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THE INFLUENCE OF ECONOMIC UNCERTAINTY ON FOOD SECURITY AND THE MODERATING ROLE OF TRADE OPENNESS IN DEVELOPING COUNTRIES

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ABSTRACT

This research examined the influence of economic uncertainty and the moderating role of trade openness on food security in 58 developing countries from 2012 to 2021. The dynamic panel data from the two-step System GMM was utilized to accomplish this. The findings of this research revealed that economic uncertainty did not exert a significant influence on food security in developing countries. Conversely, trade openness demonstrated a positive and significant effect in enhancing food security. Trade openness strengthened the adverse influence of economic uncertainty on food security in developing countries. The estimation results show trade openness has a significant positive effect of 0.0518, economic uncertainty has a positive but insignificant effect on food security, and Economic uncertainty when moderated by trade openness, shows a significant negative effect of -0.0533. The findings indicate that economic uncertainty does not significantly affect food security in developing countries. However, trade openness positively and significantly influences food security, suggesting that increased trade openness can enhance a country's food security. The results reveal a significant negative effect when considering both trade openness and economic uncertainty. It implies that implementing policies that reduce trade openness can enhance food security in high economic uncertainty.

Keywords: *Food security, Economic Uncertainty, International Trade*

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Introduction

Food security holds significant importance for individual countries and the global community, with one of the key objectives of the 2030 Agenda for Sustainable Development Goals (SDGs) being to eliminate hunger, improve nutrition, and achieve food security (UNDP, 2016). However, the current state of world food security in 2021 is worsening due to the influence of COVID-19. According to a report by the Food and Agriculture Organization of the United Nations (FAO), undernourishment (SDG Indicator 2.1.1) has continuously increased. In 2019, it stood at 8%, then rose to 9.3% in 2020 and further escalated to 9.8% in 2021. The report estimates that 828 million people worldwide will face hunger in 2021.

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Additionally, the consequences of COVID-19 are compounded by the Russia-Ukraine conflict, which began in February 2022. This conflict involves two major food-exporting countries, Russia and Ukraine, accounting for 34% of global wheat exports and 73% of sunflower oil exports. As a result, the food price index 2022 is projected to increase by 20.8%. In March 2022, the FAO's Food Price Index reached its highest level since 1990, averaging 159.3 points (FAO, 2022b).

Efforts to enhance global food security have prompted the exploration of various strategies, including international trade policies. Food security was a prominent topic of discussion at the G20 Summit in Bali in 2022, recognizing the issue's urgency. During the G20 food security forum, Fred Kempe, the CEO of the Atlantic Council, emphasized the importance of maintaining open international food trade. He advised against protecting food exports by individual countries, highlighting that such protectionist measures during a crisis can expedite increases in food prices (Atlantic Council, 2022). Pascal Lamy, the former head of the World Trade Organization (WTO), supports this stance, asserting that the food crisis of 2011 was not caused by international trade. Lamy argues that international trade has consistently lowered food prices over the years through intense competition and increased consumer purchasing power. He emphasizes that international trade brings undeniable efficiency gains to agricultural production (Lamy, 2011). The WTO, G20, and Atlantic Council strongly advocate for the liberalization of food trade. They argue that government policies that protect domestic food production, such as quantitative restrictions and tariffs, are inefficient and contribute to higher food prices.

While it is widely acknowledged that open international trade contributes to increased food security and that food export protection policies can lead to higher food prices, it is essential to recognize that many countries opt for food export protection measures in times of heightened uncertainty. Examples of such policies include the restrictions implemented by 27 countries during the 2008 global crisis, 20 countries during the COVID-19 in 2020, and 24 countries during the Russia-Ukraine war (Laborde, 2022). These decisions highlight the complexities governments face during economic uncertainty, where future conditions are highly uncertain and risky. Such policies diverge from the recommendations of international organizations like WTO, FAO, and the World Bank, which advocate for trade openness even in times of uncertainty.

Clapp (2017) highlighted specific circumstances where more open trade policies can heighten food security risks. During periods of economic uncertainty characterized by unstable and rising global food prices, declining export earnings due to exchange rates, and uncertainties in thin international markets, the potential for exacerbating food security risks is higher. Akter (2022) provided a summary of empirical evidence regarding the influence of limiting food exports on various aspects of domestic food systems. The results are diverse, indicating that the impact of export restrictions on domestic food prices and the welfare of food system actors in times of crisis varies from country to country. While some countries have successfully reduced domestic food prices by implementing export restrictions, others have experienced increased domestic prices.

Su et al. (2023) analyzed the effect of economic policy uncertainty (EPU) on food security and the moderating effects of international trade dependence and food price volatility. The findings of this research indicate that EPU has an amplifying effect on the constraints on food security, particularly when coupled with fluctuations in food prices. In addition, the degree of dependence on foreign trade intensifies the adverse effects of the EPU on food security, further exacerbating the adverse outcomes. This research sheds light on the importance of considering the interplay between economic policy uncertainty, international

trade dependence, and food price fluctuations when evaluating the implications for food security. The empirical results from Zhang et al. (2022) suggest that the effect of EPU on trade stability significantly undermines China's food security. Specifically, it negatively affects the stability of agricultural trade, which has implications for food security in China.

In contrast to the existing research that primarily examines the influence of economic policy uncertainty, the present research aims to investigate the dimensions of economic uncertainty. This research addresses the scarcity of studies focusing directly on economic uncertainty by utilizing the World Uncertainty Index (WUI) developed by Hites Ahir (International Monetary Fund), Nicholas Bloom (Stanford University), and Davide Furceri (International Monetary Fund). The WUI is a recent index that measures economic uncertainty through the frequency count of "uncertainty" (and its variance) in the quarterly reports of the Economist Intelligence Unit (EIU).

This research examined the moderating influence of trade openness and economic uncertainty on food security in developing countries. Developing countries were selected based on their heightened vulnerability to food security issues. Developing countries with less favorable macroeconomic conditions than developed countries are particularly vulnerable to shocks and food price fluctuations, where disruptions to supply chains or reduced economic access to food can lead to food conflicts (Erokhin & Gao, 2020). The research regarded data from 58 developing countries spanning 2012-2021. Investigating trade openness was driven by its relevance to the issue. Given the current state of food security, which is experiencing significant challenges, including the looming threat of economic uncertainty and a potential food crisis in 2023, it becomes imperative to examine the role of trade openness. The role of trade openness in times of heightened uncertainty has generated varying perspectives among policymakers and global organizations. Furthermore, there is a research gap in the literature regarding the specific focus on economic uncertainty and the influence of trade openness on food security. This research aims to bridge that gap by contributing new insights and understanding to the field.

Literature Review

Food security, as defined by The World Food Summit, refers to the condition where individuals, households, and communities at regional, national, and global levels have both the physical and economic means to obtain an adequate supply of safe, nutritious food and fulfills the requirements for an active and healthy lifestyle. This concept is supported by four key pillars of resilience: food availability, food access, food utilization, and food stabilization (FAO, 1996).

The theory of comparative advantage, developed by Ricardo (1917), posits that the benefits of international trade are based on relative rather than absolute advantages. It means that countries without absolute superiority in producing certain goods can still engage in trade. Trade can occur if each country has a comparative advantage in producing a particular commodity type. In cases where a country is less efficient in producing both commodities, it will specialize in producing the commodity with the most minor absolute loss. As a result, a country with a relative advantage will produce certain commodities relative to its trading partners and import commodities where the absolute disadvantage is more significant. In Ricardo's view, trade between countries is feasible as long as there are disparities in the relative price comparisons between the countries involved before engaging in trade. The theory of comparative advantage states that international trade arises from variations in labor productivity (explicitly stated factors of production) among countries. However, this theory needs to investigate the reasons behind these productivity differences.

In contrast, the modern International Trade Theory developed by Heckscher & Ohlin (1991) emphasizes that international trade is predominantly influenced by a country's factor endowments (natural resources, capital, and labor) and the prices of factors of production between countries. Based on the two discussed theories on international trade openness, it is evident that it improves trade efficiency. Consequently, this influences food security as it enhances the availability and stability of food through increased variety and the introduction of imported food.

According to research conducted by Marson et al. (2022) trade openness has a significant impact on reducing malnutrition rates in developing countries. Interestingly, these effects are primarily attributed to the import component rather than income, indicating a direct influence. Several other studies, such as those by Adamchick & Perez (2020); Dithmer & Abdulai (2017); Fusco et al. (2020); Shuaibu (2021); Sunge & Ngepah (2022) have also yielded similar results, demonstrating the positive influence of trade openness on food security. However, it is worth noting that not all studies reach the same conclusions. For instance, Sun & Zhang (2021) discovered a U-shaped relationship between trade openness and food security, where trade openness initially negatively influenced food security but later led to improvements. Other studies show that trade negatively affects food security. Zhu (2016) conducted research in China, which demonstrated that international trade increased reliance on food imports and affected food security. Bren D'Amour et al. (2020) and Luo & Tanaka (2021) show food imports lead to food supply instability. Mary (2019) found that an increase in food trade openness by 10% would increase the prevalence of undernourishment by about 6% in developing countries.

Knight (1921) views economic uncertainty as a condition where multiple outcomes are possible, but the probability of each outcome is unknown. Unlike situations involving risk, where all potential outcomes and their respective probabilities can be determined, uncertainty lacks knowledge of the outcome probabilities. Keynes (1973) defines uncertainty as a state where the probability distribution of future events, such as investment choices, is unknown. Predicting outcomes becomes challenging in uncertain circumstances as they do not adhere to a predetermined probability distribution (Davidson, 1991). The theory of economic uncertainty suggests that it has a detrimental effect on the economy, particularly unemployment and price stability. In turn, it negatively influences food security as economic downturns and unstable prices can have adverse consequences. Food security relies on two essential pillars: access and food stability. Food access encompasses physical and economic access, which refers to the ability to afford food (FAO, 1996). Economic uncertainty can hinder access to food by affecting people's purchasing power.

Additionally, food stability is also affected as stable food prices are necessitated. Since economic uncertainty disrupts price stability, it consequently undermines the pillar of food stability. Wen et al. (2021) explore the impact of EPU on food prices in China. The results show that an increase in the EPU leads to a significant increase in food prices in the short term. Similarly, based on the analysis of 172 countries from 2000 to 2014, food security is positively correlated with political and economic stability. An increase in the stability of the economic and political environment will improve the country's food security (Jianming et al., 2020).

According to research conducted by Abay et al. (2023) there are better solutions than export restrictions, as they will increase global food prices. Rising global food prices threaten importing and low-income countries' food security. Aragie et al. (2020) found that export bans can help stabilize domestic food prices but are insufficient to address domestic food price spikes caused by external price shocks. Similarly, Fuje & Pullabhotla (2020) show that export

bans can reduce domestic and relative prices in the short run. The short-term impact of export bans helps explain why policymakers use them. However, the welfare analysis shows that the long-term distortionary impact caused by the export ban outweighs its impact on welfare improvement and poverty reduction. These studies show that export restrictions affect food security negatively.

In a research conducted by Su et al. (2023), the influence of EPU on food security was analyzed in 25 countries, considering moderating variables such as international trade dependence (trade openness) and fluctuations in food prices. The findings indicate that EPU has an increasing constraining effect on food security, especially with fluctuations in food prices and foreign trade dependence. The research demonstrates that higher food dependency intensifies the negative influence of EPU on food security. International trade dependence was employed as a moderating variable. The researchers utilized Moderating Regression Analysis (MRA) and the fixed effect model for analysis. Similarly, Zhang et al. (2022) analyzed the effect of EPU on the stability component of food security in China. The empirical results indicate that economic policy uncertainty significantly erodes trade stability and negatively affects food security.

Akter (2022) revealed inconsistent findings regarding the influence of food export restrictions on various aspects of the domestic economy. Specifically, the research examines the effects on the welfare of food system actors and domestic food prices in exporting countries, including farmer welfare and economic efficiency. The analysis of 12 literature sources on the subject demonstrates diverse outcomes. Among the examined studies, two indicate an increase in domestic food prices, eight show a decrease in domestic food prices, and two suggest no significant influence on food prices.

Based on the previous theory and research, which suggests a positive effect of trade openness on food security, as well as the relationship between economic uncertainty, trade openness, and food security, the hypothesis of this research was formulated as follows:

H1: Trade openness has a positive and significant influence on food security in developing countries.

H2: Economic uncertainty negatively and significantly influences food security in developing countries.

H3: The negative effect of economic uncertainty on food security will increase with the increasing trade openness in developing countries.

Data and Research Methods

Panel data from 58 developing countries within the timeframe of 2012-2021. We chose this period and 58 developing countries because it includes the effects of the 2011 food crisis and the effects of COVID-19, as well as due to data availability. This study uses secondary data retrieved from official organization websites such as FAO, World Bank, WUI (World Uncertainty Index), and the Economist Influence Global Food Security Index (GFSI) (economist.com) were analyzed. These sources provided reliable and comprehensive information to analyze the relationship between trade openness, economic uncertainty, and food security across the selected countries.

Table 1: Data Sources

Variable	Data Sources
Food Security	Economist Impact, Global Food Security Index (GFSI) (economist.com)
Economic Uncertainty	World Uncertainty Index
Trade Openness	World Bank
GDP per CAPITA	World Bank
Food Inflation	FAOSTAT

The following data panel model was used in this research:

$$FS_{it} = \alpha + \beta 1 WUI_{it} + \beta 2 TO_{it} + \beta 3 WUI_{it} * \beta 4 TO_{it} + \beta 5 GDP_{it} + \beta 6 INF_{it} + e_{it} \quad (1)$$

In this research, the dependent variable is food security (FS), while the economic uncertainty index (WUI) and trade openness (TO) serve as independent variables. GDP (GDP per capita) and INF (food inflation) are also included as control variables. The standard error is denoted by "e." The data is collected for each country (i) over a specific period (t). The measurement of the food security variable is based on the Global Food Security Index (GFSI), which considers various factors such as food availability, quality, safety, affordability, sustainability, and adaptation. It is a dynamic model that combines both quantitative and qualitative data, incorporating 58 unique indicators that measure the driving factors of food security in developed and developing countries. The weighting of these indicators was determined by a panel of five experts in 2012 and subsequently normalized. The data for all series is transformed into a comparable value ranging from 0 to 100, where higher values indicate better food security in a country (The Economist Intelligence Unit, 2020).

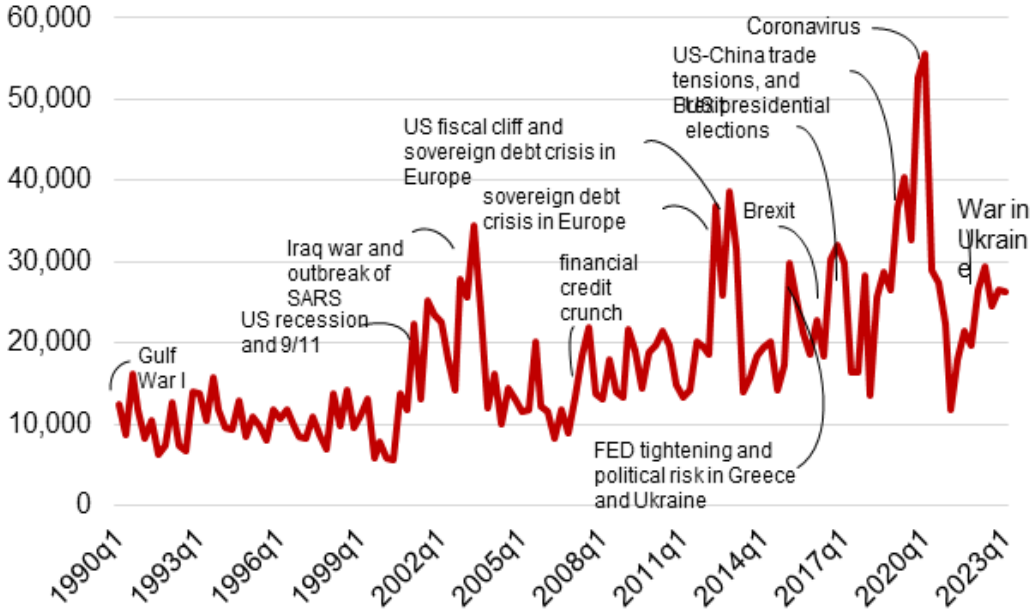

Figure 1: World Uncertainty Index 1990-2023

Source: World Uncertainty Index (2023)

Economic uncertainty (WUI) is characterized by an unknown probability distribution of outcomes in decision-making. It arises during times of future uncertainty when predicting outcomes becomes challenging due to the absence of a predetermined probability distribution (Davidson, 1991). Various factors can contribute to economic uncertainty, including natural disasters like earthquakes or hurricanes, events like the COVID-19 pandemic, financial crises,

and political instability. To measure economic uncertainty, WUI is employed, which is based on the frequency count of "uncertainty" and its variants in the quarterly reports of the Economist Intelligence Unit (EIU). This index captures both short-term and long-term uncertainties related to economic and political developments. The construction of the WUI involves counting the times uncertainties are mentioned in country reports within the EIU reports. The WUI scale is determined by calculating the number of uncertainties (and their variations) per thousand words and multiplying it by 1,000,000. Higher values on the WUI indicate higher uncertainties, while lower values indicate lower uncertainties (Ahir et al., 2022).

The variable of trade openness reflects the extent to which a government exerts control over the trade of goods and services, allowing for more significant international free trade. Trade openness is typically measured by the total value of a country's exports and imports as a percentage of its Gross Domestic Product (GDP). It indicates the degree to which a country is engaged in international trade. GDP per capita measures a nation's economic output per person (GDP/total population). Food inflation refers to the increase in food prices over one year. This variable is calculated using the base year of 2015 (FAO, 2022a):

$$r(t,t-1)=\left(\left(\frac{CPI_t}{CPI_{t-1}}\right)-1\right)*100 \tag{2}$$

where,

CPI = Consumer Price Index of food

t = Time

This research uses the panel data regression approach to analyze dynamic changes. This method offers the advantage of capturing more significant variability in the data while minimizing collinearity issues between the variables (Gujarati &Porter, 2010). To specify the dynamic panel data model, the research draws on the work of Baltagi (2005).

$$y_{it}=\delta y_{it-1}+x'_{it}\beta+u_{it} \tag{3}$$

δ is a scalar, x'_{it} matrix 1xk, β is matrix 1xk, and μ_{it} is assumed to follow the one-way component error:

$$u_{it}=\mu_{it}+\vartheta_{it} \tag{4}$$

The equations indicate that $\mu_i \sim IID(0,\sigma_\mu^2)$ represents the individual effect, while $\vartheta_i \sim IID(0,\sigma_\mu^2)$ represents an independent error. In the dynamic panel data model, the dependent variable, y_{it}, includes a lagged regressor, which introduces a correlation between y_{it-1} and u_{it}. This correlation can lead to endogeneity issues, making estimating the model using fixed or random effects inappropriate due to potential bias and inconsistency in the results.

The data analysis technique employed to examine the influence of economic uncertainty on food security while moderating trade openness is the Generalized Method of Moments (GMM). Regression analysis, explicitly utilizing the two-step system GMM method. The system GMM was selected for its efficiency and its ability to address endogeneity concerns by including lagged independent variables as regressors in the regression. The two-step GMM estimator incorporates corrected standard errors and t-tests, as outlined by Arrelano & Bond (1991). The two-step GMM estimator incorporates corrected standard errors and t-tests, as outlined by Windmeijer (2005). By simultaneously incorporating level and first difference

equations, the System GMM estimator achieves greater efficiency than the difference GMM approach. The dynamic panel data regression model in this study:

$$FS_{it} = \alpha + FS_{it-1} + \beta 1 WUI_{it} + \beta 2 TO_{it} + \beta 3 WUI_{it} * \beta 4 TO_{it} + \beta 5 GDP_{it} + \beta 6 INF_{it} + e_{it} \quad (5)$$

Two tests were conducted to assess the model specification of the GMM estimator. The consistency of the GMM estimator relies on the validity of the lagged value of the explanatory variable as an instrument. In this research, the Arellano and Bond tests for autocorrelation and the Hansen J-test for overidentifying restrictions are employed. These model specification tests ascertain whether the dynamic panel model estimated with GMM satisfies the criteria for valid and consistent instruments.

To assess the consistency of the estimation results, an autocorrelation test known as the Arellano-Bond (AB) test will be conducted. The decision criterion is based on the p-value. If the p-value is above the 1%,5%, or 10% significance level, the model is free from autocorrelation and can be considered valid. The Sargan test, also known as the Hansen test, was utilized to assess the validity of employing more instrumental variables than the estimated parameters, indicating an overidentifying restriction condition. The model is valid when the chi-square statistic or p-value is above the 1%,5%, or 10% significance level. Hypothesis testing uses partial tests (z-test) and the Wald Test.

Finding and Discussion

The description of the data used to analyze the effect of economic uncertainty and trade openness on food security in 58 developing countries in 2012-2021 is presented in the following table.

Table 2: Summary Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Food Security	580	53.56172	13.33077	18.4	75.6
Economic Uncertainty	580	0.2510803	0.181966	0	1.34288
Trade Openness	580	68.70064	32.78879	16.35219	186.4682
GDP per CAPITA	580	2845894	8555911	3526.558	5.27e+07
Food Inflation	580	5.901892	6.98786	-7.34618	68.77925

The greater the standard deviation, the more significant the data heterogeneity. It is worth noting that economic uncertainty (WUI) reaches a minimum value of 0. At the same time, trade openness has a minimum value of 16, indicating that the developing countries under research engage in international trade to varying degrees without completely closing their trade activities.

H1: Trade openness has a positive and significant influence on food security in developing countries. The estimation results show that trade openness has a significant positive effect of 0.0518 with a significance value 0.000 below 0.05. Therefore, H1 is accepted. H2: Economic uncertainty negatively and significantly affects food security in developing countries. The estimation results show that economic uncertainty has a positive but insignificant effect on food security with a significance value of 0.244, more significant than the 0.05 limit; H2 is rejected, and H3: The negative effect of economic uncertainty on food security is higher along with higher trade openness in developing countries. Economic uncertainty, moderated by trade openness, shows a negative effect of -0.0533 with a significance level of 0.001 (<0.05). Hence, H3 is accepted. The estimation results reveal contrasting influences of the GDP per capita variable and food inflation as the control variable on food security in developing

countries. Specifically, the GDP per capita exhibits a positive and significant influence with a coefficient of 0.0007327 and a significance level of 0.000 (below the threshold of 0.05). On the other hand, the food inflation variable negatively affects food security in developing countries, indicated by a coefficient of -0.0071758. However, the significance level associated with this coefficient is 0.571, suggesting it is not statistically significant. The results of the estimation using the system GMM are presented as follows.

Table 3: two-step System GMM Estimations

Variable	Food Security
L.foodsecurity	0.780*** (0.0116)
Economic Uncertainty (WUI)	1.524 (1.307)
Trade Openness (TO)	0.0518*** (0.0109)
WUI*TO	-0.0533*** (0.0155)
GDP per CAPITA (GDP)	0.000733*** (6.51e-05)
Food Inflation (INF)	-0.00718 (0.0126)
Observations	522
Number of country	58

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the sargan test, the decision criterion states that H0 should be rejected when the chi-square/p-value is below the 0.05 significance level. It is indicated that the model is considered invalid. Conversely, the model is valid when H0 is accepted, meaning the p-value is above the 0.05 significance level. In the case of the Sargan test, the result of 0.1010 suggests that the model being used is valid.

Table 4: Sargan Test

Sargan Test	
chi2(43)	55.16805
Prob > chi2	0.1010

The decision criterion is to reject the null hypothesis (H0) when the p-value is below the 0.05 significance level to assess the consistency of the estimation results. If the p-value is below this threshold, it indicates an autocorrelation problem. However, in the case of the AB test, the result of 0.8473 suggests that there is no autocorrelation problem, indicating a consistent model.

Table 5: Arellano Bond Test

Order	z	prob>z
1	-5.0401	0.000
2	-.19256	0.8473

Simultaneous Test

The model undergoes a simultaneous test to determine if a set of independent variables collectively holds significance for the model. With a significance level of 0.0000, it indicates that all variables, including economic uncertainty, trade openness, GDP per capita, and food inflation, significantly influence food security in developing countries.

The Effects of Trade Openness and Economic Uncertainty on Food Security in Developing Countries

The findings of this research indicate that trade openness has a positive effect on food security. Specifically, a 1% increase in trade openness significantly increases 0.0518 units in the food security score. The theoretical foundation of this relationship is rooted in the modern international trade theory of Heckscher & Ohlin (1991). According to this theory, international trade enhances trade efficiency, resulting in lower food prices and a wider variety of food choices. In turn, it benefits food security as lower prices make food more accessible, while a greater variety of food options improves food stability by reducing reliance solely on domestic production. This study supports evidence from previous observations (Adamchick & Perez, 2020; Dithmer & Abdulai, 2017; Fusco et al., 2020; Marson et al., 2022; Shuaibu, 2021; Sunge & Ngepah, 2022), These studies found that trade openness enhances food security. Trade openness improves food security because international trade plays a crucial role in stabilizing agricultural production, not only at a global level but also within nations or regions. It facilitates food distribution from surplus areas to regions experiencing deficits, thus helping stabilize food prices. This stability is essential considering the unpredictable weather patterns in different countries (World Bank, 2012).

The findings of this study show that economic uncertainty has a positive effect on food security, but the effect is not significant. The effect of increasing food security during times of high economic uncertainty can be caused by government policies that prepare food supplies by stockpiling foodstuffs and not exporting food goods during times of high uncertainty, such as Indonesia's policy during the Russia-Ukraine war to limit food exports through Presidential Regulation (Perpres) No. 125 of 2022 stipulating 11 types of basic foodstuffs included in the CPP (government primary reserves) which will be controlled and managed by the government during the food price crisis, India also bans sugar and wheat exports in early 2022, and according to the Laborde (2022) 20 countries had restricted their food exports during the Russia-Ukraine war and all of them were developing countries.

The Moderating Influence of Economic Uncertainty and Trade Openness on Food Security in Developing Countries

The findings of this research indicate that economic uncertainty and trade openness significantly negatively affect food security in developing countries. Specifically, a 1% increase in economic uncertainty and trade openness decreased the food security score by 0.0533 units. Interestingly, the research suggests that an increase in trade openness strengthens the negative influence of economic uncertainty on food security when economic uncertainty increases. Keynes' Theory of Economic Uncertainty (Keynes, 1973), defines uncertainty as a situation where the probability distribution of decision outcomes, such as investment, is unknown. It becomes challenging to predict future outcomes during times of uncertainty since they do not follow a predetermined probability distribution (Davidson, 1991). The findings of this research indicate that trade openness has a significantly positive effect on food security when analyzed independently. However, this effect changes in the presence of economic uncertainty. Specifically, the results suggest that the interaction between trade openness and economic uncertainty significantly negatively influences a country's food security.

These results corroborate the ideas of Su et al. (2023) who analyzed the influence of EPU on food security in 25 countries using the Fixed Effect Model, considering moderating variables such as international trade dependence and fluctuations in food prices. Their findings revealed that economic policy uncertainty exacerbates the restraining effect on food security, particularly when coupled with fluctuations in food prices and higher levels of dependence on foreign trade. The research suggests that the higher the dependency on foreign trade, the greater the negative influence of economic policy uncertainty on food security. These situations typically arise when a country heavily relies on a staple food, such as rice, traded in a limited international market. In such cases, dependence on imports increases the vulnerability to price spikes caused by disruptions in supply. Additionally, countries with large populations and high demand for certain staple food commodities face increased risks. During periods of economic uncertainty characterized by unstable and rising global food prices, declining export earnings due to exchange rates, and uncertainties in thin international markets, the potential for exacerbating food security risks is higher (Clapp, 2017).

Conclusions

This research examined the relationship between economic uncertainty, trade openness, and food security in 58 developing countries. Partial and moderate analyses were conducted using the two-step System GMM dynamic panel data method proposed by Blundell & Bond (1998). The findings indicate that economic uncertainty does not significantly affect food security in developing countries. However, trade openness positively and significantly influences food security, suggesting that increased trade openness can enhance a country's food security. The results reveal a significant negative effect when considering both trade openness and economic uncertainty. It implies that in instances of high economic uncertainty, implementing policies that reduce trade openness can enhance food security, as suggested by the findings of this research.

Further research can be conducted to enhance our understanding of the relationship between economic uncertainty, trade openness, and food security. It can involve incorporating additional dependent variables aligned with the four pillars of food security: food availability, food access, food utilization, and food stabilization. By exploring the effects of each pillar individually, future studies can provide a more comprehensive analysis of the influence of economic uncertainty and trade openness on food security. Moreover, it would be valuable for future research to examine variations among essential groups of countries, such as least-developed countries, export-oriented nations, and low-income food-deficit countries.

Declaration

Declaration includes Conflict of Interest, Availability of Data and Materials, Author's Contribution, Funding Sources, and Acknowledgments.

Conflict of Interest

There are no conflicts of interest.

Availability of Data and Materials

Data available on request

Authors' Contribution

Author 1, Author 2: Research conceptualization

Author 1: Data collection, data analysis, and writing the manuscript

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