennis, 2014; Lucotte, 2016). Lucotte (2016), for example, reports a strong co-movement between crude oil prices and food prices in the period 2007–2015, a period referred to as the post-commodity boom period by the author. Baffes and Dennis (2014) report an estimate of 0.23 maize price response to oil price changes. These empirical results are in line with earlier studies that suggest an association between energy costs in general and agricultural markets (Baffes, 2007; Hanson et al., 1993). Crude oil prices association with food prices is, thus, a pass-through effect of cost of energy used in production (Baffes, 2007; Chaudhri, 2001). The effect of energy costs on food prices in our study may not be a result of energy intensity in food production but because energy subsidies take fiscal funds away from agricultural support programmes for food production in SSA. Another expectation is the devastating effects of oil price shocks on macroeconomic outcomes in general in SSA economies.

Baffes and Dennis (2014) report also that exchange rate movements have a statistically significant association with food prices, the strongest effect in their estimates being exchange rate movements' association with rice prices. On maize prices, the relation is weak, which the authors explain as the structural effect of the US dominance in maize production. African countries are not structurally the most dominant producers of maize. In addition, SSA countries are noted for weak currencies and imported inflation. As a consequence of these factors, we expect that maize price is associated with exchange rate movements.

3 | METHODS

The study assessed whether the COVID-19 pandemic affected food prices in SSA after controlling for exchange rates, food inflation and crude oil prices, using the system dynamic general method of moments (GMM) estimation. All SSA countries that had adequate data for the months of March to September 2020 were included. The basic model specifies the determinants of maize price but estimations were also done for sorghum, imported rice and local rice prices. The selection of the food staples for the study was based on availability of data. Equations (1) and (2) were used to examine the effect of the number of reported cases of COVID-19 and the lockdown, respectively. The estimated maize models that form the basis for the estimations of the sorghum, imported rice and local rice models were as follows:

$$\ln Maizepx_{it} = \beta_1 \ln Maizepx_{it-1} + \beta_2 \ln COVID_{it} + \beta_3 \ln EXRave_{it} + \beta_4 \ln Infod_{it} + \beta_5 \ln Copave_{it} + \mu_i + \varepsilon_{it}. \quad (1)$$

$$\ln Maizepx_{it} = \beta_1 \ln Maizepx_{it-1} + \beta_2 LDD_{it} + \beta_3 \ln EXRave_{it} + \beta_4 \ln Infod_{it} + \beta_5 \ln Copave_{it} + \mu_i + \varepsilon_{it}. \quad (2)$$

where $\ln Maizepx_{it}$ is the natural log of maize price for country i in time t ; $\ln Maizepx_{it-1}$ is the lag of the natural log of maize price; $\ln COVID_{it}$ is the natural log of the number of COVID-19 infections of country i in time t ; $\ln EXRave_{it}$ is the average exchange rate of country i in time t ; $\ln Infod_{it}$ is the natural log of food inflation of country i in time t ; $\ln Copave_{it}$ is the average crude oil price; μ_i is the country invariant factors and ε_{it} is the error term. The variables and their meanings are captured in Table 1. Equation (1) tested the relationship between maize prices and COVID-19 incidence. It indicates that maize prices during the pandemic were influenced by previous levels of maize prices, exchange rate movements, inflation, crude oil prices, in addition to the number of COVID-19 cases in SSA. Equation (2) is the same as Equation (1) except for the use of lockdown as a proxy for COVID-19 instead of COVID-19 cases. A priori, it was expected that increases in the independent variables would lead to increases in food prices.

Because the selected food stuffs were based on availability of adequate data, the sample of countries used for the study varied among the maize, sorghum, imported rice and local rice models. Table 2 indicates the list of countries included in each of the models estimated.

Equations (1) and (2) are estimated using the systems dynamic panel estimation technique suggested by Roodman (2009a, 2009b). We use this approach because our models include lagged values of our dependent variables as they seek to assess the autoregressive nature of food prices. Indeed, Roodman (2009a, 2009b) provides convenient procedures to implement Arellano and Bond (1991), who show how to deal with the endogeneity problems introduced by the inclusion of the lagged dependent variables in panel data models, especially for small samples. In addition, the approach accounts for endogeneity by using the instrumental variables approach and reduces overidentification while accounting for cross-sectional dependence. These procedures are also necessary because in each of the SSA

TABLE 1 Variable names, meaning and source of data

| Variables | Definition/unit of measurement | Source of data |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $\ln Maizepx_{it}$ $\ln Sog_{it}$ $\ln ImpRice_{it}$ $\ln LocalRice_{it}$ | Natural logarithm of the respective food prices (maize, sorghum, imported rice and local rice) for country i in time t measured as the local currency price in US\$ per kg | Food and Agriculture Organisation (FAO) https://fpma.apps.fao.org/giews/food-prices/tool/public/#/dataset/domestic |
| $\ln COVID_{it}$ | The natural logarithm of new reported cases of COVID-19 for country i in time t | European Centre for Disease Prevention and Control https://www.ecdc.europa.eu/en/covid-19/data World Health Organization (WHO) https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020 |
| LDD_{it} | Lockdown dummy defined as 1 for countries that adopted lockdown during the period otherwise 0. | Tourists Exclusive https://touristexclusive.com/travel-restrictions-per-country/KAYAK https://www.kayak.com/travel-restrictions#namibia CNN Travel https://edition.cnn.com/travel/article/coronavirus-travel-bans/index.html The New York Times https://www.nytimes.com/article/coronavirus-travel-restrictions |
| $\ln EXRave_{it}$ | The natural log of the average exchange rate during the month for country i at time t . | International Monetary Fund (IMF) https://data.imf.org/regular.aspx?key=61545850 Xe Currency Converter https://www.xe.com/ MATAF https://www.mataf.net/en Fxempire https://www.fxempire.com/ |
| $\ln Infod_{it}$ | The natural logarithm of end-of-month food inflation rate for country i at time t . for the sorghum model, general inflation level was used. | TRADING ECONOMICS https://tradingeconomics.com/indicators FXEMPIRE https://www.fxempire.com/ |
| $\ln Copave_{it}$ | Natural logarithm of the average international prices for Brent per barrel were used as the crude oil prices for all the countries. | TRADING ECONOMICS https://tradingeconomics.com/commodity/crude-oil |

samples in our estimations the number of countries exceed the number of months. Prior studies such as Agyei et al. (2020), and Boateng et al. (2018) followed the Roodman (2009a, 2009b) approach and confirm its appropriateness for this study. The general form of the system GMM estimation used is specified in Equations (3) and (4).

$$\ln Maizepx_{it} = \gamma_0 + \gamma_1 \ln Maizepx_{it-\tau} + \sum_{h=1}^5 \gamma_h W_{h,it-\tau} + \theta_i + \mu_i + \varepsilon_{it}. \quad (3)$$

$$\begin{aligned} \ln Maizepx_{it} - \ln Maizepx_{it-\tau} &= \gamma_1 (\ln Maizepx_{it-\tau} - \ln Maizepx_{it-2\tau}) + \sum_{h=1}^5 \gamma_h (W_{h,it-\tau} - W_{h,it-2\tau}) + (\mu_t - \mu_{t-\tau}) \\ &+ \varepsilon_{it-\tau} + (\mu_t - \mu_{t-\tau}) + \varepsilon_{it-\tau}. \end{aligned} \quad (4)$$

where $\ln Maizepx_{it}$ is the maize price for country i in time t ; γ_0 is a constant; W is a vector of control variables (COVID-19, Exchange rate, food inflation, crude oil price); τ represents the coefficient of autoregression which is one for the specification, μ_t is the time-specific constant, θ_i is the country-specific effect, and ε_{it} the error term.

TABLE 2 List of countries included in each of the models

| Food commodity | Maize | Sorghum | Imported rice | Local rice |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Countries | Benin, Botswana, Burundi, Cabo Verde, Cameroon, Chad, DRC, Ethiopia, Ghana, Guinea, Malawi, Mali, Morocco, Namibia, Nigeria, Rwanda, Somalia, South Africa, South Sudan, Tanzania, Togo, Uganda, Zambia | Benin, Botswana, Burkina Faso, Chad, Ethiopia, Ghana, Mali, Namibia, Niger, Nigeria, Senegal, Somalia, South Sudan, Sudan, Togo | Benin, Burkina Faso, Chad, DRC, Ghana, Guinea, Ivory Coast, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Somalia, Togo | Benin, Botswana, Cabo Verde, Cameroon, Chad, DRC, Ghana, Guinea, Ivory Coast, Liberia, Malawi, Mali, Namibia, Rwanda, Sierra Leone, Tanzania, Tunisia, Uganda, Zimbabwe |
| Total | 23 | 15 | 15 | 19 |

Following Agyei et al. (2020) and Boateng et al. (2018), the explanatory indicators are defined as suspected endogenous variables and only the time-invariant variables are considered to be strictly exogenous (Roodman, 2009b). The results from the Sargan overidentification and the Hansen J tests reported in Tables 5 and 6 support the strict exogeneity of the time-invariant variables.

4 | DISCUSSION OF EMPIRICAL RESULTS

4.1 | Descriptive statistics

Table 3 presents the descriptive statistics of the variables used for the maize price model. The average maize price recorded over the 7-month period was about US\$0.43 per kg (with standard deviation of US\$0.26 per kg) implying that the variation in prices between countries was wide. On average, SSA recorded about 6738 cases of COVID-19 each month, which was low when compared with the figures of the United States and Europe. Also, about 60% of the countries in the sample embarked on one form of lockdown or the other while the average US dollar to the local currency was about US\$0.026 (with standard deviation of US\$0.044). Average food inflation hovered around 7.13% but with wide variation (7.64%). In fact, some countries recorded average food deflation of close to 2% implying that while food prices rose by 40%, others had their prices reducing for some of the periods. Finally, average crude oil price was about US\$34.

4.2 | Correlation matrix

To test for the presence of multicollinearity among the regressors which may affect the reliability of the results, the correlation matrix was used to ascertain the pairwise correlations between the variables. From Table 4 and using a general bench mark of 0.7 as the cut-off point, the results suggest that the presence of multicollinearity among the regressors was low.

4.3 | Discussion of regression results

The regression results of the systems GMM estimations are contained in Tables 5 and 6. Table 5 contains the results for all the commodities (maize, sorghum, imported rice and local rice) when the natural logarithm of new COVID-19 cases was used as the main explanatory variable while Table 6 reports the results using the lockdown dummy as the main explanatory variable. Columns 1, 2, 3, and 4 of Table 5 contain the results of the maize, sorghum, imported rice, and

TABLE 3 Descriptive statistics

| Variable | Obs | Mean | SD | Min | Max |
|----------------|-----|-----------|-----------|-----------|----------|
| <i>Maizepx</i> | 138 | 0.424928 | 0.256063 | 0.14 | 1.21 |
| <i>Covid19</i> | 161 | 6737.925 | 30796.33 | 0 | 337905 |
| <i>LDD</i> | 161 | 0.608696 | 0.489565 | 0 | 1 |
| <i>EXRave</i> | 122 | 0.0261328 | 0.0443342 | 0.0001031 | 0.186686 |
| <i>Infod</i> | 125 | 7.132 | 7.636896 | -1.9 | 40.4 |
| <i>Copave</i> | 161 | 33.90099 | 8.524825 | 16.69905 | 42.3881 |

Note: *Maizepx* is maize price; *Covid19* represents COVID-19 new cases; *LDD* is lockdown dummy; *EXRave* represents exchange rate; *Infod* is food inflation; and *Copave* is crude oil price. The descriptive statistics of the sorghum, imported rice and local rice models are available on demand.

local rice models respectively. The results from the autocorrelation, Sargan, and Hansen J tests as well as the number of instruments compared to the number of observations and cross-sections indicate that the instruments used in the study were exogenous and instrument proliferation was not a problem for all the models.

The results in Table 5 show that previous levels of staple food prices influence current prices. All the lagged food prices of maize, sorghum, imported rice and local rice exhibited a positive and significant relationship at the 1% significant level with their respective current levels. This suggests that food prices in SSA follow a partial adjustment process but the speed of adjustment is staple food dependent. Thus, managing current food prices informs their future levels.

The study depicted a positive and significant relationship between the number of COVID-19 cases and food prices. Specifically, a 1% increase in the number of COVID-19 cases was associated with a 0.0136 increase in maize price, 0.0137 increase in sorghum prices, 0.006 increase in imported rice price and 0.009 increase in local price. This could occur as a result of reduction in supply of staple food due to increased cost of inputs in the food production and distribution chain (Ejeromedoghene et al., 2020; Tamru et al., 2020) given demand, which was affected by insignificant COVID-19 related deaths. The fear of getting infected might have fuelled the reduction in labour supply and contributed to high production cost.

Also, the study reported a significant negative relationship between average exchange rate and the prices of maize, sorghum and local rice staple foods generally known to be locally supplied. Given that exchange rate was measured as the value of the local currency in dollars, increases in the exchange rate meant appreciation or strengthening of the local currency, which implied that imported staple foods like rice became cheaper than locally grown foods thereby diverting demand to imported staple foods. This condition could reduce the prices of the locally produced staple foods since demand would be diverted to foreign staple foods. The results further indicated that the exchange rate had a positive and significant relationship with imported rice. This could be construed as the opposite of the relationship between exchange rate and local food prices. The appreciation in the value of the local currency makes the imported rice relatively cheaper, which initially attracts demand but may subsequently lead to higher imported food prices. The

TABLE 4 Correlation matrix

| | <i>lnMaizepx</i> | <i>lnCovid19</i> | <i>LDD</i> | <i>lnEXRave</i> | <i>lnInfod</i> | <i>lnCopave</i> |
|------------------|------------------|------------------|------------|-----------------|----------------|-----------------|
| <i>lnMaizepx</i> | 1.0000 | | | | | |
| <i>lnCovid19</i> | -0.2034** | 1.0000 | | | | |
| <i>LDD</i> | 0.2333*** | 0.2490*** | 1.0000 | | | |
| <i>lnEXRave</i> | -0.0591 | 0.2897*** | 0.3340*** | 1.0000 | | |
| <i>lnInfod</i> | -0.1158 | -0.0331 | -0.0907 | 0.0220 | 1.0000 | |
| <i>lnCopave</i> | 0.0301 | 0.3561*** | 0.0000 | 0.0035 | -0.1285 | 1.0000 |

Note: *lnMaizepx* is maize price; *lnCovid19* represents COVID-19 new cases; *LDD* is lockdown dummy; *lnEXRave* represents exchange rate; *lnInfod* is food inflation; and *lnCopave* is crude oil price. The correlation matrices of the sorghum, imported rice and local rice models are available on demand.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

TABLE 5 COVID-19 and food prices (dependent variable: food prices of maize, sorghum, imported rice and local rice)

| Variables | COVID19 LnMaizepx | COVID19 lnSog | COVID19 lnImpRice | COVID19 lnLocalRice |
|-------------------------------|--------------------------|--------------------------|------------------------|------------------------|
| L. lnMaizepx | 0.929*** (0.0361) | | | |
| L. lnSog | | 0.901*** (0.0152) | | |
| L. lnImpRice | | | 0.870*** (0.0413) | |
| L. lnLocalRice | | | | 0.562*** (0.0804) |
| lnCovid19 | 0.0136** (0.00488) | 0.0137*** (0.00183) | 0.00570** (0.00218) | 0.00992** (0.00346) |
| lnEXRave | -0.879*** (0.298) | -0.561*** (0.154) | 0.0121*** (0.00243) | -0.0776*** (0.0197) |
| lnInfod | 0.00437*** (0.000581) | 0.00128*** (0.000124) | 0.0216* (0.0118) | 0.129*** (0.0193) |
| lnCopave | 0.000171 (0.000995) | 0.00233*** (0.000358) | 0.0192* (0.00892) | 0.0588*** (0.0109) |
| Constant | -0.169*** (0.0364) | -0.228*** (0.0204) | -0.0800** (0.0301) | -1.021*** (0.173) |
| AR(1)[p-value] | .322 | .088 | .384 | .825 |
| AR(2)[p-value] | .110 | .289 | .343 | .398 |
| Sargan OIR | 0.329 | 0.124 | 0.519 | 0.286 |
| Hansen OIR | 0.506 | 0.545 | 0.147 | 0.303 |
| DHT for Instruments | | | | |
| (a)GMM Instruments for levels | | | | |
| H excluding group | 0.756 | 0.320 | 0.157 | 0.916 |
| Diff(null, H = exogenous) | 0.292 | 0.625 | 0.210 | 0.120 |
| (b) IV(years, eq(diff)) | | | | |
| H excluding group | 0.502 | 0.457 | 0.188 | 0.314 |
| Diff(null, H = exogenous) | 0.332 | 0.721 | 0.148 | 0.260 |
| Fisher | 170.53*** | 51785.42*** | 6386.60*** | 2557.02*** |
| Instruments | 19 | 15 | 14 | 15 |
| Observations | 93 | 63 | 48 | 68 |
| Number of countries | 22 | 15 | 14 | 17 |

Note: lnMaizepx is maize price; lnCovid19 represents COVID-19 new cases; LDD is lockdown dummy; lnEXRave represents exchange rate; lnInfod is food inflation; and lnCopave is crude oil price.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

TABLE 6 COVID-19 and food prices (dependent variable: food prices of maize, sorghum, imported rice and local rice)

| Variables | Lockdown lnMaizepx | Lockdown lnSog | Lockdown lnImpRice | Lockdown lnLocalRice |
|-------------------------------|-------------------------|--------------------------|------------------------|-------------------------|
| L. lnMaizepx | 1.123*** (0.0590) | | | |
| L. lnSog | | 0.934*** (0.0184) | | |
| L. lnImpRice | | | 0.934*** (0.0453) | |
| L. lnLocalRice | | | | 0.833*** (0.150) |
| LDD | 0.132*** (0.0464) | -0.0366 (0.0282) | 0.0145 (0.0215) | -0.122 (0.232) |
| lnEXRave | 1.605** (0.594) | -0.203 (0.905) | 0.0115*** (0.00216) | -0.120*** (0.0337) |
| lnInfod | 0.00618*** (0.00185) | 0.00125*** (0.000182) | 0.00776 (0.0121) | 0.0925*** (0.0259) |
| lnCopave | 0.00448** (0.00164) | 0.00284*** (0.000476) | 0.0334*** (0.00716) | 0.0878*** (0.0207) |
| Constant | -0.135 (0.0889) | -0.0959* (0.0477) | -0.0680 (0.0454) | -1.078*** (0.323) |
| AR(1) [p-value] | .701 | .151 | .387 | .937 |
| AR(2) [p-value] | .151 | .338 | .324 | .912 |
| Sargan OIR | 0.914 | 0.072 | 0.558 | 0.725 |
| Hansen OIR | 0.915 | 0.786 | 0.284 | 0.261 |
| DHT for Instruments | | | | |
| (a)GMM Instruments for levels | | | | |
| H excluding group | 0.940 | 0.259 | 0.149 | 0.743 |
| Diff(null, H = exogenous) | 0.705 | 0.959 | 0.431 | 0.125 |
| (b) IV(years, eq(diff)) | | | | |
| H excluding group | 0.876 | 0.746 | 0.244 | 0.285 |
| Diff(null, H = exogenous) | 0.892 | 0.519 | 0.434 | 0.221 |
| Fisher | 443.67*** | 470893.92*** | 7488.98*** | 1338.28*** |
| Instruments | 19 | 15 | 14 | 15 |
| Observations | 95 | 63 | 48 | 70 |
| Number of countries | 22 | 15 | 14 | 17 |

Note: lnMaizepx is maize price; lnCovid19 represents COVID-19 new cases; LDD is lockdown dummy; lnEXRave represents exchange rate; lnInfod is food inflation; and lnCopave is crude oil price.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

relationship between food inflation and food prices was positive and significant, generally at 1%. Local rice prices suffered the biggest shock from food inflation. The findings suggest that a general increase in price levels in SSA was detrimental to food prices during the pandemic. Similar results were recorded for crude oil prices. Apart from maize, crude oil prices exhibited a positive significant relationship with the prices of all the other staple foods included in the study. As a key input cost for any production distribution system, oil price appreciation generally increases production cost. Thus, the findings offer support for the assertion that the macroeconomic environment influenced food prices during the pandemic and this is corroborated by opinions of Ahmadi et al. (2016), Cullen (2020), and Nwoko et al. (2016).

Table 6 presents the results when the lockdown dummy was used as the main explanatory variable of COVID-19. The results are largely consistent with those recorded under COVID-19 cases. Except that in the case of the relationship between lockdown and food prices, the results show that the lockdown only affected maize prices. The results suggest that countries in SSA that locked down increased their maize price by 0.083 as against the country that did not. The prominence of maize in most African kitchens coupled with its relatively cheaper price probably contributed to the significant positive relationship between the lockdown and maize prices. Most African foods, from breakfast to supper, have an ingredient of maize in it, increasing its demand relative to the other foods considered in this study. The average maize price during the period of study was \$0.42 per kg as compared to Sorghum (\$0.54), imported rice (\$0.82) and local rice (\$0.92). Thus, the attractiveness of maize to a populace with reduced income probably exacerbated the influence of the lockdown on maize price hikes. The study offers support for the anticipated negative lockdown effect on food prices through shortage of labour for the food production and distribution chain, reduction in the income levels of consumers and COVID-19 induced trade protectionism (Ayanlade & Radeny, 2020; Kathiresan et al., 2020; Sers & Mughal, 2020), even though this effect was observed for only the maize market.

5 | CONCLUSION

The main thrust of this study was to assess whether the devastating effect of the novel coronavirus extended to food prices in SSA using monthly data for maize, sorghum, imported rice and local rice and based on the system dynamic panel estimation. The study further assessed whether the macroeconomic environment of SSA economies during the pandemic also contributed to changes in food prices. The results suggest that the number of COVID-19 cases recorded influenced the food prices of the sampled food items but the lockdown only influenced maize prices and did not have any effect on sorghum, imported and local rice prices. The study concludes that COVID-19 negatively influenced food prices through the demand and supply conditions of the food market of SSA and external environmental shocks aggravated this condition. Thus, the study failed to reject the hypothesis that there is a significant relationship between COVID-19 and staple food prices. Our results indicate that resilience in food supply systems across Africa is essential if the continent desires to withstand future disruptions of the kind induced by the pandemic. We recommend that African governments begin a process of investing in infrastructure support systems for the food supply chain while strengthening the macroeconomic environment. Such investment can take the form of investment in silos and food storage facilities. These investments, we recommend, should be complemented with incentives and initiatives that encourage private sector investment in food production to reduce the sensitivity of food prices to foreign exchange markets. Also, investors in the staple food distribution chain should consider the deployment of technology to manage their processes in a cost-effective manner.

ACKNOWLEDGEMENTS

The authors are grateful to the Editor and two anonymous reviewers for their constructive suggestions. We are also grateful to Mr Kwasi Adu Boateng for proofreading the draft.

ORCID

Samuel Kwaku Agyei  <http://orcid.org/0000-0002-8167-7747>

Anokye Mohammed Adam  <http://orcid.org/0000-0003-3830-1186>

REFERENCES

Agyei, S. K., Marfo-Yiadom, E., Ansong, A., & Idun, A. A. A. (2020). Corporate tax avoidance incentives of banks in Ghana. *Journal of African Business*, 21(4), 544–559.

- Ahmadi, M., Behmiri, N. B., & Manera, M. (2016). How is volatility in commodity markets linked to oil price shocks? *Energy Economics*, 59, 11–23.
- Ahn, S., & Norwood, F. B. (2020). Measuring food insecurity during the COVID-19 pandemic of spring 2020. *Applied Economic Perspectives and Policy*, 43, 1–7. <https://doi.org/10.1002/aep.13069>
- Akter, S. (2020). The impact of COVID-19 related 'stay-at-home' restrictions on food prices in Europe: Findings from a preliminary analysis. *Food Security*, 12, 719–725. <https://doi.org/10.1007/s12571-020-01082-3>
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58, 277–297.
- Arndt, C., Davies, R., Gabriel, S., Harris, L., Makrelou, K., Robinson, S., Levy, S., Simbanegavi, W., van Seventer, D., & Anderson, L. (2020). Covid-19 lockdowns, income distribution, and food security: An analysis for South Africa. *Global Food Security*, 26, 100410.
- Arouna, A., Soullier, G., del Villar, P. M., & Demont, M. (2020). Policy options for mitigating impacts of COVID-19 on domestic rice value chains and food security in West Africa. *Global Food Security*, 26, 100405.
- Ayanlade, A., & Radeny, M. (2020). COVID-19 and food security in Sub-Saharan Africa: Implications of lockdown during agricultural planting seasons. *npj Science of Food*, 4(13), 1–6. <https://doi.org/10.1038/s41538-020-00073-0>
- Baffes, J. (2007). Oil spills on other commodities. *Resources Policy*, 32, 126–134.
- Baffes, J., & Dennis, A. (2014). *Long-term drivers of food prices*. <https://openknowledge.worldbank.org/bitstream/handle/10986/15594/WPS6455.pdf?sequence=1>
- Béné, C. (2020). Resilience of local food systems and links to food security—A review of some important concepts in the context of COVID-19 and other shocks. *Food Security*, 12, 805–822. <https://doi.org/10.1007/s12571-020-01076-1>
- Bitler, M., Hoynes, H. W., & Schanzenbach, D. W. (2020). *The social safety net in the wake of COVID-19* (NBER Working Paper No. 27796) September 2020.
- Boateng, A., Asongu, S. A., Akamavi, R., & Tchamyu, V. S. (2018). Information asymmetry and market power in the African banking industry. *Journal of Multinational Financial Management*, 44, 69–83. <https://doi.org/10.1016/j.mulfin.2017.11.002>
- Boukar, A. M., Mbock, O., Kilolo, J.-M., & M. (2021). The impacts of the Covid-19 pandemic on employment in Cameroon: A general equilibrium analysis. *African Development Review*, <https://doi.org/10.1111/1467-8268.12512>
- Bracale, R., & Vaccaro, C. M. (2020). Changes in food choice following restrictive measures due to Covid-19. *Nutrition, Metabolism & Cardiovascular Diseases*, 30, 1423–1426.
- Cardwell, R., & Ghazalian, P. L. (2020). COVID-19 and international food assistance: Policy proposals to keep food flowing. *World Development*, 135, 105059.
- Chaudhri, K. (2001). Long-run prices of primary commodities and oil prices. *Applied Economics*, 33, 531–538.
- Conceição, P., Fuentes-Nieva, R., Horn-Phathanthai, L., & Ngororano, A. (2011). Food security and human development in Africa: Strategic considerations and directions for further research. *African Development Review*, 23(2), 237–246. <https://doi.org/10.1111/j.14678268.2011.00283.x>
- Cullen, M. T. (2020). *COVID-19 and the risk to food supply chains: How to respond?* <http://www.fao.org/2019-ncov/analysis/en/>
- Devereux, S., Béné, C., & Hoddinott, J. (2020). Conceptualising COVID-19's impacts on household food security. *Food Security*, 12, 769–772.
- Eftimov, T., Popovski, G., Petković, M., Seljak, B. K., & Kocev, D. (2020). COVID-19 pandemic changes the food consumption patterns. *Trends in Food Science & Technology*, 104, 268–272.
- Eichenbaum, S., M., Rebelo, S., & Trabandt, M. (2020). *The macroeconomics of epidemics* (NBER Working Paper, No. 26882).
- Ejeromedoghene, O., Tesi, J. N., Uyanga, V. A., Adebayo, A. O., Nwosisi, M. C., Tesi, G. O., & Akinyeye, R. O. (2020). Food security and safety concerns in animal production and public health issues in Africa: A perspective of COVID-19 pandemic era. *Ethics, Medicine and Public Health*, 15, 100600.
- Espitia, A., Rocha, N., & Ruta, M. (2020). *Covid-19 and food protectionism: The impact of the pandemic and export restrictions on world food markets* (World Bank Policy Research Working Paper, 9253).
- FAO (2011). Good food security governance: The crucial premise to the twin-track approach. Background paper for FAO, workshop, Rome, 2011. December. http://www.fao.org/righttofood/project_files/goodFSgovernance/FoodSecurityGovernanceWorkshop_backgroundpaper.pdf. [Google Scholar].
- FAO Coronavirus disease 2019 (COVID-19)—addressing the impacts of COVID-19 in food crises, 2020. <http://www.fao.org/emergencies/appeals/detail/en/c/1270012/>
- FAO- Food and Agriculture Organization of the United Nations (2020). *Adjusting business models to sustain agri-food enterprises during COVID-19*. <http://www.fao.org/3/ca8996en/CA8996EN.pdf>
- Farias, D. P., & Araujo, F. F. (2020). Will COVID-19 affect food supply in distribution centers of Brazilian regions affected by the pandemic? *Trends in Food Science & Technology*, 103, 361–366.
- Farias, D. P., & Gomes, M. G. S. (2020). COVID-19 outbreak: What should be done to avoid food shortages? *Trends in Food Science & Technology*, 102, 291–292.
- Fei, S., Ni, J., & Santini, G. (2020). Local food systems and COVID-19: An insight from China. *Resources Conservation & Recycling*, 162, 105022.
- Fosso Djoumessi, Y. F. (2021). The adverse impact of the Covid-19 pandemic on the labor market in Cameroon. *African Development Review*, 1–14. <https://doi.org/10.1111/1467-8268.12508>
- Hanson, K., Robinson, S., & Schluter, G. (1993). Sectoral effects of a world oil price shock: Economywide linkages to the agricultural sector. *Journal of Agricultural and Resource Economics*, 18, 96–116.

- Headey, D., Malaiyandi, S., & Fan, S. (2010). Navigating the perfect storm: Reflections on the food, energy, and financial crises. *Agricultural Economics*, 41, 217–228.
- Hirvonen, K., Mohammed, B., Minten, B., & Tamru, S. (2020). *Food marketing margins during the COVID-19 pandemic: Evidence from vegetables in Ethiopia* (Vol. 150). Intl Food Policy Res Inst. <https://doi.org/10.1007/s10640-020-00474-5>
- Ibukun, C. O., & Adebayo, A. A. (2021). Household food security and the COVID-19 pandemic in Nigeria. *African Development Review*, 2021, 1–13. <https://doi.org/10.1111/1467-8268.12515>
- Kansiime, M. K., Tambo, J. A., Mugambi, I., Bundi, M., Kara, A., & Owuor, C. (2020). COVID-19 implications on household income and food security in Kenya and Uganda: Findings from a rapid assessment. *World Development*, 137, 105199.
- Kathiresan, A., Nagai, T., & Haneishi, Y. (2020). Policy options for galvanizing Africa's rice sector against impacts of COVID-19. *World Development*, 136, 105126.
- Laborde, D., Martin, W., Swinnen, J., & Vos, R. (2020). COVID-19 risks to global food security: Economic fallout and food supply chain disruptions require attention from policy-makers. *Science*, 369(6503), 500–502. <https://doi.org/10.1126/science.abc4765>
- Lawson-Lartego, L., Marc, J., & Cohen, M. J. (2020). 10 recommendations for African governments to ensure food security for poor and vulnerable populations during COVID-19. *Food Security*, 12, 899–902. <https://doi.org/10.1007/s12571-020-01062-7>
- Lucotte, Y. (2016). Co-movements between crude oil and food prices: A post-commodity boom perspective. *Economics Letters*, 147, 142–147.
- Mehtar, S., Preiser, W., Lakhe, N. A., Bousso, A., TamFum, J. J. M., Kallay, O., Seydi, M., Zumla, A., & Nachege, J. B. (2020). Limiting the spread of COVID-19 in Africa: One size mitigation strategies do not fit all countries. *The Lancet Global Health*, 8, e881–e883.
- Moseley, W. G., & Battersby, J. (2020). The vulnerability and resilience of African food systems, food security, and nutrition in the context of the COVID-19 pandemic. *African Studies Review*, 63(3), 449–461.
- Njatang, D. K. (2021). Impact économique de la COVID-19 au Cameroun: Les résultats du modèle SIR-macro. *African Development Review*, 2021, 1–13. <https://doi.org/10.1111/1467-8268.12516>
- Nwoko, I. C., Aye, G. C., & Asogwa, B. C. (2016). Effect of oil price on Nigeria's food price volatility. *Cogent Food & Agriculture*, 2(1), 1146057.
- Paslakis, G., Dimitropoulos, G., & Katzman, D. K. (2020). A call to action to address COVID-19-induced global food insecurity to prevent hunger, malnutrition, and eating pathology. *Nutrition Reviews*, 79(1), 1–3. <https://doi.org/10.1093/nutrit/nuaa069>
- Pu, M., & Zhong, Y. (2020). Rising concerns over agricultural production as COVID-19 spreads: Lessons from China. *Global Food Security*, 26, 100409.
- Pulighe, G., & Lupia, F. (2020). Food first: COVID-19 outbreak and cities lockdown a booster for a wider vision on urban agriculture. *Sustainability*, 12, 5012. <https://doi.org/10.3390/su12125012>
- Reardon, T., Bellemare, M. F., & Zilberman, D. (2019). *How COVID-19 may disrupt food supply chains in developing countries*.
- Resnick, D. (2019). *COVID-19 lockdowns threaten Africa's vital informal urban food trade*.
- Roodman, D. (2009a). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, 71, 135–158.
- Roodman, D. (2009b). How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*, 9, 86–136.
- Sers, C. F., & Mughal, M. (2020). Covid-19 outbreak and the need for rice self-sufficiency in West Africa. *World Development*, 135, 105071.
- Śmiech, S., Papież, M., Fijorek, K., & Dąbrowski, M. A. (2019). What drives food price volatility? Evidence based on a generalized VAR approach applied to the food, financial and energy markets. *Economics E-Journal*, 13, 1–32.
- Tamru, S., Hirvonen, K., & Minten, B. (2020). *Impacts of the COVID-19 crisis on vegetable value chains in Ethiopia*.
- Teachout, M., & Zipfel, C. (2020). The Economic Impact of COVID-19 lockdowns in sub-Saharan Africa. *International Growth Centre Policy* (Brief May 2020). www.theigc.org/covid-19
- Wegerif, M. C. A. (2020). “Informal” food traders and food security: Experiences from the Covid-19 response in South Africa. *Food Security*, 12, 797–800. <https://doi.org/10.1007/s12571-020-01078-z>
- Yu, X., Liu, C., Wang, H., & Feil, J.-H. (2020). The impact of COVID-19 on food prices in China: Evidence of four major food products from Beijing, Shandong and Hubei Provinces. *China Agricultural Economic Review*, 12(3), 445–458. <https://doi.org/10.1108/CAER-04-2020-0054>

How to cite this article: Agyei, S. K., Isshaq, Z., Frimpong, S., Adam, A. M., Bossman, A., & Asiamah, O. (2021). COVID-19 and food prices in sub-Saharan Africa. *Afr Dev Rev*, 33, S102–S113. <https://doi.org/10.1111/1467-8268.12525>