ARPHA Preprints

PENSOFT

PREPRINT

Author-formatted, not peer-reviewed document posted on 25/09/2023

DOI: https://doi.org/10.3897/arphapreprints.e113116

Analyzing the composite effect of Corruption and Socio-Economic Variables on Food Insecurity in Pakistan: A Comprehensive Study

Saira Habib, **Hasnain Didar**

ARPHA Preprints *Author-formatted, not peer-reviewed document posted on 25/09/2023* DOI: https://doi.org/10.3897/arphapreprints.e113116

Analyzing the composite effect of Corruption and Socio-Economic Variables on Food Insecurity in Pakistan: A Comprehensive Study.

Abstract

Food insecurity affects 842 million people, or 12% of the global population, with Asia and Africa containing over 92% of the undernourished. Particularly, South Asia accounts for 35% of this number. In countries like Pakistan, factors like corruption, inflation, foreign investment, remittances, education, population growth, GDP, and unemployment aggravate food insecurity. Our research, based on data from WDI and CPI (1995-2021), using the ARDL Model, uncovers short and long-term relationships between corruption and socio-economic variables. The findings indicate that while population growth and foreign investment can alleviate food insecurity, GDP, corruption, education spending, inflation, remittances, and unemployment exacerbate it. For Pakistan's long-term economic development, reducing food insecurity is crucial, emphasizing the need for political stability.

JEL: D74, Q19

1. Introduction

Food Insecurity poses critical global problem that has far-reaching implications for the well-being and development of individuals. Food and Agriculture Organization (FAO) of the United Nations defined food insecurity as “the lack of regular access to safe and nutritious food, which hampers normal growth, development, and the ability to lead active and healthy lives”. This issue affects around 842 million people globally, equivalent to around 12 percent of the world’s population. Developing countries, especially in Asia and Africa, bear the greatest burden, accounting for over 92 percent of the undernourished population. South Asia

alone is home to 294.7 million food-insecure individuals, comprising 35 percent of the total undernourished population.[1]

Food insecurity manifests at various levels, including global, regional, national, and local, as well as within households. Its determinants vary across these levels, making it a complex and multidimensional phenomenon influenced by environmental, political, economic, and social factors. Despite the overall increase in global food production, natural disasters, economic crises, political instability, rural poverty, and corruption contribute to undermining food security. Pakistan, like many other countries, faces these challenges, exacerbated by factors such as the war on terror, military operations affecting residential areas, devastating floods that destroy capital and crops, and recent earthquakes. Pakistan ranks 93rd from a total of 104 countries present in Global Hunger Index, indicating an "extremely alarming" status, despite a decrease in the score from 43.6 to 33.9 between 1990 and 2015, underscoring the persistent nature of the issue.

Addressing food insecurity is a crucial aspect of the United Nations' 17 Sustainable Development Goals (SDGs) developed for eradicating poverty and hunger by 2030. Achieving this goal necessitates a focus on increasing the production in agricultural, improving the income of smallholder farmers through optimized land utilization and other productive resources. In rural areas, food insecurity is closely tied to agriculture, which serves as primary source of nutrients and also income for houses. Therefore, the agricultural sector plays a pivotal role in ensuring food security and is considered the economic backbone of many nations. Scholars, such as Srinita (2015), Baiphethi and Jacobs (2009), have emphasized on agriculture sector and its significance for achieving food security objectives. Addressing multifaceted nature of food insecurity requires collaborative efforts at the international, regional, countrywide, and native levels, with coordinated action in environmental, political, economic, and social spheres.

Despite significant progress in poverty reduction in recent years, food insecurity remains a widespread issue in Pakistan. Pakistan, as an agricultural country, has faced difficulties in ensuring food security for its people. South Asia, including Pakistan and India, are recognized as world's most food insecure regions, with 500 million people suffering from hunger (Asghar and Muhammad, 2013).

[1]FAO, 2013

To address these issues, the government of Pakistan has implemented a variety of modern and scientific agricultural methods and techniques. Agriculture sector is critical for the country's economy, accounting for approximately 20.88% of GDP and hiring 43.5% of the labor force. The agriculture sector is also interconnected with other sectors of the economy, contributing to Pakistan's overall socio economic development. The government of Pakistan (GOP, 2018) reported that per capita income in US dollar increased from $1531 to $1629, nevertheless food insecurity remains widespread, with nearly 60% of Pakistan’s population suffering from malnutrition (World Hunger, 2018).

Pakistan is among seven nations, including China, Bangladesh, Congo, Indonesia, India, and Ethiopia that contribute to almost two-thirds of the world's undernourished population, as cited by FAO and SBP (2019). It ranks 77th in global malnutrition. In the Southern Asian Countries (SAC), Pakistan has the highest stunting and considerable wasting rates, as noted by UNICF and WHO (2019). The nation grapples with significant malnutrition in children under five, with high stunting, wasting, underweight, and overweight figures, especially compared to other developing countries. For low-income nations to combat food insecurity and malnutrition, agricultural growth and poverty reduction are crucial. However, Pakistan's agriculture has suffered from climate change in the past decade, leading to higher food prices. Data from 1980-2010 showed inflation driven by product cost increases, disproportionately impacting the poor. Sharp price hikes have affected staples like rice, meat, and wheat. As per the Pakistan Bureau of Statistics, the annual inflation rate decreased to 8.4% in November 2020, attributed to falling food and healthcare prices (Pakistan Bureau of Statistics).

Like other factors in Pakistan Corruption is a pervasive and destructive force that undermines economic growth and development. Corruption is a particularly pressing matter, because of its negative influence felt through a range of sectors, including agriculture and food insecurity. Corruption can lead to inefficient allocation of resources, as well as the diversion of resources away from public goods such as food security programs. This can have a direct impact on the availability of food and its affordability, particularly for vulnerable population. The fundamental requirement for food security in macro environments is honesty in public administration and a rejection of corruption, just as it is for economic development (Escobar et al., 2009). Countries where political and the legal system are infected with extensive corruption suffer from poorest food security. The nation's food security suffers when political power avoids transparency and accountability and corruption takes place (FAO, 2005).

2. Literature Review

Food security plays a pivotal role in household wellbeing, particularly as societies evolve. Initially viewed from a supply-side perspective, the 1980s brought attention to demand-side challenges of food security, emphasizing individual and household access to food. Research shows that food security is multidimensional, influenced by variables such as civil conflict, climate change, and natural disasters. Our study evaluates the impact of social, political, and economic variables on national food insecurity.

Hameed et al. (2020) identified socio-economic contributors to food insecurity in Pakistan. Using the PSLM 2014-15 data, they determined that 47.7% of households faced food insecurity. Major factors included low income, limited education, and unemployment. Abdullah et al. (2020) highlighted that larger households had lesser food security, while households with more income and education were more secure. Rasheed et al. (2022) found that income, education, and employment significantly impacted food security in Pakistan. Ishaq et al. (2018) noted regional disparities in food security, emphasizing the need to address underlying causes like poverty and limited education access.

Muhammad and Sidique (2019) pinpointed household income, education, and agricultural engagement as significant determinants of food security in Nigeria. Rose and Adil (2021) found that income, education, and market access influenced food security in Punjab, Pakistan. Meanwhile, Kibria et al. (2023) emphasized poverty as a primary driver of food insecurity in Peshawar. Afridi et al. (2021) identified widespread food insecurity in Pakistan, particularly in rural areas, while Munawar et al. (2021) highlighted social capital, access to resources, and education as resilience factors against food insecurity. Asghar and Muhammad (2013) identified poverty, limited education, and credit access as key contributors to Pakistan's food insecurity. Nazli and Hamid (1999) underlined gender disparities as critical factors impacting food allocation and security. Lastly, Asif (2013) highlighted climate change's impact on Pakistan's food security due to reduced irrigation availability.

Despite the growing body of literature on food insecurity in Pakistan, there is still a research gap in understanding the relationship between macro level socio- political factor (corruption) and economic variables (unemployment, inflation, infrastructures, population, economic growth, education, and foreign remittances) that contribute to food insecurity. There have been studies conducted on the national level but there is an absence of research that analyzes

the specific socio-political factors that lead to food insecurity in Pakistan. While some studies have examined the impact of corruption on economic growth, poverty, and social development, few have investigated the direct impact of corruption on food insecurity in Pakistan. Furthermore, there is also a lack of research that observes the relationship between corruption and the various social and economic factors that contribute to food insecurity in the country. Therefore, a research gap exists in exploring the part of corruption as a driver of food insecurity in Pakistan at the national level, and in understanding how it interacts with other socio-economic factors to exacerbate food insecurity. Such research could provide valuable insights into the complex relationship between corruption, food insecurity, and socio-economic development in Pakistan, and inform evidence-based policy interventions to address this issue.

Brinkman and Hendrix (2011) examined the relationship between food insecurity and violent conflicts. They discussed factors like poverty, environmental decay, and political instability that amplify food insecurity and conflict. They emphasized addressing the root causes to ensure lasting peace and development. Hellegers (2022) assessed the risk of trade dependence on Russia and Ukraine for global food security. The author highlighted the threats of political instability and climate change, emphasizing a need for a diverse and resilient food system. Onder (2021) linked corruption to food security. Using data from 75 countries, the study showed corruption negatively impacts food security. Addressing corruption is crucial for global food security improvement.

Mukhtar and Abdullahi (2020) explored factors impacting food insecurity in Nigeria. The research identified political instability, corruption, and poverty as main contributors. Malik (2011) investigated the link between food insecurity, landlessness, and violent conflict in Pakistan. The study suggested addressing poverty, access to land, and food security could reduce violent conflict risks. Kousar et al. (2021) studied correlations between food security, population growth, urbanization, water availability, and government stability. Stable governments are vital to combat food insecurity and water scarcity.

Molotoks et al. (2021) forecasted global food security up to 2050, considering climate change, population shifts, and land use. They stressed a holistic approach to ensure food security. Aziz et al. (2021) researched the relationship between women's empowerment in agriculture and household food insecurity in Pakistan. Empowered women lead to lesser food insecurity, especially in low-income households. Akbar et al. (2020) investigated factors

causing food insecurity in Pakistani households. Findings showed households headed by women, the elderly, or disabled are more food insecure. Bigger households with lesser incomes face greater insecurity. Suleiman et al. (2022) studied the effects of food inflation on daily wage earners in Pakistan, revealing that food inflation negatively impacts their livelihoods.

Mora-Rivera and Gameren (2021) analyzed remittances' influence on food security in Mexico. Results showed remittances positively affect food security, especially in households with certain attributes. Moniruzzaman (2022) examined remittances' effect on food security in Bangladesh. Remittances lead to improved living standards and food security for recipient households. Hossain et al. (2020) evaluated land degradation and its food security implications, advocating sustainable land management for future food security. Farooq et al. (2019) highlighted the link between sustainable agriculture and food security. Sustainable agriculture is pivotal for environmental sustainability and global food security.

M. Akbar et al. (2020) explored the effect of parental employment and education on food security in Pakistan. The study underscored the importance of female education and employment in enhancing household food security. Dhahri and Omri (2020) assessed global capital flows' importance in achieving SDGs. The study revealed that FDI and foreign aid significantly reduce poverty and hunger in developing countries.

While many studies address food insecurity in Pakistan, few analyze the relationship between corruption and economic factors that lead to food insecurity. The impact of corruption, coupled with other socio-economic factors, remains underexplored in Pakistan's context. This presents a research opportunity to delve into corruption as a significant contributor to food insecurity in the country.

3. Methodology:

This study employs the ARDL bounds testing to analyze the relationship between food insecurity and descriptive variables. ARDL effectively captures data processes, differentiates between dependent and explanatory variables, and outperforms the Johensen and Juselius cointegration technique for small sample sizes.

Our main goal was to understand the impact of socio-political and economic factors on food insecurity in Pakistan. Due to limited data, we opted for the ARDL bound testing, a method introduced by Pesaran et al. (2001). This approach tests the level relationship between a

dependent variable and regressors, regardless of their stationarity. It uses conventional F and t-statistics to evaluate the significance of lagged levels in a univariate equilibrium correction mechanism. Because of its efficacy in identifying variable relationships, this method is now popular in climate-agriculture studies across countries like Ghana, Pakistan, and Europe. (Ghana (Asumadu-Sarkodie & Owusu 2016), Pakistan (Arshed & Abduqayumov 2016), and Europe (Acaravci & Ozturk 2010).

4. Data and Variables

Secondary data was obtained from World Development Indicators (WDI) and Corruption Perception Index (CPI) for the period 1980 to 2021 instead of Primary data. Therefore, this paper examines the issue from a macroeconomic standpoint, engaging variables gathered at a macro level rather than a specific region or state**.** Food Insecurity is the dependent variable for which we will use Food Production Index as a proxy for food insecurity level. While the study uses foreign direct investment, GDP Current, personal remittances, government expenditure on education, inflation, unemployment, population growth and corruption as independent variables. The selection of independent variables was based on the close relation of these variables with the dependent variable.

4.1 Econometric Model

$$FIN = \beta_0 + \beta_1 FDI_t + \beta_2 GDP_t + \beta_3 REM_t + \beta_4 EDU_t + \beta_5 INF_t + \beta_6 UNE_t + \beta_7 POP_t + \beta_8 CRP_t + \varepsilon_t \quad \ldots (1)$$

Where

t= Time series

LFIN = Food Insecurity

β = Coefficient

LFDI = Foreign Direct Investment

LGDP = Gross Domestic Product

REM = Personal Remittances

EDU = Government Expenditure on Education

INF = Inflation

UNE = Unemployment

POP = Population Growth

CRP = Corruption

α = Constant

ε = Error Term

β_1, β_2 and β_3 are the coefficient of independent Variables

$$LFIN_t = \alpha_0 + \sum_{i=1}^{p} \eta_1 (LFIN)_{t-i} + \sum_{i=0}^{n} \eta_2 \Delta\, LFDI_{t-i} + \sum_{i=0}^{n} \eta_3 \Delta\, LGDP_{t-i} + \sum_{i=0}^{n} \eta_4 \Delta\, REM_{t-i} + \sum_{i=0}^{n} \eta_5 \Delta\, EDU_{t-i} + \sum_{i=0}^{n} \eta_6 \Delta\, INF_{t-i} + \sum_{i=0}^{n} \eta_7 \Delta\, UNE_{t-i} + \sum_{i=0}^{n} \eta_8 \Delta\, POP_{t-i} + \sum_{i=0}^{n} \eta_9 \Delta\, CRP_{t-i} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

4.3 ARDL Co-integration

$$LFIN_t = \eta_o + \sum_{i=1}^{p} \eta_1 (LFIN)_{t-i} + \sum_{i=0}^{q} \eta_2 (LFDI)_{t-i} + \sum_{i=0}^{q} \eta_3 (LGDP)_{t-i} + \sum_{i=0}^{q} \eta_4 REM)_{t-i} + \sum_{i=0}^{q} \eta_5 (EDU)_{t-i} + \sum_{i=0}^{q} \eta_6 (INF)_{t-i} + \sum_{i=0}^{q} \eta_7 (UNE)_{t-i} + \sum_{i=0}^{q} \eta_8 (POP)_{t-i} + \sum_{i=0}^{q} \eta_9 (CRP)_{t-i} + \varepsilon_t + \lambda_1 (FIN)_t + \lambda_2 (LFDI)_t + \lambda_3 (LGDP)_t + \lambda_4 (REM)_t + \lambda_5 (EDU)_t + \lambda_6 (INF)_t + \lambda_7 (UNE)_t + \lambda_8 (POP)_t + \lambda_9 (CRP)_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (3)$$

Where in the above equation

- Food Insecurity represents the level of food insecurity in time period t.
- FDI, GDP, Remittances, Education Expenditure, Inflation, Unemployment, Population Growth, and Corruption are the values of the independent variables in time period t.
- λ, η are the short-run coefficients corresponding to the respective lagged variables.
- ε represents the error term capturing the unexplained variation in the dependent variable.

5. Results

5.1 Augmented Dickey-Fuller (ADF):

Table 1: Augmented Dickey-Fuller Test (Augmented Dickey-Fuller)

At Level			At First Difference		Integration
Variables	t-Statistic	Prob.	t-Statistic	Prob.	
LFIN	1.7593	0.9994	-7.0026***	0.00	I(1)

LGDP	-0.5559	0.8642	-4.3563***	0.0024	I(1)
LFDI	-1.4852	0.5251	-4.2398***	0.003	I(1)
EDU	-2.8837*	0.061	-5.9516***	0.00	I(0)
INF	-2.4866	0.13	-5.9731***	0.00	I(1)
CRP	-1.4273	0.5503	-10.2751***	0.00	I(1)
POP	-1.2222	0.6456	-4.4572***	0.0025	I(1)
UNE	-1.4535	0.5406	-4.7424***	0.0009	I(1)
REM	-0.2692	0.9149	-4.1535***	0.0048	I(1)

(*) Significant at 10%; (**) Significant at 5%; (***) Significant at 1%

The ADF test in table 1 is frequently used in time series analysis to examine stationarity which is an enhanced form of the Dickey-Fuller test, particularly suitable for greater and more complex sets of time series models. All the variables, exhibit stationarity at a 1% significance level when considering the first difference while, no variables show non-stationarity at the first difference. When considering the level, Education (EDU) exhibits stationarity at 10% significance level. However, all the other variables show non-stationarity at the level.

5.2 Bounds Test

Table 2: Bounds Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	3.908425	10%	1.85	2.85
K	8	5%	2.11	3.15
		2.50%	2.33	3.42
		1%	2.62	3.77

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
			Asymptotic: n=1000	
F-statistic	**3.908425**	**10%**	**1.85**	**2.85**
k	**8**	**5%**	**2.11**	**3.15**
		2.50%	**2.33**	**3.42**
		1%	**2.62**	**3.77**

The bound test employed above in table 2 represents F-statistics and t-statistics at different levels to examine the relationship between variables. The null hypothesis conditions that no level of relationship exists. The table 4 above displays an F-statistic value of 3.9084. To interpret the results, it is necessary to compare these values at various significance levels. At 10%, 5% and 1% significance levels, the F-statistic value of 3.9084 surpasses both the greater bound values and the lesser bound values. Consequently, we reject the null hypothesis at the 10%, 5% and 1% significance levels, indicating the presence of a significant relationship at these levels.

We come to the conclusion that there is a significant relationship at these levels based on the test statistics and critical values at different significance levels. As a result, we disprove the null hypothesis, which states that there is no relationship at any level.

5.3 ARDL Method

Table 3: ARDL Results

R-squared	0.986781	Mean dependent var	81.88654
Adjusted R-squared	0.966951	S.D. dependent var	22.15456
S.E. of regression	4.027532	Akaike info criterion	5.899443
Sum squared resid	162.2102	Schwarz criterion	6.673656
Log likelihood	-60.69275	Hannan-Quinn criter.	6.122388
F-statistic	49.76424	Durbin-Watson stat	2.116129
Prob(F-statistic)	0		

In our case the table 3 shows R-squared is 0.890149, which is near to 1, so our model is good fit. It tells us about how independent variable is predicting depended variable. We normally refer adjusted R-squared in multiple regressions. May be negative (due to degree of freedom) .Rang of value is -1 to 1. Provide information about same result but there is some kind of facts that adjusted R-SQAURE is more acceptable the R-square. Durbin Watson has a range of 1.7 to 2.3 and our model is in range as our vale as 2.11

5.4 Short-run Results

Table 4: **Short Run Results**

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	-0.18482	1.076447	-0.17169	0.8671
LFIN(-1)*	-1.1612	0.300123	-3.86908	0.0031
LFDI(-1)	-0.03189	0.034484	-0.92478	0.3769
EDU(-1)	0.02087	0.018511	1.12743	0.2859
CRP(-1)	0.097344	0.026366	3.691999	0.0042
LGDP**	0.197988	0.100219	1.975557	0.0764
INF(-1)	0.005489	0.002343	2.342981	0.0411
POP(-1)	-0.00353	0.032547	-0.10831	0.9159
UNE**	0.000972	0.003408	0.285304	0.7812
REM(-1)	0.025592	0.010349	2.47294	0.0329
D(LFDI)	0.070199	0.036657	1.915038	0.0845
D(EDU)	0.041971	0.018376	2.284032	0.0455
D(CRP)	0.062728	0.017453	3.59407	0.0049
D(INF)	0.001598	0.001635	0.977462	0.3514
D(POP)	0.104527	0.053609	1.949802	0.0798
D(REM)	0.017034	0.012262	1.389176	0.1949
CointEq(-1)*	-0.64294	0.079897	-8.04715	0

The above table 4 presents the short-run estimates, illustrating the immediate effects of various factors on Food insecurity, including inflation rate, unemployment, corruption, GDP, population growth, foreign direct investments, Education, and remittances. It also provides detailed information on the coefficients, standard errors, t-statistics, and probabilities for each variable.

Specifically, Corruption (CRP), the coefficient is 0.097, signifying that a 1% rise in Corruption contributes to a 9.7% increase in Food Insecurity. Gross domestic Product (GDP) has a coefficient of 0.197, representing that a 1% increase in GDP leads to a 19.7% increase in Food Insecurity. Inflation (INF) has a coefficient of 0.0015, suggesting that Inflation impacts Food Insecurity positively by 0.15%. Remittance (REM) has a coefficient of 0.025, suggesting that Remittances impacts Food Insecurity positively by 2.5%. These variables have a significant effect on food insecurity.

Although insignificant, Population Growth (POP) has a coefficient of -0.0035, indicating a negative association between Population growth and Food Insecurity. Unemployment (UNE) has a coefficient of 0.0009, indicating that a 1% increase in Unemployment leads to a 0.9% increase in Food Insecurity. A 1% surge in population growth corresponds to a 0.35% reduction in Food insecurity. Similarly, Foreign Direct Investment (FDI) is -0.031, indicating an inverse effect between FDI and Food Insecurity (FIN). This suggests that a 1% increase in the FDI rate leads to a 3.1% reduction of Food Insecurity. The coefficient for the Education Expenditure (EDU) is 0.020, indicating a positive association between EDU and Food Insecurity. An increase 1% in the EDU corresponds to a 2% increase in Food Insecurity

(FIN). The value of error correction model (ECM) in our model is -0.64 which shows that our model will be in equilibrium after 64 years.

The t-statistics are used to assess the importance of the variables. Corruption, Inflation and Remittances with a t-statistic greater than 2 and a probability value less than 0.05, is deemed statistically significant. In contrast, the other variables are considered insignificant as their t-statistics are below 2 and their probability values exceed 0.05.

5.5 Long-run Results

Table 5: Long Run Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFDI	-0.02746	0.027371	-1.00335	0.3394
EDU	0.017973	0.014858	1.209663	0.2542
CRP	0.08383	0.022097	3.793762	0.0035
LGDP	0.170503	0.075562	2.256459	0.0477
INF	0.004727	0.002345	2.015963	0.0715
POP	-0.00304	0.027953	-0.1086	0.9157
UNE	0.000837	0.003003	0.27877	0.7861
REM	0.02204	0.006329	3.482411	0.0059
C	-0.15916	0.931187	-0.17092	0.8677

The table 5 above represents the long-run outcomes of the estimations, showcasing the effects of various factors such as the Inflation rate, unemployment, corruption, GDP, population growth, foreign direct investments, and remittances on Food insecurity. The table also includes the coefficients, standard errors, t-statistics, and probabilities for each variable.

The findings reveal that CRP, GDP, INF and REM have a significant while EDU and UNE have an insignificant positive impact on food insecurity. A 1% rise in CRP is associated with an 8.3% increase in Food insecurity. Furthermore, a 1% increase in GDP leads to a 17% increase in Food insecurity. Similarly, a 1% increase in INF is related with a 0.4% increase in Food insecurity. Furthermore, a 1% increase in REM leads to a 2.2% increase in Food insecurity. Although insignificant an increase in 1% EDU corresponds to a 1.7% rise in Food Insecurity. Finally a 1% rise in UNE leads to a 0.08% rise in Food insecurity and finally

On the other hand, POP and FDI although insignificant, have an adverse outcome on Food Insecurity. The coefficient of POP is negative (-0.003), indicating that POP in the economy negatively impacts Insecurity, resulting in a decrease of 0.3%. While that of FDI is (-0.0274)

indicating that FDI in the economy negatively impacts Food Insecurity, resulting in a decrease of 2.7%. These results highlight the contrasting effects of different factors on Food Insecurity, with EDU, CRP, GDP, INF, UNE, and REM exerting a favorable influence, while POP demonstrating an unfavorable influence.

5.6 Diagnostic Test

According to Bhatti et al. (2006), the CUSUM test enables us to assess the consistent variation of coefficient values for the variables, while the cumulative data helps indicate whether the regression coefficients are fluctuating unpredictably. Figure 2 and 3 below presents the CUSUM of squares and CUSUM graphs. At a 5% significance level, if the plot remains within the boundaries, we consider the model to be stable. In this case, as the blue line is in-between the two red lines, we conclude that the parameters are also stable. The fact that the CUSUM and CUSUM of the square fall below the threshold limits of 0.05% indicates the structural stability of the model and the overall quality of fit.

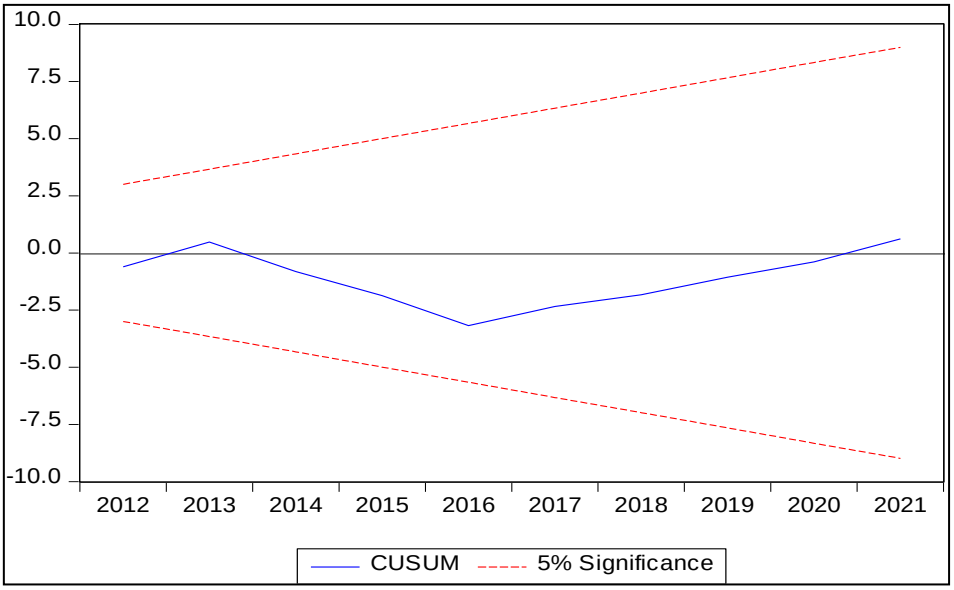

Figure 1: CUSUM

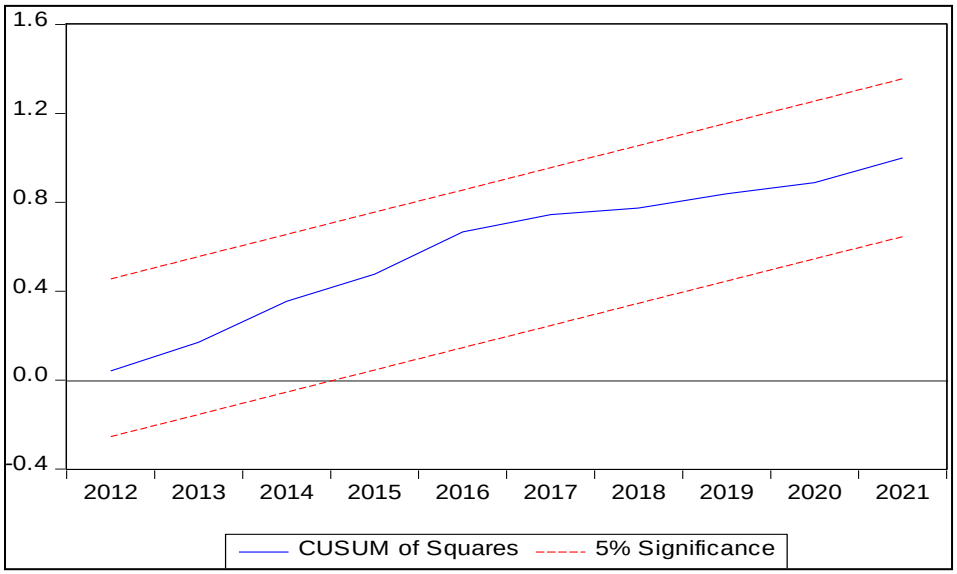

Figure 2: CUSUM of Squares

6. Discussion and Conclusion

This research paper aims to delve into the impact of various macro-level variables on food insecurity in Pakistan, a critical issue with wide-ranging implications for the nation's social and economic development. Employing the Autoregressive Distributed Lag (ARDL) approach, a widely recognized and robust econometric methodology, the study seeks to analyze the effects of several independent variables on food insecurity. These variables include foreign direct investment (FDI), gross domestic product (GDP), remittances (REM), education spending (EDU), inflation (INF), unemployment (UNE), population growth (POP), and corruption (CRP). By carefully segmenting the analysis into short-term and long-term effects, the study provides valuable insights into the complex relationships between these macro-economic factors and food insecurity in Pakistan.

The research findings shed light on the impact of population growth and foreign direct investment on food insecurity. The results reveal that population growth has a negative influence on food insecurity, drawing attention to the pressing challenges associated with rapid demographic expansion. Pakistan, being the second most populous nation in South Asia and potentially set to become the fourth most populous country globally, faces significant tasks in ensuring sufficient food availability for its burgeoning population. This finding emphasizes the need for implementing policies that focus on job creation, income generation, and equitable distribution of resources to harness the potential demographic dividend that population growth could offer.

Moreover, foreign direct investment (FDI) demonstrates a negative correlation with food insecurity, suggesting that an increase in FDI leads to a reduction in food insecurity. The study aligns with previous research highlighting the positive influence of FDI on host countries, particularly in terms of creating employment opportunities, transferring technology and knowledge, and fostering economic growth. In the context of food insecurity, this finding underscores the potential of FDI to contribute to food security by expanding agricultural production through increased investment in the sector. However, it also emphasizes the need for policies that ensure these benefits reach the most vulnerable segments of the population, effectively addressing food insecurity.

Another notable finding is that gross domestic product (GDP) has a direct and significant positive impact on food insecurity. This finding challenges the conventional belief that economic growth automatically reduces hunger and underscores the importance of delving deeper into the nuances of economic development and its relationship with food security. While economic growth is often seen as a key driver of poverty alleviation and improved living standards, the study's results caution against assuming a linear link between GDP growth and reduced food insecurity. The persistence of hunger among the poor and disadvantaged, even in times of overall food abundance, highlights the unequal distribution of economic resources as a key factor contributing to food insecurity.

The study also uncovers the adverse effects of corruption, inflation, unemployment, and education spending on food insecurity in Pakistan. Corruption is found to have a significant positive impact on food insecurity, as it infiltrates the food supply chain, disrupts resource allocation, distorts market mechanisms, and raises transaction costs, ultimately leading to decreased agricultural productivity, limited access to resources for farmers, and disrupted distribution channels. This underscores the importance of addressing corruption as a crucial component of any strategy to tackle food insecurity in Pakistan.

Similarly, inflation is shown to have a significant positive impact on food insecurity, with rising food prices exacerbating the challenges of accessing a sufficient and nutritious diet, particularly for economically disadvantaged individuals. Elevated food prices affect individuals' ability to afford essential food items and can lead to compromised food quality, limited choices, and inadequate access to vital nutrients. The study underscores the broader impact of inflation on the entire food supply chain, including increased production expenses and transportation costs, further driving up food prices.

Additionally, the study highlights the positive relationship between unemployment and food insecurity, as the loss of employment and stable income compromises individuals' ability to afford an adequate and nourishing diet. This often leads to reduced food quality, limited choices, and inadequate access to essential nutrients, particularly among the unemployed and their families. Prolonged unemployment contributes to persistent food insecurity, exacerbating vulnerability among affected populations.

Furthermore, the study uncovers an unexpected positive relationship between education spending and food insecurity. Higher education levels were found to be associated with increased vulnerability to food insecurity, which can be attributed to various factors. Firstly,

higher education often fosters elevated aspirations and expectations, leading to a shift towards costlier and less sustainable dietary patterns. Secondly, educated individuals frequently seek job opportunities in urban areas, disrupting traditional agricultural practices and diminishing household food production. Additionally, education may entail increased financial burdens, such as school fees and associated expenses, which put a strain on family budgets and make it difficult to allocate sufficient resources for food. These results highlight the complex dynamics between education and food security in Pakistan, underscoring the necessity of a comprehensive approach to addressing the underlying causes and ensuring equitable access to food for all segments of society.

To effectively address food insecurity in Pakistan, comprehensive strategies and interventions are imperative. This requires coordinated efforts from the government, civil society, and international organizations to tackle the root causes of food insecurity, including structural challenges, socio-economic disparities, and governance issues. In particular, investment in agricultural infrastructure, research, and technology is crucial to enhancing productivity and ensuring food availability.

Moreover, addressing the challenge of food insecurity in Pakistan necessitates targeted policies that focus on improving access to education, healthcare, and employment opportunities, particularly in rural areas where a significant portion of the population is engaged in agriculture. A multi-faceted approach is necessary to empower individuals and communities to break the cycle of poverty and food insecurity, promoting sustainable and inclusive development.

References

Baiphethi, M. N., & Jacobs, P. T. (2009). The contribution of subsistence farming to food security in South Africa. *Agrekon*, *48*(4), 459-482.

Srinita, S. (2018). Relationship between maternal, household, and socio-economic characteristics and household food security in Aceh, Indonesia. *International Journal of Human Rights in Healthcare*, *11*(3), 192-203.

(2015) *Pakistan Bureau of Statistics*. Pakistan. [Web Archive] Retrieved from the Library of Congress, https://www.loc.gov/item/lcwaN0016418/.

Escobar, J. C., Lora, E. S., Venturini, O. J., Yáñez, E. E., Castillo, E. F., & Almazan, O. (2009). Biofuels: environment, technology and food security. Renewable and sustainable energy reviews, 13(6-7), 1275-1287.

Von, Grebmer, K., Bernstein, J., de Waal, A., Prasai, N., Yin, S., & Yohannes, Y. (2015). 2015 Global Hunger Index: Armed conflict and the challenge of hunger. Intl Food Policy Res Inst.

Notes, H. (2011). World hunger and poverty facts and statistics. *Washington, DC: World Hunger Education Service*

State Bank of Pakistan (2019) State Bank of Pakistan various publications 2019, Government of Pakistan.

Food and Agriculture Organization (2019) Global Report on Food Crisis 2019, Food and Agriculture Organization United Nations.

UNICEF (2019) Country wise over review Malnutrition burden in Pakistan, United Nations International Children Emergency Fund, New York, USA.

World Health Organization (2019) Levels and trends in child malnutrition key findings edition, 2019. World Health Organization (WHO). United Nations New York.

Önder, H. (2021). The impact of corruption on food security from a macro perspective. *Future of Food: Journal on Food, Agriculture and Society*, *9*(1)

GOP, G. (2018). Pakistan Economic Survey 2017–18. *Finance Division, Economic Advisor's Wing: Islamabad, Pakistan*

Hameed, A., & Salam, A. (2020). Estimating the socio-economic factors of food insecurity in Pakistan: a regional level analysis.

Kousar, S., Ahmed, F., Pervaiz, A., & Bojnec, Š. (2021). Food insecurity, population growth, urbanization and water availability: the role of government stability. Sustainability, 13(22), 12336

Mukhtar, S., & Abdullahi, S. I. (2020). Testing the relationship between socio-political factors, economic variables and food insecurity in Nigeria. Journal of conflict resolution and social issues, 1(1), 148-159.

Rasheed, R., Ishaq, M. N., & Akbar, M. (2022). A Correlation of Socio-economic Determinants and Food Security Status in Pakistan. Pakistan Journal of Humanities and Social Sciences, 10(1), 416-425.

Ishaq, A., Khalid, M., & Ahmad, E. (2018). Food insecurity in Pakistan: A region-wise analysis of trends. Pakistan Insfitute of Development Economics (PIDE) Working Papers, 157, 1-26

Muhammad, N. A., & Sidique, S. F. B. A. (2019). Determinants of food security among Households in Nigeria. Pakistan Journal of Nutrition, 18, 1042-1052.

Rose, S., & Adil, S. (2021). Factors influencing the food security and nutrition expenditures in farm households in Punjab, Pakistan. Eur. Sci. J. ESJ, 17, 21-39.

Kibria, Z., Khan, M. N., Aleem, S., & Haq, Z. U. (2023). Linkages between poverty and food insecurity in Pakistan: Evidence from urban and rural households in Peshawar. Pakistan Journal of Medical Sciences, 39(2).

Afridi, G. S., Jabbar, A., Khan, S., & Akmal, N. (2021). An Analysis of Food Insecurity in Pakistan: Prevalence of Undernourishment (PoU) and Food Insecurity Experience Scale (FIES). Journal of Applied Economics and Business Studies, 5(1), 175-190.

Aziz, N., Ren, Y., Rong, K., & Zhou, J. (2021). Women's empowerment in agriculture and household food insecurity: Evidence from Azad Jammu & Kashmir (AJK), Pakistan. Land Use Policy, 102, 105249.

Munawar, M., Shiwei, X., Wen, Y., & Luqman, M. (2021). Resilience to food insecurity among rural households in the Punjab, Pakistan. Sarhad J. Agric, 37, 754-762.

Asghar, Z., & Muhammad, A. (2013). Socio-economic determinants of household food insecurity in Pakistan.

Malik, S. M. (2011). An empirical investigation of the relationship between food insecurity, landlessness, and violent conflict in Pakistan

Nazli, H., & Hamid, S. (1999). Concerns of food security, role of gender, and intrahousehold dynamics in Pakistan. Working Papers & Research Reports, RR-No

Asif, M. (2013). Climatic change, irrigation water crisis and food security in Pakistan, 1-39.

Brinkman, H. J., & Hendrix, C. S. (2011). Food Insecurity and Violent Conflict: Causes. Consequences, and Addressing the Challenges, World Food Prgramme.

Hellegers, P. (2022). Food security vulnerability due to trade dependencies on Russia and Ukraine. Food Security, 14(6), 1503-1510.

Önder, H. (2021). The impact of corruption on food security from a macro perspective. Future of Food: Journal on Food, Agriculture and Society, 9(1)

Molotoks, A., Smith, P., & Dawson, T. P. (2021). Impacts of land use, population, and climate change on global food security. Food and Energy Security, 10(1), e261.

Farooq, M., Rehman, A., & Pisante, M. (2019). Sustainable agriculture and food security. Innovations in sustainable agriculture, 3-24.

Akbar, M., Niaz, R., & Amjad, M. (2020). Determinants of households' food insecurity with severity dimensions in Pakistan: Varying estimates using partial proportional odds model.

Suleman, R., Javed, M. S., & Amjad, M. A. (2022). Influence of Food Products Sudden Inflation on Livelihoods of Daily Income Wagers of Pakistan. Annals of Social Sciences and Perspective, 3(1), 129-135.

Mora-Rivera, J., & van Gameren, E. (2021). The impact of remittances on food insecurity: Evidence from Mexico. World Development, 140, 105-349.

Moniruzzaman, M. (2022). The Impact of remittances on household food security: Evidence from a survey in Bangladesh. Migration and Development, 11(3), 352-371.

Hossain, A., Krupnik, T. J., Timsina, J., Mahboob, M. G., Chaki, A. K., Farooq, M., ... & Hasanuzzaman, M. (2020). Agricultural land degradation: processes and problems undermining future food security. In Environment, climate, plant and vegetation growth (pp. 17-61). Cham: Springer International Publishing.

Akbar, M., Amjad, M., & Iqbal, Z. (2020). Impact of Parental Education and Employment on Households' Food Security in Pakistan: Application of Bayesian Logistic Framework, 23, 1-14.

Dhahri, S., & Omri, A. (2020). Are international capital flows really matter for achieving SDGs 1 and 2: ending poverty and hunger?. Review of World Economics, 156, 731-767.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Asumadu-Sarkodie, S., & Owusu, P. A. (2016). The relationship between carbon dioxide and agriculture in Ghana: a comparison of VECM and ARDL model. Environmental Science and Pollution Research, 23, 10968-10982.

Arshed, N., & Abduqayumov, S. (2016). Economic impact of climate change on wheat and cotton in major districts of Punjab. International Journal of Economics and Financial Research, 2(10), 183-191.

Bhatti, A., Canelli, F., Heinemann, B., Adelman, J., Ambrose, D., Arguin, J. F., ... & Yun, G. (2006). Determination of the jet energy scale at the Collider Detector at Fermilab. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 566(2), 375-412.