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Determinants of Food Inflation in Tanzania: Comparative Analysis Before, During and After Covid-19 Shock

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Abstract: *This study examines determinants of food inflation before, during and after COVID-19 in Tanzania. The study used monthly time series data covering both pre-COVID and post-covid periods. The Chow test was employed to analyze whether the prevalence of the pandemic has influenced food prices. The results reveal that the price of fuel and global food prices account for food inflation in Tanzania. The effects, however, are bigger during and after the pandemic than before the crisis because of COVID-19-induced movement restrictions and lockdowns, which have battered the food supply chain. The study further finds that before the pandemic increase in extended broad money supply and government expenditure in the form of wages and salaries have no significant contribution to food inflation. However, after the pandemic, these accommodative expansionary fiscal and monetary policy measures to restore the economy to equilibrium resulted in inflationary pressure in the country. Moreover, the results show that the national food reserve has no significant effect on food prices, neither before nor after the pandemic. This outcome is partly attributable to the shortage of food caused by drought. Thus, to control food inflation, the government has to increase measures towards reducing fuel prices. These include reducing fuel import duties along with revising the whole fuel importation system. Also, the government needs to inspire its citizens to increase food production through increasing subsidies on agricultural inputs to cut down production costs. This is important to take advantage of high food prices in the international markets while maintaining adequate national food reserves. In addition, both fiscal and monetary authorities need to control public expenditures and money supply in the economy. While the government needs to reduce avoidable and unnecessary government expenditures the BOT has to ensure the growth rate of the money supply does not exceed the expansion of the economy.*

Keywords Food inflation, COVID-19, Tanzania.

JEL classification: C35, D63, I35

1.0 Introduction

Since 2015, when President Magufuli came into Power, Tanzania has undertaken new fiscal and monetary consolidation efforts to enhance economic growth. As a result, on July 2020 the World Bank upgraded the Tanzanian economy from a low-income to a middle-income country. However, this promising picture of relatively stable macroeconomic performance in Tanzania was dampened by the prevalence of COVID-19 in the world. For instance, the GDP growth rate declined from an average of 7% per annum between 2015 and 2016 to 4.8% per annum between 2021 and 2022 (BOT, 2022). There is a widespread agreement among the economists that coronavirus pandemic had severe negative impacts on the economy. Epidemics, of the size of COVID-19, have huge economic impacts not just from the costs of managing the health of the people and losing the labour force but stopping them, restoring the economy to equilibrium and keeping it functioning. Early estimates by the World Bank and IMF predicted that most of the economies will lose at least 2.4% of the value of their GDP over 2020 due to COVID-19. The predictions were made before COVID-19 became a global pandemic and before the implementation of social contact restrictions (Duffin, 2020).

The agricultural sector has been playing an important role as a driver for Tanzanian economic growth since independence. As of now, about 65% of the entire population depends on agriculture. The sector contributes about 28 % of the country's GDP and about 24% of the total exports and ensures food security in the country (FYDP3, 2021). These facts, however, literally mean that two-thirds of Tanzanians are working to produce only one-third of the country's GDP. Like in many other developing countries, the economic growth in Tanzania has been coupled with a high rate of inflation. However, a major economic challenge the country is facing now is high food price inflation. The current statistics show that for the period ending October 2022, the share of inflation to food and non-alcoholic beverages accounts for 9.1% (BOT, 2020). This figure is higher compared to headline inflation, which was 4.9% during this period. Food inflation is a key concern across the world because it reduces consumers' purchasing power leading to poor living conditions of people. Following high food inflation in Tanzania, different policy measures have been undertaken. They include consumer-oriented policy measures such as national food stock control and producer-oriented policy measure such as the provision of subsidies, but food inflation is still high in Tanzania.

There is a growing theoretical and empirical consensus that both demand and supply-side factors and policy decisions are the main driving forces of food price inflation (Boon and Edler, 2018; Hochman, Rajagopal, Timilsina, and Zilberman, 2014). The supply-sided factors include lower levels of cereal stocks by the world‘s major cereals producers, which leads to higher price volatility; reduction in productivity as a result of bad weather conditions, increasing petroleum prices, which affect food prices through rising transport costs; high cost for agricultural inputs such as fertilizers pesticides and quality seeds; yield variability and international price arbitrage (Ojeleye, 2017; McDonald, 2017; Adam *et al.,* 2016; Clay *et al.,* 2011). On the demand side, inflation occurs when the aggregate demand outpaces aggregate supply. For example, increasing demand from the emerging biofuels market and changes in consumption patterns in large emerging economies such as China and India (Kalkuhl *et al.,* 2016; Mitchell, 2008). Also, demand-pull inflation occurs when the money supply grows faster than the output in the economy. Policies such as export bans by key wheat and rice producers and the use of food grains to produce biofuels, financial market speculation and international trade policy also contribute to the problem (Kalkuhl *et al.*, 2016; Mitchell, 2008).

Scholars in developed, emerging, and Sub-Saharan African (SSA) have devoted a great deal of empirical efforts analyzing the determinants of food inflation: Reziti (2005) for Greek; Kargbo (2007) for South Africa; Yu (2014) for China and Sasmal (2015) Gulati and Saini (2013) for India; Basu (2011) for India; Nair and Eapen (2012) for India, Carrasco and Mukhopadhyay (2012) for South Asia; and Robles (2011) for Asia and Latin America. However, results are ambiguous and vary considerably across countries due to different economic structures, policies and methodologies used. Thus, to understand the determinants of food inflation, each country must be analyzed separately. Despite the importance of understanding the determinants of food inflation in Tanzania, there exists little empirical evidence on this subject matter (see e.g., Adam *et al.,* 2013; Nelly, 2020). Most of the previous studies focused on the determinants of general price level; they did not specify the causes of food inflation. In addition, the previous studies did not take into account the effects of structural changes brought by COVID-19; thus, failed to give policy suggestions to manage food inflation before, during and after the crisis. It is from this point of departure; this study fills this gap in the literature. Managing food inflation is important for households, fiscal and monetary authorities, international organizations, and policymakers, particularly during economic hard times.

The rest of this paper is organized as follows: Section 2 is the literature review; Section 3 is the methodology; Section 4 presents research findings, and Section 5 is conclusion and policy implications.

2.0 Literature Review

2.1 Theoretical Review

Neo – Keynesian theory points out three major types of inflation: demand-pull inflation, cost-push inflation, and built-in inflation. Demand-pull inflation accelerates when aggregate demand increases beyond the power of the economy to supply its potential output. Thus, demand-pull inflation encourages economic growth since the excess demand will stimulate investment and consumption. Cost-push inflation is caused by a drop in aggregate supply independent of demand due to an increase in the costs of production. A rise in production cost may happen because wages have gone up or because raw material prices have increased or may be due to natural disasters. Built-in inflation theory states that inflation is induced by adaptive expectations, in which in economics, adaptive expectations are a hypothesized process by which people form their expectations about what will happen in the future based on what has happened in the past. This is often linked to the "price/wage spiral" because it involves workers trying to keep their wages up with prices, and firms passing these higher labour costs on to their customers as higher prices, leading to a 'vicious circle'. Built-in inflation reflects events in the past, and so might be seen as hangover inflation (Gordon, 1975).

According to Monetarists economists, the most significant factor influencing inflation or deflation is how fast the money supply grows or shrinks relative to the expansion of the economy; i.e. when money supply grows faster than output inflation occurs but when it grows slower than output deflation occurs. Fisher's formulation of the quantity theory of money postulates that monetary expansion leads to high output tied with inflation (Mishkin, 2004). The classical dichotomy, however, holds that monetary expansion will typically result in higher prices, and not more output (Stieglitz *et al,* 2006). Therefore, "inflation is always and everywhere a monetary phenomenon" (Friedman, 1968). That is, a persistent rise in the general price level is necessarily preceded by a sustained increase in the money supply. Monetarists also believe that rational expectations partially affect what happens to the economy in the future. For instance, if producers believe that the price will be higher in the future, they will make a rational decision to slow production until the price rises. This decision weaken supply while demand stays the same, hence likely to cause inflation (Shiffrin, 1996).

Overall, agricultural price exhibits sharp fluctuations over time compared to non-agricultural prices. This is because the elasticity of demand for most agricultural products is so low that a small change in supply with demand remaining constant or a small change in demand with supply remaining unchanged causes a large change in agricultural prices (Sasmal, 2015). Thus, change in food supply brought by internal or external shocks such as natural disaster, unfavourable weather conditions, rise in oil price and the prevalence of pandemics may alter food prices. The structuralists believe that the roots of food inflation are found in bottlenecks of "inelastic supply" in the agricultural sector. Thus, structural inflation, results from inelastic supply (Nelly, 2020). Also, structural inflation arises due to the unstable growth rate of export, which is inadequate to support the required growth rate of the economy. In addition, a uniform rate of growth of money wages throughout the economy leads to permanent cost pressures in the service sector, which have lower productivity growth.

2.2 Empirical Review

There exist numerous studies on determinants of food inflation in developed and developing countries. Samal *et al.,* (2022) analyzed the impact of macroeconomic factors on food price inflation in India by utilizing the monthly time series data covering January 2006 to March 2019. The long-run relationship was found among variables using ARDL bounds testing to co-integration. The results showed that per capita income, money supply, global food prices, real exchange rate and agricultural wages positively and significantly influenced food price inflation in both the short and long run. Nadiah and Mansur (2019) investigated factors for food price inflation in Malaysia using Nonlinear Autoregressive Distributive Lag (NARDL) technique and found that the exchange rate was the most variable determining food price inflation in the long run, unlike the short-run period. Similarly, Ismaya and Anugrah, (2018) investigated the determinants of food price inflation in Indonesia using quarterly data (2008: Q1 to 2017: Q4) and a GMM estimator. The results revealed that food production, agriculture sector output, infrastructure, food import, agriculture sector credit, level of demand (M1/consumption), and seasonal events have a strong impact on food price inflation.

Abdullah and Kalim (2017) conducted a study on the determinants of food inflation in Pakistan. The study used time-series data from 1997 through 2017 and employed Ordinary Least Square (OLS). The study found that agricultural value addition, food imports and money supply have significant positive effects on food price inflation. Anam et al. (2014) conducted a similar study on the determinants of food price inflation in Pakistan using time series data ranging from 1962 to 2012, obtained from World Development Indicator (WDI). The study established that there is a positive and significant impact of food exports, food imports and population on food price inflation. A study done by Abdullah (2008) to identify the main determinants of food price inflation in Pakistan using data from 1972 to 2008 and Johansen’s co-integration technique found that there are the long run relationships among food price inflation and its determinants such as money supply, per capita GDP and food imports and food exports. All determinants were found to have a positive and significant effect on food price inflation except money supply and per capita income. These studies reflect that both domestic agricultural production and global food price matter for food inflation.

Fasanya and Olawepo (2018) examined the determinants of food price volatility in Nigeria from January 1997 to April 2017 using the GARCH approach, in particular, Baba-Engle-Kraft-

Kroner (BEKK) and Dynamic Conditional Correlation (DCC) models. The study found that information shocks originating in Consumer Price Indices (CPI), lending rates, exchange rates and oil market have a direct effect on current conditional volatility in market food prices. Haji and Gelaw (2012) studied determinants of food price inflation in Ethiopia from 1997 to 2010 using co-integration error correction modelling (ECM). The study found that both external and domestic factors cause food inflation. In addition, the study found that food inflation is a monetary phenomenon in Ethiopia. Nelly (2020) analyzed the effect of macroeconomic variables on food price inflation in Tanzania using quarterly data from 2006-2019. The study employed Vector Error Correction Model and found that food import, exchange rate, and Per capita GDP have positive and significant effects on food price inflation. Most previous studies give insight into determinants of food inflation, but they do not specifically consider the effects of COVID-19. This study is, therefore, an attempt to analyse the determinants of food inflation before, during and after the pandemic in Tanzania.

3.0 Methodology

3.1 Data

The study used monthly time series data covering the pre-covid season from July 2017 to November 2019 and the post-covid season from January 2020 to Match 2022. This sample period was selected to solely capture the effects of structural changes brought by covid-19 on food inflation while excluding the effects of the Russia-Ukraine War, which began in April 2022. Data on the global food price index was drawn from Food and Agricultural Organization (FAO) while data on national food stock, food inflation, price of petroleum products, government spending on wages and salaries, and extended broad money supply were extracted from the Bank of Tanzania (BOT)'s Monthly Economic Review.

3.2 Preliminary Tests

To overcome spurious regression, Phillips-Perron (P-P) test for the unit root was used. Given the presence of structural breaks, the P-P test was used instead of the standard Dickey-Fuller (DF) test because DF test results are biased towards non-rejection of the unit-roots when structural breaks are incorporated in the data set (Indraratna, 2003; Li, 2001). Thereafter, the Johansen procedure was used to ascertain whether variables are bound together in the long term. The Johansen test is superior to residual-based test because it enables testing for the existence of multiple co-integrating vectors (Verbeek, 2004).

3.3 Model

The error correction model (ECM) was used to analyze determinants of food inflation during the crisis. The ECM has more forecasting power than the vector autoregressive model (VAR) when the variables used pass the co-integration test. Given the existence of co-integration, all terms in ECM are stationary; therefore, standard regression techniques with their associated statistical inferences are valid (Green, 2003). To derive ECM, the autoregressive distributed lag model (ADL) is specified as follows:

$$Yt = \delta + \alpha Y_{t-1} + \beta_1 X_t + \beta_2 X_{t-1} + \varepsilon_t \quad \text{..........} \quad (1)$$

Where: Y; is food inflation, X; is a vector representing determinants of food inflation and εt; is a classical error term. If the time series is not stationary, equation (1) can generate spurious results. Thus, with co-integrated but non-stationary data, the best alternative is to estimate the ECM of the form:

$$FI_t = \alpha + \beta_1 FIN_{t-1} + \beta_2 \Delta GFP_t + \beta_3 \Delta FEU_t + \beta_4 \Delta NFS_t + \beta_5 \Delta WAS_t + \beta_6 \Delta M3_t + \gamma ECT \ldots\ldots (2)$$

Where: γ is the adjustment coefficient and ECT is the corresponding error correction term. β are the short-run elasticities and α is a constant. FIN is food inflation measured as the rate of change in the price of food both processed and unprocessed. GFP is a global food price index measured as a monthly change in international prices of a basket of food commodities. FEU is the fuel, energy and utility index. NFS is the national food stock or reserve measured in tons per month. WAS is wage and salaries defined as monthly government expenditure on wages and salaries for public servants. M3 is extended broad money supply measured as broad money supply (M2) plus foreign currency deposits.

4.0 Results and Discussion

4.1 Unit Root Test Results

To establish whether variables are stationary the Phillips - Perron (P-P) test was used for each variable in log-level and log – difference (Table 1).

Table 1: Phillips – Perron Test Results

Variables	Levels		First Difference		Order of Integration
	Test Statistics	Critical Value	Test Statistics	Critical Value	
FIN	-1.625	-3.556	-6.053**	-3.558	1(1)
FEU	-1.511	-3.556	-7.329**	-3.558	1(1)
GFP	-0.265	-3.556	-5.856**	-3.558	1(1)
NFS	-1.334	-3.556	-4.381**	-3.558	1(1)
WAS	2.269	-3.556	-6.048**	-3.558	1(1)
M3	1.414	-3.556	-10.914**	-3.558	1(1)

Notes:
FIN: natural log of domestic food price index; FEU: natural log of fuel, energy and utility price index; GFP: natural log of global food price index; NFS: natural log of national food stock; WAS: natural log of government expenditure on wage and salaries; M3: natural log of extended broad money supply; and ** indicates the rejection of the null hypothesis of non-stationary.

The results revealed that all variables were not stationary at their levels. Though, after taking their first differences all variables became stationary. This is shown by their test statistics, which are now less than their corresponding critical values at 5% levels of significance. Therefore, the null hypothesis of the presence of a unit root is rejected at 5% significance level; suggesting that all variables are stationary and integrated of order one 1(1).

4.2 Lag Selection Criteria Results

To ensure robustness of the results the study employed the Akaike Information Criteria (AIC), Hannan - Quin Information Criteria (HQIC), and Schwarz Bayesian Information Criteria

(SBIC) to establish and select the optimal lag length. The results in Table 2 present the output of the choice criteria for selecting the order of the model. Based on the results, the AIC, HQIC, and SBIC select three (3) lags. Thus, the optimal three (3) lags was used because it can still preserve degrees of freedom for estimation. The use of appropriate lag is emphasized to mitigate the problem of autocorrelation.

Table 2: Lag Selection Results

Lag Order	AIC	HQIC	SBIC
0	73.66	73.74	73.86
1	72.02	73.06	74.66
2	72.04	73.56	75.92
3	71.66**	72.22**	73.09**
4	72.03	74.03	77.12

Note:
** = indicates the optimum lag length selected by the respective criterion at 0.05 levels of significance. The decision criteria is that "the smaller the value the better the lag length chosen".

4.3 Co-integration Test Results

The Johansen co-integration test was used to determine whether the variables have long-run equilibrium (Table 3).

Table 3: Johansen Co-Integration Test Results

Null Hypotheses	Trace Statistics	Critical Value	Max-Eigen Statistics	Critical value
		2017 - 2019		
r = 0	157.22	94.15	53.47	39.37
r ≤ 1	103.75	68.52	40.36	33.46
r ≤ 2	63.39	47.21	29.554	27.07
r ≤ 3	33.84	29.68	19.54**	20.97
r ≤ 4	14.30**	15.41	12.53	14.07
r ≤ 5	1.76	3.76	1.76	3.76
		2020 - 2022		
r = 0	149.38	94.15	60.84	39.37
r ≤ 1	88.54	68.52	38.31	33.46
r ≤ 2	50.24	47.21	27.21	27.07
r ≤ 3	23.08**	29.68	12.44**	20.97
r ≤ 4	10.59	15.41	10.55	14.07
r ≤ 5	0.04	3.76	0.04	3.76
		2017 - 2022		
r = 0	167.24	94.15	54.05	39.37
r ≤ 1	113.20	68.52	43.56	33.46
r ≤ 2	69.64	47.21	26.84**	27.07
r ≤ 3	42.80	29.68	24.36	20.97
r ≤ 4	18.43	15.41	12.84	14.07
r ≤ 5	5.58	3.76	5.58	3.76

Note:
r represents the number of co-integrating vectors; if there are k stochastic variables in the equation, there can be up to k-1 co-integrating vectors, i.e. r = k-1; if 0 < r < k there are r independent linear combinations of y's that are 1(0), but it may not be easy to give all these

relationships an economic interpretation; if r = k estimation of the model as VECM is not necessary; and ** indicates the accepted null hypotheses at 0.05 levels of significance.

The results of the co-integration test in Table 3 rejected the null hypothesis of no co-integration (r = 0) against the alternative (r ≠ 0), as evident by test statistics of $\lambda trace$ and λmax, which are greater than the critical values at 5% significance level. This means there is a long-run relationship among the variables for the pre-covid period, post-covid period, and the whole sample period. In addition, the Johansen test reveals that there is more than one co-integrating vector, for the pre-covid period, post-covid period, and the whole sample period. The pre-covid period $\lambda trace$ shows the existence of at most four (r ≤ 4) vectors while λmax suggests at most three (r ≤ 3) vectors; thus, we conclude that there are at most four vectors since $\lambda trace$ is more powerful than λmax. For a post-covid period, both $\lambda trace$ and λmax show existence of at most three (r ≤ 3) vectors. For the whole sample period, λmax indicates the existence of at most two (r ≤ 2) vectors while $\lambda trace$ is silent; thus, we conclude that there are at most two vectors because λmax is used to supplement $\lambda trace$.

4.4 Error Correction Model Results

Table 4 presents ECM estimation results for the pre-covid period, post-covid period and whole sample period. It also shows the results of the Chow test, which determine whether the structural change has taken place. The Chow test results reveal that the computed F (3.97) is greater than the tabulated or the critical *F (3.12) at percent significance level. This outcome implies that the sub-period regressions (pre-covid and post-covid periods) are statistically different. Therefore, the null hypothesis of *"no structural change"* is rejected; meaning that the prevalence of COVID-19 has statistically and significantly altered the relationship between food inflation and its determinants. This outcome coincides with findings by Mishra et al. (2022) that the price of essential food items increased significantly during the pandemic compared to the pre-pandemic period. The alternatively but plausible interpretation of the Chow test result is that the pooled regression is dubious because the relationship between food inflation and its determinants, i.e., global food price, price of petroleum, national food reserve, wage and salaries, and money supply has undergone structural change. Therefore, based on the Chow test, whole sample period estimation results are econometrically meaningless.

The ECM results show that before COVID-19, the speed of adjustment, i.e., error correction term is negative and significant, i.e. – 0.7388; implying that, holding other factors constant, global food price, price of fuel, food reserve, wage and salaries, and money supply affect food inflation in the long-run. Likewise, after COVID-19, the speed of adjustment is negative and statistically significant, i.e. – 0.8637; meaning that food inflation adjusts towards long-run equilibrium in response to global food price, price of fuel, national food reserve, wage and salaries, and money supply. The results demonstrate that before the pandemic about 73 percent of the last period's disequilibrium is corrected in the next period while after the pandemic about 86 percent of the last period's disequilibrium is adjusted in the next period. This means that food inflation responded more quickly or faster to changes in its determinants after the pandemic compared to before the pandemic period. This outcome suggests that COVID-19 has exaggerated the effects of global food prices, price of fuel, national food reserve, wages and salaries, and extended broad money supply on food inflation in Tanzania. That is, food supply chain disruptions caused by COVID-19 have led to immediate and greater changes in food prices.

Turning to short-run effects, the results show that before the pandemic price of fuel is positively and significantly related to food inflation as evident by the coefficient of fuel, energy, and utility price index. Similarly, the results reveal that after the COVID-19 shock, the price of fuel relates positively and significantly to food inflation as supported by the coefficient of fuel, energy and utility index. However, a closer examination of the results reveals that a percentage increase in the price of oil had more profound effects on food inflation during and after the pandemic compared to the period before the pandemic. This discrepancy in findings before and after the pandemic implies that the prevalence of COVID-19 has aggravated the effects of oil price shock on food inflation in Tanzania. In practice, an increase in the price of petroleum products contributes to high food inflation through rising production costs and/or transportation costs. The COVID-19-induced movement restrictions and lockdowns have battered both the supply of and demand for fuel. The disruptions in the transportation sector due to the COVID-19 lockdowns and movement restrictions severely affected food markets, creating supply shortages and increasing transaction costs, hence high food prices.

The results also show that before COVID-19, food prices in international markets relate positively and significantly to food prices in Tanzania. This is evident by the coefficient of the global food price index. Likewise, the results reveal that after the pandemic, the increase in global food prices positively and significantly affected domestic food prices. A closer examination of the results, however, shows that the effect of global food prices on domestic food prices after the pandemic is much more compared to the effect before the crisis. This is partly because trade policy restrictions such as export bans imposed in some countries, particularly major producers, to reduce the impact of COVID-19 have also affected food markets in several ways including increasing food prices in the world market. This increase in the global food price of the commodity in turn influences the domestic price through international trade mechanisms. The export increases as the global food price increases resulting in a decrease in domestic market supply followed by a hike in prices. On the contrary, the rise in imports raises the domestic substitute food item’s price followed by a surge in domestic market price. Robles (2011) and Samal et al (2020) found a similar outcome that international price transmission has a positive impact on the domestic agricultural market in Asian and Latin American countries.

The results show that before COVID-19, change in wage and salaries in the public sector does not affect food inflation. This is evident by statistically insignificant coefficients of government spending on wages and salaries. This outcome indicates that before the pandemic additional wage and salaries were lower than additional labour productivity in the public sector. By contrast, the results reveal that during and after the pandemic, increase in wage and salaries positively and considerably influenced food inflation in Tanzania. This is strongly evident by positive and statistically significant coefficients of government spending on wages and salaries. This suggests that an increase in wages and salaries during and after the pandemic was not commensurate with marginal labour productivity, i.e., additional wage and salaries outweighed additional labour productivity. In addition, it appears that an increase in government spending on wages and salaries after the pandemic led to inflation because it involved reducing investment spending on productive sectors. Khan et al (2021) noted that healthcare budgets had increased significantly to fight COVID-19 with various stringency measures in many developing and emerging countries. As a result, public spending in other sectors and the food supply was disrupted, which directly and indirectly increased food prices and undernourishment.

Table 4: Error Correction Model Results

VARIABLES	FIN BEFORE COVID-19		FIN DURING AND AFTER COVID-19		FIN OVERALL PERIOD	
	1	2	1	2	1	2
FIN	0.1449	-0.0161	-0.0631	0.2171	0.2854	0.0857
	-0.618	-0.945	-0.766	-0.214	-0.114	-0.571
GFP	0.1219	0.252	0.0659	0.1097	-0.0426	-0.043
	-0.222	(0.019) **	(0.087) *	(0.002) ***	-0.148	-0.147
FEU	0.2668	0.2094	0.0309	0.3334	0.0784	0.0023
	(0.040) **	(0.054) *	-0.668	(0.022) **	-0.203	-0.963
NFS	0.0003	-0.0004	1.7E-05	1.8E-05	1.5E-05	-7E-06
	-0.274	-0.186	-0.276	-0.753	-0.18	-0.513
WAS	1.1E-05	8E-06	3.6E-05	1.2E-05	2.7E-05	1.2E-05
	-0.435	-0.264	(0.006) ***	-0.125	(0.017) **	(0.056) *
M3	0.00014	0.00011	0.00039	0.00041	0.00049	9.8E-05
	-0.735	-0.777	(0.088) *	(0.090) *	-0.11	-0.678
ECT	-0.7388		-0.8637		-0.27	
	(0.083) *		(0.000) ***		(0.034) **	
CON	-0.1863		0.1873		0.0521	
	-0.41		-0.768		-0.616	
Chow Test	Computed F = 3.97 > Critical *F = 3.12					

Note: FIN: natural log of domestic food price index; FEU: natural log of fuel, energy and utility price index; GFP: natural log of global food price index; NFS: natural log of national food stock; WAS: natural log of government spending on wage and salaries; M3: natural log of extended broad money supply; ECT: error correction term; CON: constant; 1 and 2 represents coefficient estimates of lagged variables and figures in parentheses are their corresponding p-values; ***, ** & * means significant at 1%, 5% & 10% levels, respectively.

The results also reveal that before the prevalence of COVID-19, an increase in the level of extended broad money supply though positive has no considerable effect on food inflation in Tanzania. However, the results show that following the COVID-19 shock, an increase in extended broad money supply as a monetary policy anchor positively and significantly accelerated food inflation, as evident by the coefficient of M3. This outcome reflects that before the pandemic food inflation was not a monetary phenomenon. Rather, the results suggest that the accommodative expansionary monetary policy measures to restore the economy to equilibrium during and after the pandemic resulted in higher growth rates of money supply than expansion of output leading to inflationary pressure in the economy. The BOT and NBS statistics (2022) show that while the extended broad money supply increased from an average of 4.5 percent before the pandemic (2017-2018) to an average of 15.5 percent after the pandemic (2020-2021) the growth rate of the economy (GDP) declined from an average of percent before pandemic (2017-2018) to an average 4.5 percent after pandemic (2020-2021). Mellor and Dar (1968) found that the expansion of the money supply largely determines upward pressure on food grain prices. A closer examination of the results shows that change in the national food reserve has no substantial effect on food prices in Tanzania neither before nor after the prevalence of COVID-19, as evident by statistically insignificant coefficients of the national food stock in both sub-periods. This outcome partly reflects that climate change particularly drought contributed to food shortage in the country. TMA reports show that many parts of Tanzania received lower rainfall than normal over the study periods. This shortage of food due to drought renders the effectiveness of the national food reserve agency (NFRA) in controlling prices of food commodities in the country for both sub-periods. In practice, NFRA is supposed to buy food items when there is a surplus and sell them at a relatively lower price when there is a deficit. This outcome coincides with the previous findings by Pierre et al (2017) that NFRA has had an insignificant impact on maize prices during 2010/11 – 2014/15 despite its pricing strategy. In addition, the results demonstrate that previous food item prices have no significant effect on future food inflation neither before nor after COVID-19. This outcome suggests that the current food price development is not contributed by the previous food price index; rather it is determined by global food price, the price of petroleum products, the extended broad money supply, and wages and salaries.

4.5 Diagnostic Test Results

Given the fact that time series estimation suffers from a number of econometrics problems, the study conducted the diagnostic tests to validate the research findings. First, the Lagrange Multiplier (LM) test was employed to ascertain the presence of residual autocorrelation. The results in Table 5 show that there is no serial autocorrelation at lag order as evidenced by the p-values, which are greater than 0.05 significance level. The LM test is superior over the Durbin Watson test (DW) in dynamic models. Second, the Jarque-Bera (JB) test was employed to establish whether residuals are normally distributed. The results demonstrate that the residuals are normally distributed before and after the COVID-19 shock, as supported by p-values, which are greater than 0.05 level of significance.

Table 5: Diagnostic Test Results

BEFORE COVID-19				**AFTER COVID-19**			
LM TEST				**LM TEST**			
1		2		1		**2**	
Ch2	Prob>Ch2	Ch2	Prob>Ch2	Ch2	Prob>Ch2	Ch2	Prob>Ch2
26.6873	0.8706	37.415	0.4039	36.8185	0.4308	32.4722	0.6372
JB TEST				**JB TEST**			
Ch2		Prob>Ch2		Ch2		Prob>Ch2	
1.233		0.5397		0.724		0.6964	
Skewness		Kurtosis		Skewness		Kurtosis	
0.5036		2.9203		0.2447		2.4173	

5.0 Conclusion

The study analyzed the determinants of food inflation before, during and after the prevalence of COVID-19 in Tanzania. To understand the effects of the global pandemic, the study used monthly time series data covering pre-covid and post-covid periods.The results show that a rise in the price of fuel and global food prices account for high food inflation before and after the pandemic. Though the effects are relatively bigger during and after the pandemic because of COVID-19-induced movement restrictions and lockdowns, which have battered food markets. The study further finds that before the pandemic increase in extended broad money supply and government expenditure in the form of wages and salaries have no significant contribution to food inflation. However, after the pandemic, these accommodative expansionary fiscal and monetary policy measures to restore the economy to equilibrium resulted in inflationary pressure in the country. Also, the results show that the national food reserve has no significant effect on food prices, neither before nor after the pandemic. This outcome is partly attributable to low food crop production (shortage of food) over the period in the country caused by drought. Therefore, to mitigate food inflation, the government has to increase measures towards reducing fuel prices. These include reducing fuel import duties along with revising the whole fuel import system. Also, the government needs to inspire its citizens to increase food production through increased provision of subsidies on agricultural inputs and improving irrigation schemes. This is important to take advantage of high food prices in international markets while maintaining a high national food reserve. In addition, the government needs to reduce avoidable and unnecessary spending while BOT has to ensure the growth rate of the money supply does not exceed the expansion of the economy.

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