**Nexus of Political Instability, Conflict, and Food Prices: Sahel Region and Russia-Ukraine War**

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**Abstract**

This study investigates the interplay between political instability, conflict, and food prices in the Sahel region amidst the Russia-Ukraine war. Utilizing panel data from eight Sahel African countries between January 2018 and September 2023, this study aims to uncover the nuanced relationships that shape food prices in complex geopolitical landscapes. By employing descriptive statistics, correlation analysis, unit root tests, and panel regression models, this study navigates multifaceted dynamics. Surprisingly, the inverse relationship between inflation and food prices (-56.1227, p < 0.001) challenges conventional assumptions. Additionally, higher exchange rates were associated with increased food prices, while increased agricultural GDP showed a paradoxical link to lower food prices (-0.00116, p < 0.001). Most strikingly, the Russia-Ukraine war correlated with a substantial decrease in food prices (-2148.59, p < 0.001), contrary to anticipated inflationary effects. These findings underscore the intricate nature of regional markets, geopolitical events, and market dynamics. This study recommends nuanced policy responses that consider the diversification of trade, resilient agricultural strategies, and adaptive market mechanisms to mitigate the impacts of geopolitical tensions on food security. These insights emphasize the need for context-specific policies that adapt to evolving global dynamics, emphasizing resilience in regional food markets amid geopolitical unrest.

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**Introduction**

In our contemporary era, marked by intricate geopolitical shifts and regional complexities, a critical focus of scholarly inquiry emerges, centered on the intricate interplay between political instability, armed conflicts, and global food prices. This focus stems from the undeniable fact that as our world continues to grow more interconnected, the repercussions of these dynamics transcend mere regional boundaries, exerting a profound and far-reaching influence on international security, humanitarian endeavors, and the sustainability of our food systems, which is underscored by a body of academic work and empirical evidence that has consistently highlighted the repercussions of political instability, conflicts, and food price fluctuations in global affairs (Arezki & Bruckner, 2011; Umaroh & Pangaribowo, 2020; Dasgupta & Robinson,2021) . Notably, the work of scholars such as RezaeeDaryakenari et al. (2020) exemplifies the connection between these dynamics, with concrete implications for societies, both at the local and global levels. Therefore, this study embarks on an in-depth exploration of this intricate nexus through a comparative analysis of coups and conflicts in the Sahel region, and the consequences of the Russia-Ukraine War on global food prices.

Notably, some regions, such as Nigeria in the Sahel, do not allocate a significant portion of their budget (approximately 1%) towards agriculture, underscoring the social unrest prompted by escalating food prices (Ogbodo et al., 2023). These countries rely heavily on grain and processed imports, particularly from Europe, for sustenance, making them particularly susceptible to fluctuations in food prices. For instance, a study conducted by Ogundipe (2020)  underscores this vulnerability. Moreover, Rezaee Daryakenari (2020) highlighted the link between food price volatilities and the increased likelihood of violence against civilians by insurgent groups, with a pronounced impact in regions with a higher proportion of agricultural land. Furthermore, scholars such as Arezki and Brueckner (2011), Hendrix and Haggard (2015), and Duvallet et al. (2021) have consistently drawn connections between inflation, food price spikes, unfavorable exchange rates, interest rates, and political unrest across various regions, which, coupled with the history of conflicts and political instability, significantly affect food supply and lead to surges in food prices, subsequently inciting social unrest (Quak, 2021). Furthermore, the escalating impacts of climate change in the region exacerbate food supply disruptions and price hikes, aggravating an already precarious situation. Despite efforts to source relevant literature, our scopus-based search yielded nine documents, with only two focusing on the Sahel region and Russia-Ukraine War. Given these critical implications, it is imperative to address this knowledge gap, as emphasized in the Economic Commission for Africa's 2019 report, which calls for evidence-based policymaking and the collection of more data and information to inform decision-making. This study contributes to the literature by filling the void in our understanding of the intricate relationship between political instability, conflict, and food prices in the Sahel region.

Therefore, the specific objectives of the study were to (a) examine the impact of political instability, armed conflicts,  the Russia-Ukraine conflict,  and other economic variables on food price fluctuations in food items in the Sahel region and to investigate the causal relationship between armed conflicts, political instability, and fluctuations in food prices, emphasizing the specific mechanisms through which conflicts affect food availability, distribution, and affordability in both regions. We examined this issue using panel data from eight countries in the Sahel region from January 2018 to September 2023. The variables considered are political instability; armed conflicts; economic variables such as inflation, exchange rates, interest rates, food supply, and Gross Domestic Product; and climate variables such as temperature. For instance, previous studies have not fully explored the extent to which the Russia-Ukraine conflict influenced food prices in the Sahel region.

This study fills this research gap by providing a comparative analysis of the impacts of conflicts in the Sahel region as well as the Russia-Ukraine War on food prices in Nigeria, Burkina Faso, Niger, South Sudan, Sudan, Central African Republic, and Mali. In doing so, it sheds light on the nuanced relationship between political instability, conflict, and food prices, taking into account the specific socioeconomic and political contexts of each country. Furthermore, this study utilizes a comprehensive methodology that involves a quantitative approach, drawing on data from various sources such as international reports, government publications, and statistical databases. The data on the Ukraine-Russia war were derived using dummies indicating 0 and 1 to represent the presence or absence of war during specific time periods. This study also employs econometric techniques such as panel data analysis to statistically analyze the relationships between the variables. This approach provides a robust analysis of the nexus between political instability, conflict, and food prices in the Sahel region and the impact of the Russia-Ukraine conflict on food prices in the selected countries.

**Literature Review**

The relationship between conflict and food prices has been a subject of recent research. Winne and Peersman (2019) observed that increases in food prices resulting from harvest shocks outside Africa significantly escalated the conflict in African regions. This finding underscores the potential of external factors to influence local conflicts and highlights the need for a deeper understanding of these relationships. Conversely, Martin-Shields and Stojetz (2019) highlight the challenge of endogeneity in the link between food security and conflict. This emphasizes the necessity for improved data quality and more refined causal interpretation in such studies. Evidence from RezaeeDaryakenari et al. (2020) further suggests that food price volatilities increase the likelihood of violence against civilians by insurgent groups in sub-Saharan Africa, revealing the intricate connection between food insecurity and societal stability. These studies collectively indicate the multifaceted nature of the relationship between food prices and conflict dynamics, demanding nuanced analysis.

Examining empirical evidence, Amare et al. (2020) investigated the impact of COVID-19 lockdown measures on food security in Nigeria. Combining pre-COVID-19 face-to-face surveys with post-COVID-19 phone surveys, the study revealed a 12 percentage point increase in households' experiences of food insecurity due to lockdown measures. This methodological approach offers insights into dynamic changes in food security indicators after external shocks, revealing the vulnerability of populations to sudden disruptions. Moreover, Rezaee Daryakenari et al.'s (2020) use of observational panel data regression across sub-Saharan African districts corroborated the link between food insecurity and increased violence by insurgent groups, underlining the societal repercussions of food insecurity on conflict dynamics. However, Feng et al. (2023) focused solely on the Russia-Ukraine crisis's impact on food security and trade patterns, highlighting the need for broader analyses encompassing various geopolitical scenarios and their effects on global food prices.

Considering macroeconomic factors, inflation has emerged as a critical determinant of food price in Africa. Ibikunle et al. (2022) demonstrated the detrimental effects of rising food prices due to inflation on child health, leading to higher infant and neonatal mortality rates. Umoru and Amedu (2022) reveal a positive relationship between exchange rate variations and food commodity prices, signifying the influence of currency dynamics on food affordability. However, studies such as Unsal et al. (2022) highlight the role of global food prices and domestic factors in driving food price inflation in Sub-Saharan Africa, illustrating the multifaceted nature of the inflation-food price nexus. This finding highlights the complexity of the role of inflation and the need for comprehensive analyses that incorporate both global and domestic factors.

Furthermore, the influence of the exchange rate on food prices demonstrates variability across African countries. Demeke and Tenaw (2021) identify the exchange rate as a key driver of non-food inflation in Ethiopia, emphasizing its multifaceted impact on diverse economic sectors. Conversely, Osuji et al. (2020) highlighted its significant role in food security in Nigeria. This variance in impacts, as elucidated by Bala et al.'s (2022) threshold effect of oil exports on trade balance in African OPEC members, underscores the necessity for nuanced analyses that consider country-specific dynamics. Bonuedi et al.'s (2020) emphasis on the role of poor trade facilitation in driving food insecurity links exchange rate fluctuations to broader economic vulnerabilities, highlighting the need for policy interventions to address trade barriers.

Agricultural GDP serves as a key indicator of food prices, albeit with varying significance across countries. Ru et al. (2023) identify its role in contributing to economic growth in developing economies, highlighting its importance in these contexts. However, Bajan and Mrówczyńska-Kamińska (2020) noted a comparatively lower share in more developed nations as a proxy for food production's contribution to economic growth. This significant variation, as revealed by Alston (2009) in the context of Meiji Japan's improved living standards due to increased agricultural output, emphasizes the complex relationship between agricultural GDP and food prices. The diverse impacts highlighted by Langyintuo (2020), Tenaye (2020), Asogwa (2020), and Bonuedi (2020) stress the need for nuanced policy responses targeting agricultural productivity, food supply, and trade facilitation to stabilize food prices across African regions.

Interest rates demonstrate a significant relationship with food prices, thus influencing economic growth and stability. Sebo and Nafi (2021) noted the lack of significant effects on stock prices in the food and beverage sector from inflation, exchange rates, and interest rates, suggesting the nuanced role of interest rates in impacting specific sectors. Conversely, Iddrisu and Alagidede (2021) highlight the destabilizing effect of contractionary monetary policy on food prices in Ghana, emphasizing the importance of monetary policies in influencing food affordability. Melaku's (2020) identification of interest rates as a key factor in determining food price volatility suggests intricate connections between monetary policies and food price dynamics, necessitating a deeper understanding of these relationships for effective policy formulation.

The relationship between real GDP and food prices in Africa has multifaceted implications for economic growth and food affordability. Egwuma et al. (2017) and Olayungbo and Hassan (2016) identify a positive relationship between real GDP and food price inflation in Nigeria and developing oil-exporting countries, respectively, highlighting the complex interplay between economic growth and food affordability. Bogmans et al.'s (2021) emphasis on income shocks driving food insecurity, with limited impact from food price shocks, underscores the diverse factors that influence food prices beyond mere economic growth. This complexity necessitates a deeper exploration of the specific mechanisms through which GDP affects food prices in Africa, especially concerning climate change factors that influence agricultural productivity and food supply.

The impact of climate change on food prices in Africa necessitates comprehensive policy responses owing to its multifaceted consequences. Dasgupta and Robinson (2021) demonstrated that climate and weather shocks increase food insecurity and exert upward pressure on food prices, highlighting the urgency of addressing the impact of climate change on food affordability. Kim and Sung's (2021) identification of climate variables that significantly affect crop production further emphasizes the intricate connections between climate change, agricultural productivity, and food prices. Moreover, Cho et al.'s (2020) exploration of changes in consumer behavior due to inadequate temperatures showed the multifaceted nature of climate change influences on food prices, necessitating comprehensive policy responses to mitigate these effects.

Violent and political conflicts in Africa have significant repercussions on food prices, requiring immediate attention and strategic intervention. Hatcher et al.'s (2022) link between food insecurity and violence against women and girls highlights how conflict exacerbates food price volatility by reducing agricultural productivity and disrupting supply chains. Duvallet (2021) underscores the importance of stable agricultural yields, which are often negatively affected by conflicts, emphasizing the need for stability in food production regions. Ogundipe (2020) stressed the role of trade policy in mitigating the adverse effects of commodity price volatility resulting from conflicts, indicating the multifaceted impact of conflicts on food prices and the broader economy. Therefore, addressing violent conflicts remains imperative to stabilize food prices in Africa, particularly considering the exacerbation of these issues by external factors, such as the Russian-Ukraine war.

The Russian-Ukraine war significantly impacted food prices in Africa, particularly in poverty-dependent countries, exacerbating food insecurity and volatility. As observed by Ogundipe (2020), this global conflict intensifies food price fluctuations in these regions, compounding the challenges posed by climate and weather shocks (Dasgupta & Robinson, 2021). Additionally, the emergence of new supermarkets in African cities, as noted by Foley et al. (2020), influences food prices and dietary behaviors, further complicating the landscape. The al.'s (2020) link between household food insecurity and lower early childhood development outcomes in Ghana signifies the pervasive consequences of food insecurity, highlighting its multifaceted nature. These factors collectively underscore the complex and multifaceted nature of the issue, with war serving as a key driver of food price volatility in Africa.

**METHODOLOGY AND DATA**

**3.1. Model Specification**

The Hadri LM test is used to assess the presence of unit roots in the panel data by considering a slightly different model than the traditional unit root tests. The test involves a regression of the first differences of individual series on lagged levels and the first differences of the mean of the series (Bailey et al., 2021). The specifications for the Hadri LM test with a trend can be described as follows:

(1)

​ represents the first difference in the dependent variable for individual 'i' at time 't.’

denotes the lagged levels of the dependent variable.

represents the lagged first differences of the dependent variable.

denotes the time series mean of the dependent variable for each individual.

t represents the time trend.

α,β,γ, and δ are coefficients to be estimated.

where εit​ is an error term.

The inclusion of a trend component (δt) in the Hadri LM test extends the examination of unit roots by considering the potential presence of deterministic trends in the data. This becomes crucial as time trends are often present in economic and financial series due to various factors, such as technological advancements, population growth, and policy changes (Clark et al., 2021). By including the trend term, the test allows for a more comprehensive analysis, capturing potential non-stationarity due to linear trend components that may exist in the data-generating process (Ertefaie et al., 2018).

Additionally, the Hadri LM test addresses the issue of cross-sectional dependence in panel data by incorporating the mean of the series (yi) into the test statistics. This inclusion helps to account for the potential correlation or dependence between the individual units in the panel, ensuring a more robust and accurate inference compared to traditional unit root tests that might overlook such dependencies (Leszczensky & Wolbring, 2019).

Table 1: Unit root test result

|  |  |  |
| --- | --- | --- |
| Variables | z | Prob. |
| FPI | 64.2911 | 0.0000 |
| INF | 13.7551 | 0.0000 |
| ECR | 53.3832 | 0.0000 |
| FGDP | 2.4874 | 0.0064 |
| INT | 40.5362 | 0.0000 |
| GDP | 78.0968 | 0.0000 |
| TMP | 49.6164 | 0.0000 |
| CON | 8.0962 | 0.0000 |
| RUW | 69.9155 | 0.0000 |

The unit root test results estimated using Equation 1 indicate the stationarity properties of the variables under consideration. Stationarity implies that a time series has statistical properties that do not change over time (Heidrich et al., 2023). Generally, stationary series are preferred in econometric analyses because they ensure stable relationships and reliable statistical inferences ( Table 1).

* Food Price Index (FPI): The extremely high z-value (64.2911) and probability of 0.0000 indicate a strong rejection of the null hypothesis of a unit root. Therefore, the Food Price Index variable was stationary, suggesting that it exhibited stable statistical properties over time.
* INF (Inflation Rate): Similar to FPI, the high z-value (13.7551) and a probability of 0.0000 suggest that the inflation rate variable is stationary, exhibiting consistent statistical behavior over time.
* Exchange Rate (ECR): The high z-value (53.3832) and low probability of 0.0000 indicate rejection of the null hypothesis of a unit root. Thus, the exchange rate variable appears to be stationary.
* FGDP (Food Supply as Agricultural GDP): Although the z-value (2.4874) is lower compared to other variables, it is statistically significant at the 0.0064 probability level. This suggests that the FGDP variable is stationary, albeit with slightly weaker evidence than the other variables.
* INT (Interest Rate): The high z-value (40.5362) and probability of 0.0000 suggest that the interest rate variable is stationary, showing consistent statistical properties.
* Gross Domestic Product (GDP): A very high z-value (78.0968) and probability of 0.0000 strongly reject the presence of a unit root, indicating that the GDP variable is stationary.
* TMP (temperature): A high z-value (49.6164) with a probability of 0.0000 indicates that the temperature variable is stationary.
* CON (Number of Violent and Political Conflicts): With a z-value of 8.0962 and probability of 0.0000, the test suggests that the conflict variable is stationary.
* RUW (Russia-Ukraine War Period): A high z-value (69.9155) with a probability of 0.0000 indicates that the Russia-Ukraine War Period variable is stationary.

All variables (FPI, INF, ECR, FGDP, INT, GDP, TMP, CON, and RUW) display strong evidence of the presence of unit roots. This suggests that these variables are stationary and exhibit stable statistical properties over time, providing a solid foundation for further econometric analyses, such as regression modeling, without concerns about non-stationarity affecting the results.

Model specifications for both Fixed Effects (FE) and Random Effects (RE) panel regression models, including the Hausman test:

**Fixed Effect Model Specification**

(2)

**Random Effect Model Specification**

(3)

:Entity-specific fixed effects capturing unobserved heterogeneity.

:Error term

: The error term represents the combined error term (composed of both individual-specific effects and idiosyncratic errors).

The Hausman test assesses the choice between Fixed Effects (FE) and Random Effects (RE) models by testing the null hypothesis that the preferred model is the Random Effects model against the alternative hypothesis that the Fixed Effects model is preferred owing to the endogeneity of the regressors (Ariyo et al., 2019).

**3.2 Empirical strategy**

Employing descriptive statistics offers a glimpse into the dataset's central tendencies and distributions (Canbek, 2022). However, while these statistics provide an initial understanding, they only scratch the surface of complex data characteristics. However, they play a pivotal role in identifying outliers and obtaining a sense of the data distribution.

Transitioning to correlation analysis, this method scrutinizes the linear relationships between variable pairs, offering hints of potential associations. It acts as a crucial step in appraising possible multicollinearity, where highly intercorrelated predictors can skew the regression outcomes. Although no coefficients surpassing 0.7 in the matrix, indicating weaker linear links among variables, it does not entirely dismiss the likelihood of subtle multicollinearity (Ilo et al., 2020).

Furthermore, we employed the Hadri LM Unit Root test, which is crucial for affirming stationarity in the panel data analysis. Embracing panel data regression models (Random and Fixed Effects) allowed us to navigate the individual-specific effects. Fixed Effects grapple with unobserved heterogeneity, although they can potentially lead to omitted variable bias. Conversely, Random Effects presume that these effects are unrelated to regressors (Nwakuya & Ijomah, 2017). Introducing the Hausman test to the mix enabled us to gauge endogeneity, albeit contingent on sturdy assumptions.

**3.3 Data and source**

The panel data used in this study span from January 2018 to September 2023, encompassing eight countries situated in the Sahel region of Africa. These countries include Nigeria, Burkina Faso, Niger, Mali, Chad, the Central African Republic, Sudan, and South Sudan. The dataset draws upon multiple sources specific to each country, ensuring the comprehensive coverage of various economic indicators and conflict-related data.

For Nigeria, critical indicators such as the Food Price Index, inflation rates, and agricultural GDP originate from the National Bureau of Statistics. Likewise, data on exchange rates and interest rates were obtained from the Central Bank of Nigeria, ensuring a reliable foundation for Nigerian-centric analysis.

The datasets for Burkina Faso, Niger, Mali, Chad, Central African Republic, Sudan, and South Sudan encompassing similar indicators—Food Price Index, inflation rates, exchange rates, interest rates, and agricultural GDP—stem from their respective national statistical institutions and central banks. These sources include the Institut National de la Statistique et de la Demographie (Burkina Faso), Institut National de la Statistique du Niger (Niger), Institut National de la Statistique (Mali), Bank of Central African States (Chad), Institut Centrafricain des Statistiques et des Etudes Economiques et Sociales (Central African Republic), Central Bank of Sudan (Sudan), and National Bureau of Statistics (South Sudan). This meticulous sourcing aims to ensure accuracy and reliability in analyzing each country’s economic dynamics.

Additionally, data on the GDP and temperature across the eight countries were derived from the World Bank. This choice of source ensured uniformity and consistency in accessing these crucial macroeconomic and environmental variables across the studied nations.

Moreover, the datasets pertaining to conflicts within these countries were sourced from the Armed Conflict Location & Event Data Project (ACLED), providing detailed information on the occurrence and nature of conflicts within the Sahel region.

Regarding the Ukraine-Russia war data, dummies were employed to represent the presence (coded as 1) or absence (coded as 0) of the conflict during specific time periods (Halkia et al., 2020; Orzechowski, 2022). This methodological choice allows for the incorporation of this geopolitical event into the analysis, facilitating the exploration of its potential impact on the variables under investigation within a specified timeframe.

**EMPIRICAL RESULTS**

**4.1 Descriptive and Correlation Analysis**

The observations (552 in total) show a substantial variation in the Food Price Index, indicated by a mean of 1964.07 and a notably large standard deviation of 7718.76, as presented in Table 2. The values range from -32.6 to a maximum of 38796.56, illustrating considerable dispersion in food prices across the observed periods. With a mean of 9.75 and a standard deviation of 21.64, the inflation rates exhibit a considerable spread. The range spans from -13.3 to 186.6, signifying fluctuations in inflationary pressures during the observed time frame. The mean exchange rate is 473.77, with a standard deviation of 175.54, suggesting moderate variability in currency exchange rates. The values range from 45 to 779.05, reflecting fluctuating exchange rates over the observed period. The agricultural Gross Domestic Product has a mean of 556,664.2 and a substantial standard deviation of 1,499,269. The values range from 5.03 to 5,650,000, indicating significant disparities in agricultural productivity across the observed countries. The mean interest rate stands at 8.28, with a standard deviation of 6.58. The interest rates vary between -5.4 and 27.8, showcasing a wide spectrum of interest rate fluctuations. The mean GDP was 1.08E+11 (equivalent to 108 billion), with a standard deviation of 2.51E+11. The values range from 3.12 to a maximum of 7.77E+11, reflecting substantial variability in economic output across the observed countries. The mean temperature recorded was 27.97°C, with a small standard deviation of 1.19, suggesting relatively stable temperatures across the observed periods. The range falls between 25.48 and 30.01°C, indicating a moderate range of temperature fluctuations. The mean number of conflicts stands at 280.01, with a substantial standard deviation of 399.82. The number of conflicts ranged from 0 to a maximum of 2221, depicting significant variability in conflict occurrences across the observed countries. This binary variable (0 or 1) representing the presence (1) or absence (0) of the Ukraine-Russia war demonstrates a mean of approximately 0.29, suggesting that the conflict was present in approximately 29% of the observed periods (Ilo et al., 2020). These descriptive statistics highlight the diverse range and notable variability within the dataset, reflecting the wide spectrum of economic, climatic, and conflict-related dynamics across the eight countries in the Sahel region over the observed timespan.

The correlation coefficients depict the degree and direction of the linear relationships between variables, as presented in Table 2. In this analysis, the correlation coefficients ranged from -1 to 1, where values closer to 1 or -1 signified stronger positive or negative linear relationships, respectively, while values closer to 0 indicated weaker associations.

Upon examining the correlation coefficients, it was evident that none of the coefficients exceeded 0.7. This observation is crucial because it suggests a lack of strong linear correlations among the variables. When assessing potential multicollinearity, a threshold of 0.7 or higher is often considered indicative of problematic levels of intercorrelation between predictors in regression models (Ilo et al., 2020).

Notably, the correlation coefficients between the variables are mostly modest, hovering around zero or displaying weak correlations. The correlation between the Food Price Index (FPI) and other variables, such as inflation (INF), Exchange Rate (ECR), Agricultural GDP (FGDP), Interest Rate (INT), GDP, Temperature (TMP), conflicts (CON), and the Russia-Ukraine War (RUW), remained notably low (below 0.25).

Minimal-to-weak correlations were observed between most pairs of variables, indicating a lack of pronounced linear relationships among the studied factors. This absence of strong correlations exceeding the threshold of 0.7 provides assurance against severe multicollinearity. This suggests that the variables in the dataset do not exhibit high interdependency, reducing concerns about inflated standard errors or biased coefficient estimates in the regression analyses.

**4.2 Hausman Test**

The Hausman test results in Table 4 assess the consistency between the coefficients estimated from the Fixed Effects (FE) and Random Effects (RE) models in panel regressions. The test results suggest a systematic difference between the coefficients obtained from the FE and RE models for several variables. Overall, the chi-squared statistic of 240.25 with a p-value of 0.0000 (indicating statistical significance), suggests that at least one coefficient significantly differs between the FE and RE models (Mostafaiy & Faridrohani, 2015). We reject the null hypothesis and focus our discussion on the fixed-effects model (see equation 2). However, the estimates of the random effects model estimated from Equation 3 are presented in the appendix.

**Fixed Effect Regression**

The Fixed Effect regression estimates in Table 5 provide insights into the relationships between various factors and inflation (INF), Exchange Rate (ECR), Agricultural GDP (FGDP), Interest Rate (INT), GDP, Temperature (TMP), conflicts (CON), and the Russia-Ukraine War (RUW)—and their impacts on the Food Price Index (FPI) in the Sahel region.

The coefficient of -56.1227 (p < 0.001) suggests that a one-unit increase in inflation corresponds to a significant decrease in the Food Price Index, indicating an inverse relationship between inflation and food prices. This finding holds substantial implications within the context of the relationship between inflation and the Food Price Index (FPI) in the Sahel region. A negative coefficient implies that for every one-unit increase in inflation, there is a corresponding substantial decrease in the Food Price Index (Okou et al., 2022). This seemingly paradoxical inverse relationship between inflation and food prices contradicts conventional economic expectations, warranting a deeper exploration of the potential underlying factors.

The coefficient of 26.24312 (p < 0.001) implies a positive association between the exchange rate and Food Price Index. In this model, a higher exchange rate seems to correspond to higher food prices. This finding suggests that the positive relationship between exchange rates and food prices within the model has crucial implications within the broader context of the nexus between political instability, conflict, and food prices in the Sahel region, especially concerning the impact of economic variables on food security (Demeke & Tenaw, 2021).

With a coefficient of -0.00116 (p < 0.001), the agricultural GDP sector exhibits a negative relationship with the Food Price Index. This finding suggests that an increase in agriculture GDP is associated with lower food prices. A higher agricultural GDP or increased food supply can contribute to a surplus in food production, leading to a subsequent decrease in food prices  (Asogwa, 2020). In the Sahel region, where agriculture often constitutes a substantial portion of the economy, enhanced agricultural productivity can lead to increased food availability, thereby potentially stabilizing or reducing food prices for consumers (Bajan & Mrówczyńska-Kamińska, 2020; Abban, 2020).

The coefficient of 1297.86 (p < 0.001) indicates a positive relationship between interest rates and food prices. In the analysis, higher interest rates were linked to higher food prices. Elevated interest rates can influence the cost of borrowing, thereby increasing the cost of capital for businesses including agricultural enterprises (Iddrisu & Alagidede, 2021). This heightened cost of capital can translate into increased production costs for farmers, which in turn may lead to higher prices for agricultural products and subsequently impact food prices in local markets.

The GDP coefficient of 7.63E-09 (p < 0.001) showed a positive relationship between GDP and the Food Price Index. A higher GDP aligns with higher food price. A higher GDP often signifies increased economic activity, rising income, and improved standards of living (Egwuma et al., 2017). This economic growth can drive the overall demand for food products, as people have more purchasing power, leading to increased consumption. Consequently, a higher demand for food might drive prices upward, particularly for certain food categories, thus impacting their affordability (Berk, 2022).

A TMP coefficient of 2104.339 (p < 0.001) signifies a positive association between temperature and food prices. In this context, higher temperatures seem to correspond to higher food prices. The Sahel region is vulnerable to climate change and experiences increasing temperatures and erratic rainfall patterns (Graves et al., 2021). Higher temperatures can adversely affect agricultural productivity, crop yields, and food production. This finding aligns with the broader narrative that climate change influences global food security and pricing globally (Dasgupta & Robinson, 2021).

The coefficient of -4.69495 (p < 0.001) suggests that conflict has a negative impact on food prices. Increased conflict occurrences are linked to decreased food prices in this model (Duvallet, 2021). In conflict-affected regions, such as the Sahel, disruptions to local economies, agricultural activities, and trade networks often occur. Such disruptions can lead to decreased market demand, causing a decline in food prices (Olumba et al., 2022). Heightened conflicts might deter buyers or disrupt regular market operations, leading to reduced demand and subsequently lower prices (Marchal, 2021).

The coefficient of -2148.59 (p < 0.001) indicates that the Russia-Ukraine War negatively affects food prices. Food prices tend to decrease (Lopes & Martin-Moreno, 2022). Traditionally, conflicts and geopolitical tensions have been associated with disruptions in trade routes or restrictions on imports and exports (Hassen & Bilali, 2022). In the case of the Sahel region, the Russia-Ukraine war might not directly affect the primary food supply chains (Ogundipe, 2020). Alternatively, these regions might have diversified their imports, relying less on affected areas for essential food items.

The R-squared values indicate that approximately 67.42% of the variation in food prices is explained by the included variables within each country (within-group variation). The overall explanatory power of the model is moderate, suggesting that these factors collectively contribute to the changes in food prices across the Sahel region. The F-statistic (F(8, 536) = 138.65, p < 0.001) indicates that the overall model is statistically significant, thus supporting the notion that the included variables jointly have a significant impact on the Food Price Index. Additionally, the negative correlation (corr(u\_i, Xb) = -0.9297) between the unobserved individual effects and explanatory variables implies an inverse relationship, validating the relevance of the Fixed Effect model. Overall, this fixed-effect regression analysis provides valuable insights into how various economic, climatic, and conflict-related factors influence food prices in the Sahel region, offering important considerations for policy and intervention strategies.

**DISCUSSION AND POLICY IMPLICATION**

In some cases, inflation may reflect reduced consumer purchasing power due to economic downturns or recessionary periods (Vp, 2021; Saha, 2022; Frimpong, 2022). Consequently, reduced demand for goods, including food items, could lead to a decrease in prices, despite inflation. This could hold particularly true in regions where consumers face constrained budgets and prioritize spending on essential goods, potentially impacting food prices inversely to inflation rates. Elevated inflation may not necessarily influence food prices uniformly across different sectors of the economy (Adamou et al., 2021). If agricultural productivity increases due to technological advancements or favorable weather conditions, it could result in a higher food supply, thereby exerting downward pressure on prices despite inflationary pressures in other sectors (Umoru & Amedu, 2022). Government policies, such as subsidies for essential food items, could counterbalance the inflationary effect, ensuring stable or reduced food prices for consumers despite general inflationary trends (Unsal et al., 2022). In some cases, strategic interventions by governments or international organizations might effectively mitigate the impact of inflation on essential food commodities (Suleman et al., 2022). International trade dynamics and global market fluctuations may also play a role in this relationship. A weakening of global demand or surplus production of certain food commodities, influenced by international market conditions, could lead to decreased food prices despite inflation in the local economy (Brankov, 2022).

Exchange rate fluctuations may be symptomatic of broader economic volatility (Osuji et al., 2020). In situations of economic uncertainty, such as geopolitical tensions or global economic crises, local currencies can face devaluation, impacting the cost of imported goods, including food items (Tran, 2021; Phan et al., 2021). Conflicts, geopolitical tensions, or international trade disruptions, such as the Russia-Ukraine War, can contribute to currency instability, subsequently affecting food prices in the Sahel (Mukhtar, 2023). Elevated exchange rates could also influence the entire supply chain of food commodities (Mehta & Gor, 2022). Higher costs incurred by importers due to unfavorable exchange rates may be passed on to consumers, affecting food prices in local markets (Fawaz & Hamaad, 2021). Additionally, disruptions in transportation or logistics linked to currency fluctuations can further impact food availability and prices (Rožić et al., 2022). The positive relationship between exchange rates and food prices underscores the significance of policies aimed at stabilizing currencies and managing exchange rate fluctuations (Bonuedi et al., 2020). Measures such as fiscal policies, foreign exchange reserve management, and trade agreements can play a pivotal role in mitigating the adverse effects of currency fluctuations on food prices, thereby enhancing food security.

Improved agricultural output can positively affect food security by ensuring a consistent and adequate supply of food. Increased food availability resulting from robust agricultural GDP might lead to a lower dependency on imported food commodities, thus mitigating the vulnerability of the region to external market fluctuations and disruptions (Blancard et al., 2021). The observed relationship emphasizes the importance of policies that promote agricultural development, technological advancements, and infrastructural investments in the agricultural sector (Olayungbo & Hassan, 2016). Supporting smallholder farmers, enhancing irrigation systems, providing access to quality seeds and fertilizers, and improving farming practices could foster increased agricultural output, consequently positively influencing food prices. Climate variability significantly affects agricultural productivity (Atube et al., 2021). Increased agricultural GDP may also reflect adaptation measures against climate change, which could improve food production resilience and contribute to lower food prices by mitigating the impact of weather-related crop failures (Gómez-Zavaglia et al., 2020). Higher agricultural GDP not only influences food prices, but also contributes to socioeconomic development in rural areas (Gholizade et al., 2022). It can generate income for farming communities, reduce poverty, and stimulate local economies, thereby indirectly affecting food accessibility and affordability for the vulnerable populations.

Higher interest rates can also reflect broader macroeconomic conditions, such as inflation or attempts by central banks to curb inflationary pressure (Melaku, 2020). In such scenarios, higher interest rates might indicate efforts to control inflation, but these measures can inadvertently increase the cost of agricultural inputs, impacting food production costs and subsequently food prices (Vp, 2021). Higher interest rates can affect consumer spending patterns by increasing the cost of credit, reducing disposable income, or dissuading investments in non-essential goods (Graves et al., 2021). This change in consumer behavior might lead to shifts in demand for food items, potentially affecting food prices based on the market dynamics of supply and demand (Maksimova & Bondarenko, 2022; Gheorghe & Sima, 2021). The positive correlation between interest rates and food prices underscores the complexity of monetary policy and its potential impact on food affordability. Policymakers must balance the need to control inflation, while ensuring that such measures do not disproportionately burden vulnerable populations by increasing food prices. Higher interest rates impacting food prices could disproportionately affect marginalized communities in conflict-ridden regions, such as the Sahel. Vulnerable populations already grappling with political instability and limited access to resources might face additional challenges in providing essential food items, exacerbating food insecurity. It is essential to consider the influence of external factors, such as global financial market conditions, international trade dynamics, and the interplay between local and global interest rate trends, on this relationship, which could further complicate the relationship between interest rates and food prices.

With economic growth, there may be changes in the structure of the economy, including shifts in land use, increased urbanization, or alterations in agricultural production patterns. Such changes could affect the supply side of food markets, potentially affecting food prices. Increased GDP might also lead to rising production costs, labor wages, or land values, influencing agricultural input costs and, subsequently, food prices (Kulyk, 2021). As the GDP grows, the income elasticity of demand for certain types of food might increase. This means that as income rises, people may shift their consumption patterns towards higher-value or more specialized foods, potentially disproportionately impacting the prices of these items disproportionately (Kharisma et al, 2021). Policymakers face the challenge of managing economic growth while ensuring food affordability in all segments of society. The positive correlation observed between GDP and food prices suggests the need for policies that balance economic development with measures to mitigate potential inflationary pressures on food prices. While economic growth is generally positive for overall development, its impact on food prices might disproportionately affect vulnerable communities (Machado et al., 2021). Higher food prices resulting from increased GDP could pose challenges for low-income households, exacerbating food insecurity, especially in conflict-affected regions, such as the Sahel (Tkachenko, 2021).

Elevated temperatures often lead to drought, decreased soil moisture, and shortened growing seasons. These climatic conditions are detrimental to agricultural output, particularly in regions that are highly reliant on rain-fed agriculture (Tsutsui et al., 2021). Reduced crop yields can tighten food supplies, potentially leading to higher food prices owing to scarcity. Climate-related factors can disrupt the entire food supply chain from farming to transportation and storage. Crop failures or reduced harvests due to temperature increases may create shortages, increasing prices as a consequence of decreased supply availability (Dasgupta & Robinson, 2021). In conflict-prone regions such as the Sahel, where political instability and violence already strain resources, climate stressors, such as higher temperatures, can exacerbate existing vulnerabilities (Singh, 2022). Resource competition amid climate-induced scarcity might intensify conflicts, further disrupting food supply chains and amplifying food price volatility (Anónimo et al., 2021). Higher temperatures pose challenges to agricultural adaptation strategies. Farmers might face difficulties adapting their cultivation practices to cope with changing climates, which can directly impact food production and, consequently, food prices (Khawlasaysouka et al., 2021).

Conflicts may disrupt the entire food supply chain, from production to distribution. Localized conflicts can impact transportation routes, disrupt agricultural activities, and hinder access to markets. Such disruptions might flood local markets with surplus produce owing to logistical challenges in moving goods, leading to temporary price decreases (Duvallet, 2021). During conflicts, humanitarian organizations often provide food aid and relief assistance (Shehu & Spahiu, 2021). This inflow of external support, including food supplies, can momentarily alleviate food shortages and contribute to a short-term decrease in food prices. In conflict zones, the population may experience decreased purchasing power due to displacement, loss of livelihoods, or economic instability (Alina et al., 2021). This reduced consumer demand for food products can lead to price drops, as sellers compete to attract buyers. Conflicts can disrupt agricultural activities and reduce output. However, in some cases, localized conflicts might not significantly affect overall food production or the availability of essential crops, leading to temporary surpluses and subsequent price drops due to oversupply (Gliessman, 2022).

The conflict's influence on global food markets might have triggered a shift in sourcing strategies for Sahel countries (Serra, 2021). They could have diversified their import sources or substituted imports from conflicted regions with alternatives, potentially mitigating the impact on local food prices. The Sahel region might rely less on food imports affected by the Russia-Ukraine conflict and instead prioritize regional or domestic production, contrary to the report of Nchasi et al. (2022). This shift in focus toward local agricultural production might not only ensure food security, but also stabilize prices, potentially countering the expected inflationary impact. The anticipation of global market changes due to geopolitical tensions might lead to speculative behavior, influencing food prices in unexpected ways (Pénasse & Renneboog, 2021). If market participants anticipate the long-term impact of the conflict, they might react by lowering prices in the short term to manage inventories or gain market share (Galanov & Galanova, 2023).

**Conclusion**

Understanding the intricate nexus between political instability, conflict, and food prices in the Sahel region while considering the ramifications of the Russia-Ukraine war is crucial for shaping policies and interventions. This study traversed various empirical analyses, revealing the multifaceted dynamics that challenge conventional assumptions and demand nuanced interpretations. Regression analysis revealed intriguing findings. The inverse relationship between inflation and food prices (-56.1227, p < 0.001) defied conventional expectations, emphasizing the need for a context-specific understanding. Moreover, the association between higher exchange rates and increased food prices has highlighted the role of currency dynamics in shaping regional food markets. Contrary to our assumptions, higher agricultural GDP was linked to lower food prices (-0.00116, p < 0.001). This outcome highlights the complexities of the supply and demand dynamics, suggesting potential market diversification or resilience in local agricultural production. The unexpected negative impact of the Russia-Ukraine War on food prices (-2148.59, p < 0.001) raised intriguing questions. It challenged the anticipated inflationary effects of geopolitical conflicts, urging a deeper exploration of diversified trade strategies or humanitarian aid dynamics that influence regional markets. These findings underscore the complexity and context-specific nature of the interplay between geopolitical events, market dynamics, and food price. These unexpected outcomes call for nuanced policy responses, emphasizing regional diversification, resilient agricultural strategies, and the importance of market adaptations to global geopolitical tensions.

However, interpreting these results warrants caution, acknowledging the limitations inherent in the data sources, model assumptions, and dynamic nature of global markets. Further research should delve into the nuanced contextual factors influencing these relationships and consider temporal shifts in market behavior. This study provides valuable insights into the intricate interdependencies between political instability, conflict, and food prices in the Sahel region amidst the Russia-Ukraine war. This illuminates the need for adaptive policies that consider the multifaceted dynamics of global trade, regional market resilience, and the diverse impacts of geopolitical events on food security and pricing.

**Table 2 Descriptive statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Obs | Mean | Std. dev. | Min | Max |
| FPI | 552 | 1964.069 | 7718.762 | -32.6 | 38796.56 |
| INF | 552 | 9.750988 | 21.6445 | -13.3 | 186.6 |
| ECR | 552 | 473.7651 | 175.5434 | 45 | 779.05 |
| FGDP | 552 | 556664.2 | 1499269 | 5.031292 | 5650000 |
| INT | 552 | 8.275072 | 6.576625 | -5.4 | 27.8 |
| GDP | 552 | 1.08E+11 | 2.51E+11 | 3.12 | 7.77E+11 |
| TMP | 552 | 27.97053 | 1.18803 | 25.48 | 30.01 |
| CON | 552 | 280.0054 | 399.8217 | 0 | 2221 |
| RUW | 552 | 0.289855 | 0.454107 | 0 | 1 |

**Table 3 Correlation Coefficients**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *FPI* | *INF* | *ECR* | *FGDP* | *INT* | *GDP* | *TMP* | *CON* | *RUW* |
| FPI | 1 |  |  |  |  |  |  |  |  |
| INF | -0.05661 | 1 |  |  |  |  |  |  |  |
| ECR | 0.065207 | -0.43169 | 1 |  |  |  |  |  |  |
| FGDP | -0.09376 | 0.103682 | -0.17394 | 1 |  |  |  |  |  |
| INT | 0.608063 | 0.358955 | -0.54588 | 0.297467 | 1 |  |  |  |  |
| GDP | -0.0289 | -0.12093 | 0.156102 | -0.15942 | -0.20905 | 1 |  |  |  |
| TMP | 0.035722 | -0.06506 | 0.158208 | -0.1496 | -0.07013 | -0.73276 | 1 |  |  |
| COM | -0.08954 | -0.10654 | 0.334012 | -0.04848 | -0.1925 | -0.17974 | 0.654386 | 1 |  |
| RUW | 0.23972 | -0.07914 | 0.346933 | 0.007979 | 0.16347 | 0.002633 | 0.063634 | 0.220502 | 1 |

**Table 4 Hausman Test**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (b) | (B) | (b-B) | sqrt(diag(V\_b-V\_B)) | |
|  | re | fe | Difference | Std. err. |
| INF | -56.1227 | 2.898907 | -59.0216 | 2.407193 |
| ECR | 26.24312 | 37.13395 | -10.8908 | . |
| FGDP | -0.00116 | -0.00017 | -0.00099 | . |
| INT | 1297.86 | 633.4213 | 664.4388 | . |
| GDP | 7.63E-09 | -6.90E-08 | 7.66E-08 | . |
| TMP | 2104.339 | 1121.532 | 982.8067 | . |
| CON | -4.69495 | -2.02438 | -2.67057 | 0.180138 |
| RUW | -2148.59 | -2082.91 | -65.6794 | 178.7975 |
| b = Consistent under H0 and Ha; | obtained from | xtreg. |  |  |
| B = Inconsistent under Ha, efficient under H0; | obtained from | xtreg. |  |  |
| Test of H0: Difference in coefficients not systematic | | | | |
| chi2(5) = (b-B)'[(V\_b-V\_B)^(-1)](b-B) | | | |  |
| 240.25 |  |  |  |  |
| Prob > chi2 = 0.0000 | |  |  |  |
| (V\_b-V\_B is not positive definite) | | | |  |

**Table 5 Fixed Effect regression Estimates**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| FPI Coefficient | Std. err. | z P>z |  | [95% conf. | interval] |  |
| INF | -56.1227 | 8.912907 | -6.30 0.000 | | -73.5917 | -38.6537 |
| ECR | 26.24312 | 1.450489 | 18.09 0.000 | | 23.40021 | 29.08602 |
| FGDP | -0.00116 | 0.00014 | -8.29 0.000 | | -0.00143 | -0.00089 |
| INT | 1297.86 | 36.32957 | 35.72 0.000 | | 1226.655 | 1369.065 |
| GDP | 7.63E-09 | 1.53E-09 | 4.97 0.000 | | 4.62E-09 | 1.06E-08 |
| TMP | 2104.339 | 415.0297 | 5.07 0.000 | | 1290.895 | 2917.782 |
| CON | -4.69495 | 0.787288 | -5.96 0.000 | | -6.23801 | -3.15189 |
| RUW | -2148.59 | 459.4611 | -4.68 0.000 | | -3049.12 | -1248.06 |
| Constant | -77758.7 | 11576.24 | -6.72 0.000 | | -100448 | -55069.7 |
| sigma\_u | 0.0000 |  |  |  |  |  |
| sigma\_e | 3315.543 |  |  |  |  |  |
| rho | 0 | (fraction | of variance due | to | u\_i) |  |
| R-squared: Obs per group: | | | | |  |  |
| Within = 0.6742 min = | 69 |  |  |  |  |  |
| Between = 0.0017 avg = | 69 |  |  |  |  |  |
| Overall = 0.0326 max = | 69 |  |  |  |  |  |
|  |  |  |  |  |  |  |
| F(8, 536) = | 138.65 |  |  |  |  |  |
| corr(u\_i, Xb) = -0.9297 0.0000 > F = |  |  |  |  |  |  |

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Appendix

|  |  |  |
| --- | --- | --- |
| Random-effects GLS regression | Number of obs = | 552 |
| Group variable: Countries | Number of groups = | 8 |
|  |  |  |
| R-squared: | Obs per group: | |
| Within = 0.5948 | min = | 69 |
| Between = 0.9715 | avg = | 69 |
| Overall = 0.7372 | max = | 69 |
|  |  |  |
|  | Wald chi2(8) = | 1523.49 |
| corr(u\_i, X) = 0 (assumed) | Prob > chi2 = | 0 |
|  |  |  |
|  |  |  |
| FPI Coefficient Std. err. | z P>z [95% conf. | interval] |
|  |  |  |
| INF -56.12269 8.912907 | -6.30 0.000 -73.59167 | -38.6537 |
| ECR 26.24312 1.450489 | 18.09 0.000 23.40021 | 29.08602 |
| FoodGDPsupply -.0011602 .00014 | -8.29 0.000 -.0014346 | -0.00089 |
| INT 1297.86 36.32957 | 35.72 0.000 1226.655 | 1369.065 |
| GDP 7.63e-09 1.53e-09 | 4.97 0.000 4.62e-09 | 1.06E-08 |
| Temp 2104.339 415.0297 | 5.07 0.000 1290.895 | 2917.782 |
| Conflicts -4.694949 .7872881 | -5.96 0.000 -6.238006 | -3.15189 |
| UKRusian -2148.59 459.4611 | -4.68 0.000 -3049.117 | -1248.06 |
| \_cons -77758.68 11576.24 | -6.72 0.000 -100447.7 | -55069.7 |
|  |  |  |
| sigma\_u 0 | |  |
| sigma\_e 3315.5426 | |  |
| rho 0 (fraction | of variance due to u\_i) | |