Impact of Food Price Volatility on Household Food Insecurity in Burkina Faso and Nigeria: Evidence from the LSMS-HFPS data

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Abstract:
The global economic meltdown has exacerbated the vulnerabilities of households in the global south with Sub-Saharan Africa being the worst hit. This poly-crisis era is marked by price volatility, food insecurity, and high unemployment rates. While evidence abounds that price volatility may influence the food security status of households differently depending on their geographical location there is no universal consensus as to whether the impact of food price volatility on food security is higher in coastal or landlocked countries. We therefore examined the differential impacts of food Price volatility on food security in Nigeria and Burkina Faso using the Living Standard Measurement Study High-Frequency Phone Survey (LSMS-HFPS) data sets from 2020-2023. We fit a Linear probability Random-Effects (RE) model, controlling for other vector variables that can affect the food security status of the household. Our findings revealed the distinct patterns of food insecurity challenges between Burkina Faso and Nigeria. While food insecurity was aggravated by food price volatility in both countries, Nigerian households experienced greater severity of the food insecurity crises. The other significant drivers of food insecurity include gender, dependency ratio, and urban residency. Our findings provide a distinct understanding of how geographical differences between a landlocked and a coastal country influence food security dynamics. We concluded that Targeted policy interventions are essential to mitigate the adverse effects of food price volatility on food security in both countries. Policy implications are discussed in the paper.

Keywords: price volatility, food security, poly crisis, climate change, landlocked, coastal[1]

1. Introduction

In the current poly-crisis era, characterized by the convergence of multiple, simultaneous global crises such as climate change, conflicts, and COVID-19 [1,2], the volatility of food prices has emerged as a critical issue with profound implications for food security [3]. The complex

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interplay between market dynamics, climatic disruptions, and geopolitical instabilities has exacerbated the vulnerability of households, particularly in developing countries with sub-Saharan Africa being the worst hit [4,5]. Therefore, understanding how food price volatility affects food security is increasingly crucial for designing targeted, proactive, and mitigating policies, particularly in this region [6,7].

Research efforts have been devoted to examining seasonal fluctuation of prices due to agricultural production cycles [8,9] and reports have shown that food prices are greatly affected by the seasonality of agricultural commodities in sub-Saharan Africa whose economy relies hugely on subsistence farming [8,10,11]. Food prices are cheaper during harvest and high during the off-season [12]. Price fluctuations are essentially worsened in sub-Saharan Africa due to inadequate processing and storage facilities [13,14]. In addition, most agricultural production in Sub-Saharan Africa is rain-fed hence, households in this region are also faced with food price shocks due to changing climate [15,16]. Other identified factors include market failures, weak governance [17], insurgencies, and emerging risks and uncertainties like the COVID-19 pandemic [18]. In light of this, policymakers have channeled efforts to enact policies to reduce the impact of seasonality as well as uncertainties on food prices in sub-Saharan Africa [3].
While a lot of research efforts have been devoted to analyzing the nexus of food price volatility on food security, these studies usually zoom their investigation lens toward one country at a time. To be best of our knowledge none of these countries have compared countries that represent different geographical contexts, particularly in sub-Saharan Africa. To be able to fill this research gap, we used the Living Standard Measurement Study- High-Frequency Phone Survey (LSMS-HFPS) data sets from Nigeria and Burkina Faso to analyze the impact of the volatility of food prices on food insecurity situations in diverse geographical contexts.

Nigeria and Burkina Faso present compelling case studies due to their distinct geographical, economic, and social contexts. Nigeria, with its extensive coastline, benefits from maritime trade routes and diverse agricultural zones, yet it faces significant challenges, including political instability and fluctuating oil revenues, which indirectly influence food prices [19]. Conversely, Burkina Faso, being landlocked, contends with limited access to international markets, higher transportation costs, and a heavy reliance on subsistence agriculture, making it particularly susceptible to price shocks [20].

Our analysis offers four unique contributions to empirical debates on food price volatility -food security nexus: first, our findings provide a distinct understanding of how geographical differences between a landlocked and a coastal country influence their food security dynamics; secondly, we suggested targeted policy recommendations necessary to curb the negative effects of food price volatility on food security in both countries; thirdly, using the LSMS High-Frequency Phone Surveys (HFPS) dataset for our analysis is unique because it provides high-frequency, longitudinal data that captures the dynamic impacts of global shocks and uncertainties, such as Climate change and the pandemic, on socioeconomic conditions in multiple countries. This dataset allows for detailed tracking of changes at the household and individual levels over time, which is invaluable for understanding the immediate and evolving effects of crises on food security; finally, we have contributed to the research arguments by confirming that the negative impact that food price volatility has on food security is not necessarily worsened by being landlocked but that factors such as food production dynamics, food storage strategies, economic policies, conflict management, and social capital play a rather greater role.

2. Theoretical framework:

Our study relies on the Entitlement Theory. This theory was proposed by Amartya Sen in 1981 [21]. He opines that food security is not just a function of the availability of food but is strongly connected to both its economic and legal access. The theory clearly illustrates how frequent food price spikes can hamper the ability of a household to purchase food thus affecting the food security status of such household. In his illustration, Sen identified four unique pathways in which individuals derive food entitlements namely; production, trade, labour, and transfer pathways.
The direct effect of food price volatility on trade-based entitlements is through a reduction in purchasing power; as such households tend to have reduced access to food even at the same income level [22,23]. This theory thus emphasizes the processes through which economic shocks translate into food insecurity, making it especially pertinent to our comparative study of Nigeria and Burkina Faso [24].

In Nigeria, for instance, food price volatility can severely impact urban households that are dependent on market purchases, as their entitlements are primarily trade-based [19]. In contrast, in Burkina Faso, where subsistence farming is prevalent, households might still face food insecurity due to reduced trade entitlements despite having some production-based entitlements [20].

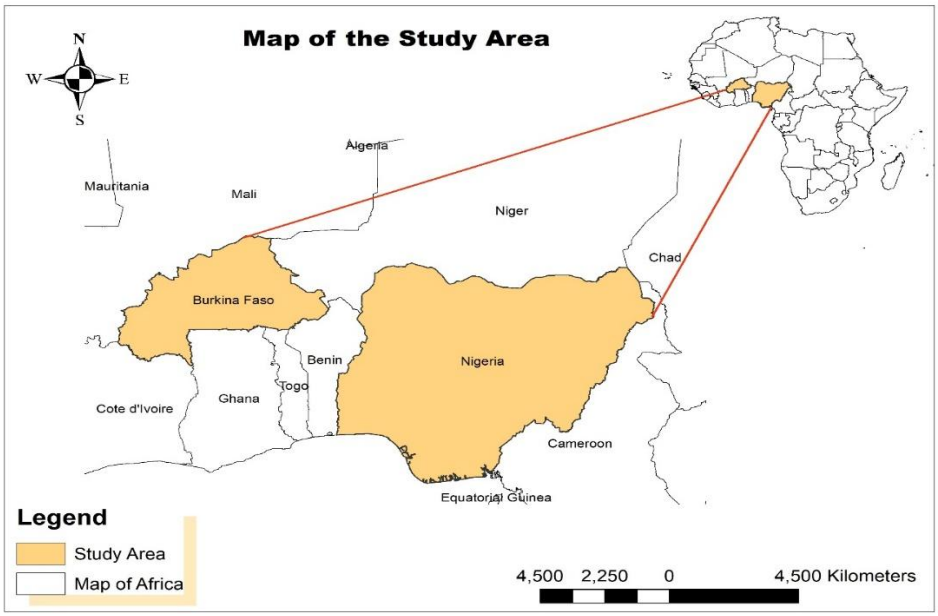

Figure 1: The Study Area Map
Source: Authors' design via ArcGIS

The motive behind the choice of our selection of Nigeria and Burkina Faso stems from the fact that both countries are located in sub-Saharan Africa and represent different geographic, and economic contexts, thus offering a thorough grasp of how food price volatility affects food insecurity in diverse environments. For instance, Burkina Faso is a landlocked nation that mostly depends on rainfed agriculture and has higher transportation expenses when compared with Nigeria due to a lack of access to seaports and reliance on the port facilities of neighbouring nations [25]. On the other hand, Nigeria is a coastal country with direct access to global markets, which can help prevent shocks to domestic food prices [26]. This disparity in both countries under consideration makes it possible to investigate how access to international markets and trade infrastructures affects food security.

Furthermore, both nations also have significant rates of food insecurity, but they respond differently to price volatility due to differences in social, economic, and policy frameworks [26]. Critically analyzing these two nations thus provides insights for developing proactive and targeted policies.

3. Data and Methods

We used the LSMS-HFPS panel data set to analyze the impact of food price volatility on the food insecurity experience of households in Nigeria and Burkina Faso.

Household survey data in Burkina Faso

The Institut National de la Statistique et la Demographie (INSD) conducted the phone survey in Burkina Faso, using the mobile phone numbers of household members gathered during the 2018/19 Enquête Harmonisée sur le Conditions de Vie des Ménages, EHCVM survey. The comprehensive data gathered from the EHCVM offers a wealth of contextual information for the COVID-19 High-Frequency Phone Survey conducted among Households. Utilizing this background data can help evaluate how the pandemic has affected the nation differently. A series of fundamental questions regarding the main pathways through which people and households are anticipated to be impacted by the COVID-19-related limitations will be posed to the sampled households each month.

Channels like employment, non-labor sources of income, and access to essential services are probably going to be affected. In addition to the main questionnaire, there are monthly rotating questions on particular subjects. This enables the government and development partners to access data almost instantly, facilitating an evidence-based crisis response. The primary goals of this panel survey include to: examine the types of households that are either directly or indirectly impacted by the pandemic; identify the main channels through which the pandemic affects households; and provide pertinent data on socioeconomic indicators and income to evaluate the pandemic's impact on welfare. Phase 1 was carried out for 11 Rounds between June 2020 and July 2021, once a month. Phase 2 was carried out every two months beginning in April 2022 (beginning with Round 12). Phase 3 will begin in July 2023 and run every two months (beginning with Round 18).

Household survey data in Nigeria:

The Nigeria National Longitudinal Phone Survey (NLPS) is a high-frequency phone panel survey of households. It is therefore a critical tool for understanding the socioeconomic effects of the COVID-19 pandemic on households in Nigeria.

The Nigeria COVID-19 NLPS Phase 1 was successfully implemented by the NBS between April 2020 and April 2021. The Poverty and Equity Global Practice and a World Bank team provided technical support. During Phase 1, the General Household Survey-Panel (GHS-Panel) 2018/19 was used to identify over 1,700 households for 12 rounds of monthly phone interviews by the NBS. A wealth of background data on Nigerian NLPS homes was gathered for the GHS Panel, which was formed just over a year before the pandemic. This data can be used to evaluate the disparate effects of the health crisis throughout the nation. Phase 2 of the survey includes bimonthly questionnaire revisions to capture the changing nature of the pandemic and macroeconomic shocks.

Price data

We employed the use of the local currency units (LCU) per dollar as the uniform unit of food price across both countries, enabling a standardized comparison.

Adapting the methodology of Amolegbe et al., 2021 [3], we presumed that the deflated real prices of food items, p, possess a trend element, τ, as well as a component of random error, ε. That is $P = f(\tau, \varepsilon)$. Since our main goal is to comprehend the impacts of food price volatility,

we go above and beyond by detrending the deflated data to make sure that the unexpected price volatility has been fully separated. To do so we start by detrending the price series for each commodity. To achieve this, we begin by detrending each commodity's price series. Our method involves creating a continuous time variable called t_{my}, where time is equal to 1 for June 2020, 2 for July 2021..., and 21 for July 2023. Next, we regress the deflated price for commodity x in month m, represented by p_{my}^{x}, on the time variable t_{my}.

Our equation can be expressed as follows:

$P_{m,y}^{x} = \alpha^{x} + \beta_{m,y}^{x}$ ... (1)

Next, we were able to linearly forecast the deflated prices, $\widehat{P_{m,y}^{x}}$ and estimated the detrended, deflated prices $dP_{m,y}^{x}$ by subtracting the fitted prices for each commodity x as follows:

$dP_{my}^{x} = P_{my}^{x} - \hat{P}_{my}^{x}$ ... (2)

After that, we break down the remaining variation in food prices by first demeaning the prices to derived the price deviation., $\sigma P_{m,y}^{x}$ as follows:

$\sigma P_{my}^{x} = dP_{my}^{x} - \overline{dP}_{my}^{x}$ ... (3)

Our Food Insecurity model is thus presented as follows:

$F_{imy} = \beta_0 + \sum_{x=1}^{i}(\beta_1^{x}\, dP_{m,y}^{x} + \beta_2 \varepsilon_{my}^{x}) + rC_{imy} + e_{imy}$ ... (4)

Where:

F_{imy} = is the food Insecurity status of the household as captured by the Food Insecurity Experience Scale (FIES)

ε_{my}^{x}= price volatility of item x

C_{imy} = vector of control variables

The food items are indexed by x . We included key vector control variables such as household size, respondent's gender and age, and various food prices, including dried fish, beef, mutton, eggs, fruits, fresh milk, cereals, and non-food item prices.

4. Results and Discussion

Figure 2 presents the disaggregated result of the Food Insecurity Experience Scale (FIES)indicators. This illustrates the picture of the food insecurity situation in Nigeria and Burkina Faso. The results revealed that households in Nigeria are more food insecure than households in Burkina Faso. While 61.08% of Nigerian households are worried about not having enough food, 52.97% of households in Burkina Faso experience a similar situation. This might be due to the escalating rates of conflicts and insurgencies in Nigeria which disrupts food supply chains and markets [36,37].

In the same vein, a larger percentage (70.69%) of Nigerian households experience the inability to eat healthy and nutritious food when compared with households in Burkina Faso where 36.74% of households experience such hardship. This result is in tandem with the FAO's report that poor economic conditions severely affect dietary diversity and food quality in Nigeria. This situation might have probably been exacerbated by the high rate of corruption and inefficient food distribution systems likely exacerbate this issue because a study [27] opined that governance and the effectiveness of food aid programs also play crucial roles in ensuring access to a healthy and nutritious diet.

The result further revealed that 67.79% of Nigerian households ate only a few kinds of foods, while only 45.67% of Burkina Faso households were in that condition. This result is in support of the findings of Smith & Haddad (2017), who reported that food price volatility and reduced household income hampers dietary diversity, especially in countries with high inflation rates like Nigeria [28]. The lower percentage in Burkina Faso suggests relatively better food availability or coping mechanisms.

Another important indicator in the FIES module is having to skip a meal. Our analysis reveals the severity of this phenomenon in Nigeria as 65.9% of the sampled households answered yes in affirmative. The challenge is milder in Burkina Faso as only 20.13% reported to have experienced such. The significantly lower percentage in Burkina Faso might probably reflect that households in Burkina Faso had more effective social safety nets or community support systems than their Nigerian counterparts which must have helped to mitigate extreme food insecurity.

Furthermore, 65.50% of Nigerian households reported that they ate less than they required, while only 28.56% of households in Burkina Faso experienced such a situation. Our report confirms the findings of a similar study, that highlight the impact of economic access to food on consumption patterns [27]. The higher percentage in Nigeria indicates more severe economic barriers to food access, likely due to the galloping inflation rates the country is experiencing lately.
In addition, 54.67% of Nigerian households ran out of food, this challenge is milder in Burkina Faso where the statistics stand at 11.16%. The lower percentage in Burkina Faso may reflect better food reserve strategies or more stable local food production systems. Similarly, 50.72% of Nigerian households were hungry but did not eat, compared to 14.12% in Burkina Faso.

Lastly, our analysis revealed 25.01% of Nigerian households went without eating for a whole day, compared to 7.80% in Burkina Faso. This finding is consistent with the FAO's report that extreme food insecurity is more prevalent in regions with ongoing conflict and economic distress, as seen in Nigeria [37]. Generally, our analysis revealed that Nigeria is experiencing a significantly higher rate of food insecurity when compared with Burkina Faso. Our findings are largely consistent with existing literature, confirming that economic instability, conflict, weak policies and poor governance are major drivers of food insecurity. The disparities between the two countries underscore the urgent need for targeted policy interventions in Nigeria to address the underlying causes of food insecurity and to improve food access and availability.

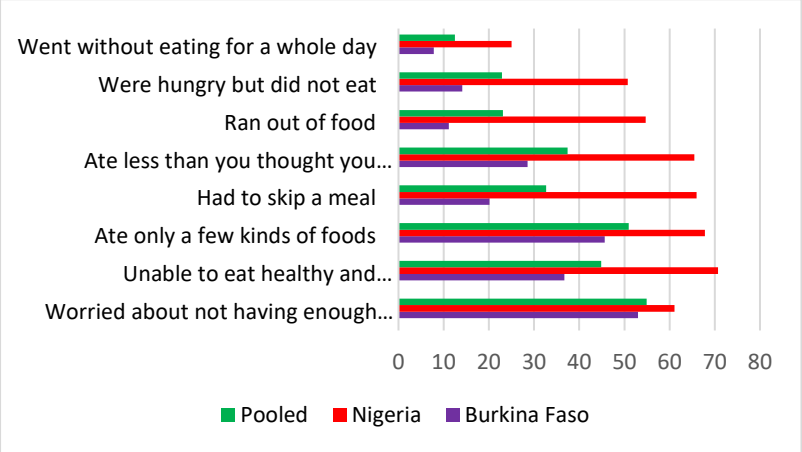

Figure 2: **Disaggregated Food Insecurity Experience Scale between Burkina Faso and Nigeria**
Food insecurity levels in Nigeria and Burkina Faso

In our analysis, we went further to categorize the food insecurity experiences of households into 3 categories. The results are presented in Figure 3.

The majority (83.41%) of households in Burkina Faso only experienced mild food insecurity, with 41.01% of Nigerian households in this category. Conversely, 37.71% of households in Nigeria experience severe food insecurity, on 7.49% of households in Burkina Faso Experiencing this. Additionally, 21.28% of Nigerian households experience moderate food insecurity, compared to 9.1% in Burkina Faso. A similar study confirmed that Nigeria's inflation crises have raised food prices, aggravating the country's food insecurity experience [29].

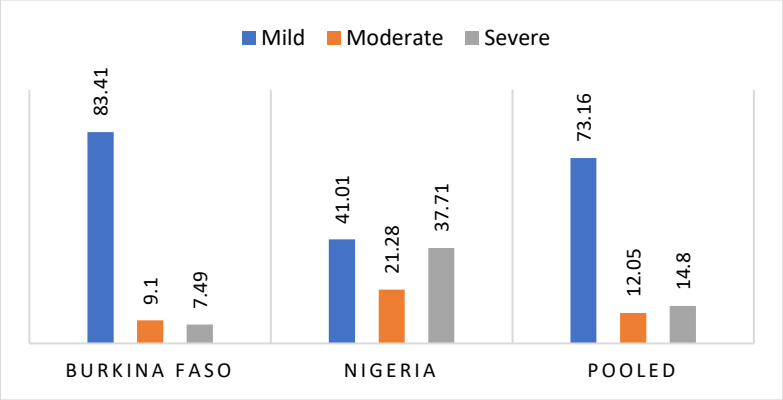

Figure 3: **Food insecurity levels of sampled households across Burkina Faso and Nigeria**

Figure 4 shows the results of the impact of food price volatility on household food security without controlling for socioeconomic variables. The results revealed that the coefficients of deflated price (dev) for pooled and Nigeria datasets were statistically and positively significant ($p<0.05$). A unit increase in price deflations of food as well as non-food items increases the food security of households by $6x10^{-6}$ and $7x10^{-6}$ units. Although the coefficient of deflated price of items was positive for household food security in Burkina Faso it was not as significant and high as the value for Nigeria. These could exist when food and non-food items are in surplus and the purchasing power of households are high to afford both food and non-food items.

However, the household food security showed a statistically significant negative signal with coefficients of the price of beef for the pooled and Nigeria datasets. The same negative signals were experienced with the price of mutton, though the coefficients were not statistically significant. While Nigeria's borders were temporarily shot down during the COVID-19 pandemic to control the spread of the disease, a shortage of many food items, including beef evolved, which raised beef prices.

The coefficient for the price of fresh milk was also not statistically significant but showed a negative influence on household food security. The coefficient for the price of cereal shows a negative influence on household food security in pooled, Burkina Faso and Nigeria datasets. The results were expected because households in both Burkina Faso and Nigeria relied on cereal-based food items such as rice, maize, sorghum, teff, and millet. Nigeria felt the price increase impact more than Burkina Faso because of food market disruptions from COVID-19 movement restriction protocols coupled with their high demands for the products. Nigeria also felt the negative impact of the price of vegetables despite their potential to invest in irrigation farming. The findings may carry some cultural preferences to food consumption. Most of Nigeria's food goes with the demand for vegetables, unlike Burkina Faso where daily intake levels of vegetables are below recommendations and the total diet is largely cereal-based [30].

The coefficient for the price of root and tubers reflected a slightly significant negative effect on household food security in Burkina Faso. These findings were not shown for Nigeria, owing to their strength in the production of yam, cassava, and potatoes. The coefficients for fat and oils and beans and other pulses showed significant negative signs against food security of Nigerian households. The overall food price volatility situations boil down to the persisting effect of COVID-19 pandemic of household food security.

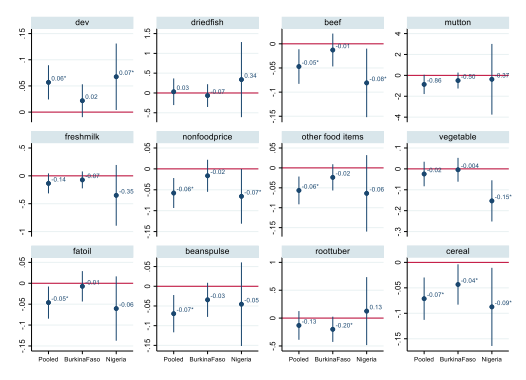

Figure 4: Impact of food price volatility on household food security without controls
Note: Significant level: *p<0.05 and all coefficients multiplied by 10^4 to fit the graph
Source: Authors, (2024)

Table 1 presents the results of the impact of food price volatility on the food security status of households, controlling for socioeconomic characteristics in Nigeria and Burkina Faso.
The pooled analysis demonstrates several significant effects of food price volatility on household food security. Notably, increases in beef and mutton prices negatively impact food security, with beef price increases showing a strong significance (p<0.01). This aligns with previous research by Tadesse et al. (2016), which emphasized the importance of protein-rich foods in maintaining food security. Similarly, non-food prices and prices of other foods also exhibit significant negative impacts (p<0.01), highlighting the broader economic pressures on household food security.

The price of cereals shows a highly significant negative effect (p<0.01), consistent with the findings of other researchers [31], who noted the critical role of cereals in household diets. The positive effect of price deflation on food security (p<0.01) indicates that reduced prices can alleviate food insecurity, underscoring the importance of economic stability in food markets.
In Burkina Faso, the analysis reveals significant negative impacts of root tuber prices (p<0.1) and cereal prices (p<0.05) on food security. These findings align with the research by Headey and Ecker (2013) [32], which highlighted the vulnerability of rural households to price fluctuations in staple foods. The dependency ratio shows a significant negative effect (p<0.01), suggesting that households with more dependents face greater food insecurity, as supported by

literature [34]. Urban residence, however, has a positively significant impact on food security ($p<0.01$), indicating better access to resources and markets in urban areas.

In Nigeria, the results indicate that increases in beef prices significantly worsen food security ($p<0.05$), echoing the importance of protein-rich foods identified by Tadesse et al. (2016). The prices of cereals also have a significant negative impact ($p<0.05$), consistent with the literature [31]. Additionally, the negative impact of vegetable prices ($p<0.01$) suggests the critical role of diverse diets in maintaining food security. The positive effect of price deflation ($p<0.05$) again highlights the benefits of stable and reduced food prices.

Control variables in Nigeria reveal that female-headed households are more vulnerable to food insecurity, with a significant negative effect ($p<0.05$). This finding is in line with literature [35], who found similar patterns of vulnerability among female-headed households. The age of the household head also negatively affects food security ($p<0.1$), indicating that older household heads may struggle more with economic challenges.

The critical role of staple foods such as cereals and the importance of protein-rich foods like beef is evident in the results of our study. Our findings are in line with past literature, reinforcing the significant impact of food prices on household food security [31,31]. The vulnerability of rural households and the beneficial effects of urban residence aligns with the conclusions drawn by a similar study [33]. The negative impacts of higher dependency ratios and the increased vulnerability of female-headed households are also supported by the literature [34,35].

Table 1: impact of food price volatility on household food security with controls

Variables	**Pooled**	**Burkina Faso**	**Nigeria**
Dried fish price	4.25e-07	-6.64e-06	3.41e-05
	(1.68e-05)	(1.47e-05)	(4.83e-05)
Beef price	-4.41e-06***	-1.33e-06	-8.56e-06**
	(1.79e-06)	(1.74e-06)	(3.61e-06)
Mutton price	-8.28e-05*	-5.03e-05	-4.02e-05
	(4.62e-05)	(3.90e-05)	(1.72e-04)
Fresh milk price	-1.22e-05	-7.21e-06	-3.53e-05
	(8.98e-06)	(7.75e-06)	(2.77e-05)
Non-food price	-5.29e-06***	-1.68e-06	-6.93e-06**
	(1.80e-06)	(1.96e-06)	(3.33e-06)
Other food price	-5.23e-06***	-2.38e-06	-6.84e-06
	(1.74e-06)	(1.68e-06)	(4.88e-06)
Vegetable	-2.33e-06	-4.30e-07	-1.55e-05***
	(2.94e-06)	(2.92e-06)	(5.02e-06)
Fat oil	-4.02e-06**	-7.50e-07	-6.40e-06
	(1.93e-06)	(1.86e-06)	(3.92e-06)
Beans pulse	-6.96e-06***	-3.45e-06	-4.78e-06
	(2.37e-06)	(2.21e-06)	(5.40e-06)
Root tuber	-1.16e-05	-1.98e-05*	1.28e-05
	(1.29e-5)	(1.16e-05)	(3.10e-05)
Cereal	-6.69e-06***	-4.33e-06**	-9.17e-06**
	(2.08e-06)	(2.02e-06)	(3.91e-06)
Price deflation	5.29e-06***	2.19e-06	7.15e-06**
	(1.64e-06)	(1.60e-06)	(3.23e-06)

Dependency ratio	-0.03*	-0.07***	0.02
	(0.02)	(0.02)	(0.03)
Urban (yes=1)	0.24***	0.04***	0.01
	(0.01)	(0.01)	(0.02)
Household size	1.72e-03*	-1.90e-03	-5.94e-04
	(9.97e-04)	(1.41e-03)	(2.43e-03)
Gender (yes=1)	-0.09***	-0.01	-0.09**
	(0.01)	(0.01)	(0.02)
Age	-4.46e-04*	-1.08e-04	-9.29e-04*
	(2.28e-04)	(3.00e-04)	(4.79e-04)
Constant	0.68***	0.87***	0.59***
	(0.02)	(0.02)	(0.04)
LR chi2 (Prob>ch2)	1179.06 (0.00)	48.60 (0.00)	48.89 (0.00)
Log-likelihood	-2625.17	3085.82	-946.33
Number of obs	32,047	23,574	8, 473

Note: Significant level: ***p<0.01, **p<0.05, *p<0.1. In Parenthesis (standard errors).

5. Robustness check

Different models were also adopted to check the sensitivity of our regression results. Most of the estimates from RE logit regression and FE logit regression were close to the results of the linear probability RE regression model. However, the Linear probability RE model resolved the issue of multicollinearity that caused the omission of results in the RE and FE logit models. Furthermore, the Hausman test failed to reject the null hypothesis, indicating that the Linear probability RE model is suitable for our study.

6. Conclusion and policy implications

Our analysis has confirmed that food price volatility negatively affects food security. We found out that Nigeria experienced greater food insecurity challenges even though the country is a coastal nation, having direct access to international trade through her port. This result has further approved the body of literature that says food insecurity might not be necessarily worsened by being landlocked but that factors such as food production dynamics, food storage strategies, economic policies, conflict management, and social capital play a rather greater role. Additionally, urbanization and gender are significant drivers of food security, confirming the critical socioeconomic dimensions of food security. Thereby underlining the need for targeted interventions to address food insecurity, particularly among vulnerable populations.

Our study has critical policy implications, especially in the context of the African Continental Free Trade Area (AfCFTA) to enhance trade liberalization and economic integration. The following policy implications can therefore be drawn from our findings:

a. The negative and significant impact of food price volatility on household food security in Nigeria and Burkina Faso underscores the need for mechanisms to stabilize food prices in West Africa. Efforts should be geared towards implementing price stabilization policies as well as effective grain reserves to buffer against price shocks.
b. Given the vulnerability of rural households to price fluctuations, targeted support for smallholder farmers through subsidies, access to credit, and improved agricultural inputs can enhance productivity and food security. Integrating these support measures within the AfCFTA framework can help farmers benefit from larger markets while mitigating the risks of price volatility.
c. Our study revealed the increased vulnerability of female-headed households and those with higher dependency ratios thereby highlighting the need for targeted social

protection programs. Policies that provide safety nets, such as cash transfers and food assistance which can help mitigate the adverse effects of price volatility on these vulnerable groups should thus be enacted.

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