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Does food inflation exacerbate poverty in the Arab world? Assessing the impact of rural development and institutional quality

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ABSTRACT

The rise in global food prices has significantly exacerbated hunger and poverty, particularly in low – and middle-income countries. While previous studies have explored various aspects of these issues, a critical gap remains in understanding their combined impact within the distinctive socio-economic and political landscape of Arab countries. Therefore, this study examines the joint effects of food inflation, rural development, and institutional quality on poverty levels in the Arab world from 2004 to 2021. Recognizing cross-sectional dependence and heterogeneity among the panels, the study employs advanced panel cointegration methods. The findings from panel-corrected standard errors (PCSE) and feasible generalized least squares (FGLS) analyses consistently indicate that food price inflation exacerbates poverty rates, particularly in low – and middle-income Arab countries, while its impact remains negligible in those with high-incomes. The evidence further confirms that higher income inequality correlates with increased poverty across all income groups. However, economic growth and institutional quality play a crucial role in poverty reduction. Notably, rural development does not significantly contribute to poverty alleviation in low – and middle-income Arab countries. Additionally, the method of moments quantile regression (MMQR) analysis reinforces the robustness of these findings. To mitigate poverty in the Arab world, the study proposes several policy recommendations.

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Poverty; rural development; income inequality; institutional quality; food inflation; food prices

1. Introduction

The escalating global food prices, spurred by geopolitical conflicts, climate change, and economic upheavals, are deepening poverty and food insecurity, especially in low – and middle-income countries (Açci et al. 2024). Food is essential to life for all individuals, yet the proportion of household income spent on food varies significantly between affluent and impoverished families (Ellahi et al. 2015). Impoverished households, particularly those with the lowest incomes, are severely impacted by rising food prices as they allocate a substantial portion of their income to necessities (Solaymani and Yusma Bt Mohamed Yusoff 2018). Many poor individuals in developing economies, as net food purchasers, are disproportionately affected. For these households, the unstable nature of food costs exacerbates poverty and famine through second-round effects, wherein rising food prices drive higher aggregate price levels (De Gregorio 2012). Therefore, increases in food prices typically result in decreased nutrition, increased poverty, and reduced access to vital services such as healthcare and education (Laborde, Lakatos, and Martin 2019). The sharp rise in hunger and poverty in low-income countries has been attributed to the combined effects of food price shocks and income shocks triggered by global food and financial crises (Akter and Basher 2014). Due to the widespread impact on the costs of nearly all products, the welfare effects will be more extensive and prolonged throughout the poor countries (World Food Programme 2022).

Rising food prices have a dual impact: they can boost farmers' revenue while simultaneously lowering the purchasing power of consumers by driving up household food expenditures; if household income remains static, this reduces buying power and exacerbates poverty (Abdi, Mohamed, and Mohamed 2024; Faharuddin et al. 2023). In low-income countries that import food, an increasing proportion of individuals are unable to afford a nutritious diet due to escalating food prices (Hodjo, Dalton, and Nakelse 2024). Unpredictable

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weather patterns, droughts, and floods further impair agricultural output, decrease food availability, and raise costs (Abdi, Warsame, and Sheik-Ali 2023). Small-scale farmers, who make up a significant portion of the population, are particularly vulnerable due to their disproportionate exposure to climate impacts and food price volatility. The conflict in Ukraine has further exacerbated global food costs, which push millions into poverty and hunger (Bachmann et al. 2022). Shortly after Russia invaded Ukraine, the FAO food price index reached its highest recorded level, threatening food security in many low – and middle-income countries heavily reliant on Ukrainian and Russian grain exports (World Bank 2024a). This geopolitical instability has forced Arab countries to source grains from India and the EU at higher costs, which reveals the economic pressures on import-dependent nations (World Economic Forum 2023). By April 2024, compared to January 2020, maize prices had risen by 19%, wheat by 24%, and rice by 46% (World Bank 2024a). Consequently, geopolitical conflicts and climate change continue to drive up food prices, worsening famine in hunger-stricken countries like Somalia, Sudan, and Yemen (Welthungerhilfe 2023).

Inflation remains a critical issue in the MENA region, with many countries experiencing double-digit rates, particularly in food prices. While Gulf Cooperation Council (GCC) economies face persistently high inflation, conflict-affected Arab countries experience rising prices driven by economic downturns, further worsening food insecurity and economic instability for poorer households (Gatti et al. 2024). As of 2024, over 59% of low-income and 63% of lower-middle-income countries report food price inflation rates above 5%, including many African and Asian countries heavily reliant on Ukraine for 95% of their wheat imports in 2021 (World Bank 2024a; World Economic Forum 2023). Local markets in Arab countries, which depend heavily on food imports, have absorbed much of these price increases, leaving them highly vulnerable to global fluctuations. The combined effects of the COVID-19 pandemic and global shocks, such as the war in Ukraine, pushed 712 million people into extreme poverty in 2022, an increase of 23 million from 2019 (World Bank 2024b). In many African nations, where agriculture is a cornerstone of the economy, rising food prices reduce purchasing power, hinder farmers' ability to afford essential supplies, and threaten agricultural output, thereby prolonging poverty (Abdi, Sugow, and Halane 2024; Adam et al. 2016). Addressing the effects of food inflation on poverty in low-income countries necessitates overcoming numerous policy challenges (Gaddis 2016).

In addition to food inflation, higher income inequality exacerbates poverty by disproportionately impacting poor individuals due to extreme vulnerability (McKnight et al. 2017; Baloch et al. 2020). Inequality impedes social progress by creating poverty traps, wasting human potential, and perpetuating unequal access to essential services like health and education, which transmits unequal opportunities across generations (Nosratollah Nafar 2021). Increases in inequality often push more individuals below the poverty line relative to the mean income of the population, directly linking shifts in inequality to changes in poverty levels (Marrero and Servén 2022; Bergstrom 2022). Promoting sustainable rural development is crucial for reducing economic inequality, fostering economic growth, and increasing employment opportunities in rural areas (Chowdhury and Ahmed 2015). Enhancing rural infrastructure and providing essential public services can mitigate premature rural-urban migration, support income generation, and improve the living standards of impoverished populations (Handoyo, Hidayatina, and Purwanto 2021; Liu, Guo, and Zhou 2018). Access to rural financial services, such as microfinance and credit, is instrumental in empowering poor households, facilitating resilience, and reducing poverty (Zhu et al. 2021). Nevertheless, rural development in the Arab world presents unique challenges, as many countries in the region face limited arable land, water scarcity, and governance issues that hinder effective policy implementation. Hence, strengthening institutional quality in rural areas can further enhance the effectiveness of development efforts by ensuring fair resource allocation and transparency, which is essential for fostering inclusive growth and poverty alleviation (Appiah-Otoo et al. 2022; Jindra and Vaz 2019).

The primary objective of this study is to examine the impact of food inflation, rural development, and institutional quality on poverty in 18 Arab countries using panel data from 2004 to 2021. The Arab world is distinctive due to its high reliance on food imports, combined with significant socio-economic disparities, persistent income inequality, and a high prevalence of poverty, with more than two-thirds of the countries in our sample exhibiting poverty rates exceeding 35%. These factors, coupled with the region's vulnerability to geopolitical conflicts and climate change, amplify the impact of food inflation and institutional quality on poverty. Despite previous research addressing various aspects of these issues, there remains a significant gap in understanding their combined effect within the unique socio-economic and political context of the Arab nations. Against this backdrop, this research is expected to make several critical contributions to the literature and

policymakers. Firstly, it offers a comprehensive analysis by integrating the study of food inflation, income inequality, rural development, and institutional quality. By examining these factors together, the study provides an integral view of their interaction and impact on poverty in Arab countries. Secondly, a vital contribution of this study is its differentiated analysis based on income levels within Arab countries. By employing separate models for all Arab countries, low – and middle-income Arab countries, and high-income Arab countries, the study provides a detailed understanding of how food inflation impacts poverty across different economic contexts. Thirdly, the study employs advanced panel methodologies, including panel-corrected standard errors (PCSE), feasible generalized least squares (FGLS), and the method of moments quantile regression (MMQR), to account for variations across different countries and regions within the Arab world. Finally, the findings will equip policymakers with targeted insights to address challenges in the Arab context, promoting rural development, stabilizing food prices, and reducing poverty.

The remainder of this paper is structured as follows: Section 2 provides a detailed review of the relevant literature. Section 3 details the variables and econometric approaches employed in the analysis. Section 4 presents and discusses the results. Finally, Section 5 concludes the study and outlines relevant policy implications.

2. Literature review

Several studies have assessed the impact of food inflation on poverty levels across different contexts. Layani et al. (2020) examined the effects of food price shocks on urban households in Iran, focusing on eight food groups: cereals, meats, dairy, cooking oil, sugar, fruits, vegetables, and tea and coffee. Their findings revealed that rising food costs negatively impacted many urban households, significantly increasing the number of low-income families. Similarly, Shabnam, Aurangzeb, and Riaz (2023) explored the implications of rising food prices on poverty in Pakistan. They noted that urban households were more affected than rural ones in a calorie-based poverty model. The study concluded that increasing food prices are likely to exacerbate poverty levels in Pakistan. In Indonesia, Faharuddin et al. (2023) demonstrated that rice, vegetables, and fish are the food groups with the most significant price effects on poverty. The study also found that a price increase in these food types led to considerable rises in the headcount ratio. According to Sarris (2011), dependence on food imports makes countries vulnerable to global price shocks, which amplify the adverse effects of poverty.

Contrasting these findings, Headey and Hirvonen (2023) examined the impact of higher food prices on poverty and economic growth in 33 middle-income countries over a 19-year period. Their research discovered that, except in more urban or non-agrarian economies, annual increases in the actual price of food were generally associated with declines in poverty rates. Additionally, Hodjo, Dalton, and Nakelse (2024) exhibited that an increase in millet prices reduces rural welfare, while a rise in sorghum prices primarily affects urban households' welfare. The study also indicated that future food price shocks could result in higher welfare losses for consumers due to population growth, acreage-driven millet and sorghum production growth, and income elasticities. The transmission mechanism through which food inflation exacerbates poverty often lies in its disproportionate impact on low-income households, which allocate a significant share of their income to food (Shabnam, Aurangzeb, and Riaz 2023). As food prices rise, these households face reduced purchasing power, diminished access to essential goods, and an increased likelihood of falling below the poverty line (Faharuddin et al. 2023). In contexts with weak institutional frameworks, the absence of effective price stabilization policies and social safety nets further amplifies these effects (Mojeed, Elizabeth, and Kfilah 2023).

The relationship between rural development and poverty reduction has been a focal point in numerous studies. Zhu et al. (2021) found that rural financial development contributes to poverty alleviation and widens the urban-rural income gap. This study also indicates the significance of spatial spillover effects, which conventional models often overlook, thereby demonstrating that the benefits of rural financial growth can extend beyond the immediate implementation area. Handoyo, Hidayatina, and Purwanto (2021) provide further evidence from Indonesia, showing that regions with developed villages experience significant reductions in poverty severity and enhanced economic growth. This indicates that well-implemented rural development initiatives can substantially improve local economic conditions and reduce poverty. In Kenya, Agayi and Karakayaci (2022) identify critical factors such as access to water and food as key to addressing rural poverty. Their study suggests that increasing income levels, rather than just land size, is crucial for reducing poverty. Chowdhury and Ahmed (2015) demonstrate that comprehensive rural development programs in Bangladesh can significantly reduce poverty rates, particularly in housing, agriculture,

health, and education. This reinforces the idea that multidimensional approaches to rural development are essential for sustainable poverty alleviation. According to Nejadrezaei and Ben-Othmen (2020), encouraging rural development, mainly through a thriving smallholder agricultural economy, is essential for reducing poverty and hunger. Thus, comprehensive and sustained rural development initiatives are vital for achieving equitable economic growth and long-term poverty alleviation.

The significant role of economic growth in alleviating poverty has been the central theme in numerous studies. Balasubramanian, Burchi, and Malerba (2023) investigated this relationship in low – and middle-income countries using innovative multidimensional poverty indexes. Their findings suggest that economic growth substantially reduces poverty, particularly in nations with lower initial poverty levels and during periods of sustained economic expansion. Ebong (2013) examined the association between economic growth and poverty reduction in Nigeria by emphasizing the significant role of institutional quality. The study revealed that economic growth and strong institutions positively influence household consumption. This indicates that effective institutional frameworks can amplify the poverty-reducing effects of economic growth. Similarly, Mogess, Eshete, and Alemaw (2023) focused on sub-Saharan Africa by demonstrating a strong correlation between economic growth and poverty reduction through the generalized method of moments (GMM). This reinforces the notion that sustained economic expansion is crucial for improving living standards in developing regions. In Indonesia, Mardiana et al. (2022) explored the impact of per capita income and labor on poverty. The findings indicate that increases in per capita income significantly alleviate poverty. Korankye et al. (2020) provided further evidence from Africa by displaying that economic progress plays a vital role in reducing poverty across the continent. Their study unveils that specific aspects of economic development are instrumental in improving living conditions.

Furthermore, the studies on income inequality and poverty nexus reveal critical insights into how disparities in income distribution can hinder poverty reduction efforts. Nosratollah Nafar (2021) highlights the global rise in income inequality, with the wealthiest segments earning a disproportionate share of total income. This disparity constrains poverty reduction despite economic growth, emphasizing the intertwined nature of income distribution, poverty, and economic development. By exploring this dynamic in Central Sulawesi Province, Darise indicates that while economic growth had minimal long-term effects on poverty, income inequality significantly impacts poverty levels. Barak (2022) extends this analysis to the BRICS countries, finding that increased income inequality and non-renewable energy consumption exacerbate poverty, while economic growth and renewable energy consumption contribute to its reduction. In the sub-Saharan African context between 1990 and 2018, Amponsah, Agbola, and Mahmood (2023) reveal that income inequality adversely affects poverty levels and hinders inclusive growth. This study suggests that reducing income disparities is crucial for improving poverty outcomes and promoting broader economic inclusion across the region. In addition, Uchechi and Ibrahim (2020) focus on Nigeria, demonstrating that income inequality has significantly contributed to rising poverty over the past three decades. They pointed out the importance of policies addressing income disparities to effectively combat poverty.

The impact of institutional quality on poverty reduction has been a critical focus of research. The literature consistently presents that strong, transparent, and effective institutions are vital for fostering economic growth, improving income distribution, and addressing environmental challenges. Singh (2021) investigated institutional quality and poverty reduction in BRICS countries. The study found that the rule of law significantly aids in poverty alleviation. By employing advanced econometric techniques, the study demonstrates that other governance aspects impact poverty indirectly through income distribution effects. By covering data from 1984 to 2018, Ahmed and Hakim (2023) provided similar insights into the Economic Community of West African States (ECOWAS). They found that enhancements in institutional quality markedly reduce poverty levels. Analyzing data from 132 countries over several decades, Kaidi, Mensi, and Ben Amor (2019) found that financial development alone does not necessarily improve the conditions of low-income people. Instead, institutional quality's positive impact on poverty and financial development depends on the specific indicators considered. Rizk and Slimane (2018) concluded that higher institutional quality not only reduces poverty but also enhances environmental protection across 146 countries. Their findings suggest that while environmental degradation and poverty reinforce each other, effective institutional frameworks can mitigate these adverse effects. On the other hand, institutional failures contribute to poverty by causing resource misallocation, market exclusion, and inefficiency (Aracil, Gómez-Bengoechea, and Moreno-de-Tejada 2022). Poor institutional quality, particularly corruption and the absence of a politically

stable environment, significantly contributes to high poverty rates as it impedes the country's safe and successful economic activities (Mojeed, Elizabeth, and Kfilah 2023).

3. Methodology

3.1. Data and variables

This study employs annual balanced panel data from 2004 to 2021 to explore the effects of food inflation, rural development, and institutional quality on poverty across 18 Arab countries. The countries included in the sample are Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Tunisia, and the United Arab Emirates. To further investigate the effects of food inflation on poverty across different income levels, the sample countries were classified into low – and middle-income Arab countries and high-income Arab countries. This classification allows for a deeper understanding of which group of countries is most affected by food inflation. This is particularly important as many studies suggest that food inflation may disproportionately impact lower-income countries, where a more considerable household income is spent on food (Hodjo, Dalton, and Nakelse 2024; Shabnam, Aurangzeb, and Riaz 2023). The data for this study were obtained from reputable sources, including the United Nations Economic and Social Commission for Western Asia (UNESCWA), the Food and Agriculture Organization (FAO), the World Development Indicators (WDI), and the World Income Inequality Database (WIID). A comprehensive description of the data sources, symbols, and measurement units is provided in Table 1.

The dependent variable is poverty, measured by the poverty rate. The primary explanatory variables are food inflation, measured as the percentage of food price inflation; rural development, quantified through rural development disbursements; and institutional quality, measured by the control of corruption estimate. To account for additional factors that may influence poverty, economic growth, measured by GDP at constant 2015 U.S. dollar prices, and income inequality, captured through the Gini Coefficient Index, are included as control variables. These variables were selected based on their well-documented significance in influencing poverty levels in the Arab region. Food inflation directly impacts the cost of living and access to necessities, while economic growth creates opportunities for income generation and development (Abdi et al. 2024; Balasubramanian, Burchi, and Malerba 2023; Faharuddin et al. 2023; Mohamed and Abdi 2024). Conversely, rising income inequality exacerbates poverty by pushing more individuals below the poverty line compared to the average income of the population (Marrero and Servén 2022). Rural development initiatives are critical in predominantly agricultural economies, helping to improve infrastructure and livelihoods (Chowdhury and Ahmed 2015). Institutional quality, particularly control of corruption, is essential for ensuring that resources are effectively allocated and reach the intended beneficiaries (Ahmed and Hakim 2023; Singh 2021).

Table 1. Variables, symbols, measurement unit, and sources.

Variable	Code	Measurement	Source
Poverty	POV	Poverty rate (%)	UNESCWA
Food inflation	FPI	Food price inflation (value %)	FAO
Economic growth	GDP	GDP, constant 2015 (billions of US $)	WDI
Income inequality	GI	Gini Coefficient Index	WIID
Rural development	RDEV	Rural Development, Disbursement (millions of US$)	FAO
Institutional quality	INQ	Control of Corruption: Estimate	WGI

3.2. Model specification

This research builds on the preceding empirical investigations of Shabnam, Aurangzeb, and Riaz (2023), Adam et al. (2016), Chowdhury and Ahmed (2015), Mardiana et al. (2022), Uchechi and Ibrahim (2020), and Singh (2021), who included variables such as food inflation, economic growth, income inequality, rural development, and institutional quality in their studies. Unlike previous studies, which often focused on a narrower set of variables, we considered a broader context that includes income inequality, rural development, and institutional quality. Consequently, we adopted the following model to examine the impact of these variables on poverty across Arab countries:

$$POV_{it} = \alpha_0 + \beta_1 FPI_{it} + \beta_2 GDP_{it} + \beta_3 GI_{it} + \beta_4 RDEV_{it} + \beta_5 INQ_{it} + \mu_{it} \quad (1)$$

where the variable POV represents poverty, which is the dependent variable. FPI represents food inflation, GDP signifies gross domestic product, GI indicates income inequality, RDEV stands for rural development, and INQ represents institutional quality, while β_1, β_2, β_3, β_4, and β_5 represent the coefficients of the corresponding variables; μ indicates the error term, and subscripts i and t represent the country and time, respectively. For the purpose of comparing the direct elasticity value and the reduction of the variables' heteroscedasticity,

the equation's variables have been converted into natural log form except for food inflation and institutional quality. Following is the updated model:

$$lnPOV_{it} = \alpha_0 + \beta_1 FPI_{it} + \beta_2 lnGDP_{it} + \beta_3 lnGI_{it} + \beta_4 lnRDEV_{it}\ \beta_5 INQ_{it} + \mu_{it} \quad (2)$$

3.3. Econometric strategy

To identify the appropriate techniques, the cross-sectional dependence test is applied at the beginning of the empirical analysis. Given the proximity and shared characteristics of the units, there is a high likelihood of cross-sectional dependence (CSD) among the panels. CSD can lead to biased estimations and inferences (Pesaran 2004). To prevent this, the Pesaran (2004) test for CSD, suitable for both small and large panels, is used. Cross-sectional dependence in the data can arise from shared economic ties, trade relations, and common external shocks. Therefore, to ensure the reliability of our econometric models, we first assess CSD and heterogeneity among the panel data. The Pesaran (2004) CSD test is used for this purpose, with the test statistic calculated as follows:

$$CSD = \sqrt{\frac{2T}{N()N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \quad (3)$$

where N is the number of cross-sections, T is the time dimension, and $\hat{\rho}_{ij}$ represents the sample estimate of the pairwise correlation of the residuals. The null hypothesis of no cross-sectional dependence is rejected if the CSD statistic is significantly different from zero. Additionally, to test for slope heterogeneity, we employ the Pesaran and Yamagata (2008) test. The standardized dispersion statistic for testing homogeneity is given by:

$$\Delta = \sqrt{N}\left(\frac{\bar{S} - k}{\sqrt{2k}}\right) \quad (4)$$

where $\bar{S}$ is the average of the individual slope coefficients and k is the number of regressors. This test helps determine whether the slope coefficients vary significantly across cross-sections, which implies the need for heterogeneous panel estimators.

Based on the results of the CSD test, the appropriate unit root test is selected. Initially, the first-generation unit root test, the Maddala and Wu (1999) test, is employed to determine the stationarity of the panel data by testing for unit roots across individual cross-sections. However, if CSD is detected, first-generation unit root tests become inadequate. In the presence of cross-sectional dependence, we utilize second-generation unit root tests, such as the cross-sectional Augmented Dickey-Fuller (CADF) test developed by Pesaran (2007). The CADF test addresses cross-sectional dependence by incorporating cross-sectional averages of lagged levels and the first differences of the series into the test equation. This adjustment ensures that the test accounts for the common factors affecting the cross-sections. The CADF test equation is specified as follows:

$$\Delta y_{it} = a_i + \delta_i y_{i,t-1} + \theta_1 \bar{y}_{t-1} + \sum_{j}^{k} \theta_{ij} \Delta \bar{y}_{i,t-1} + \sum_{j=0}^{k} \Delta y_{i,t-1} + \varepsilon_{it} \quad (5)$$

where Δ denotes the first difference, $\bar{y}_{t-1}$ is the cross-sectional average of y_{t-1}, and ε_{it} is the error term.

To investigate the long-run relationships between variables, panel cointegration tests by Pedroni (1999; 2004) and Kao (1999) are utilized. The Pedroni test provides several statistics for within-dimension and between-dimension tests. The test equation is specified as follows:

$$Y_{it} = \alpha_i + \delta_{it} + \beta_i X_{it} + \epsilon_{it} \quad (6)$$

where Y_{it} is the dependent variable, X_{it} are the independent variables, α_i are individual fixed effects, and δ_{it} captures the deterministic trend. The null hypothesis of no cointegration is rejected if the test statistics are significant. Additionally, the Kao (1999) cointegration test is employed to validate the findings from the Pedroni cointegration test. The Kao test accounts for heterogeneity and cross-sectional dependency when assessing the presence of cointegration among variables such as food inflation, income inequality, economic growth, rural development, institutional quality, and poverty in Arab countries. The alternative hypothesis suggests the existence of cointegration between these variables, while the null hypothesis argues against it. Rejection of the null hypothesis, based on statistically significant probability values at the 1%, 5%, or 10% significance levels, indicates the presence of a long-run cointegration relationship.

Due to the presence of cross-sectional dependency and cointegration among the variables, we estimate the Prais-Winsten regression model with panel-corrected standard errors (PCSE) and feasible generalized least squares (FGLS) to account for heteroscedasticity and serial correlation. The PCSE estimator, proposed by Beck and Katz (1995), is utilized to address heteroskedasticity and contemporaneous correlation in the residuals across panels. Beck and Katz recommend using PCSE

over ordinary least squares (OLS) standard errors for parameter estimates due to its superior robustness and efficiency, as demonstrated by their Monte Carlo analysis. The variance-covariance matrix of the parameter estimates is given by:

$$Var(\widehat{\beta}) = (x'x)^{-1}[x'\Omega\, x](x'x)^{-1} \quad (7)$$

where Ω represents the error covariance matrix, which incorporates time-invariant cross-sectional dependency, panel heteroskedasticity, and first-order common autocorrelation. The covariance framework is modified as follows:

$$\Omega = \Sigma \otimes I_T \quad (8)$$

where $\otimes$ denotes the Kronecker product, Σ captures the cross-sectional dependence, and I_T is the identity matrix for the time dimension. Consequently, the variance-covariance matrix becomes:

$$Var(\widehat{\beta}) = (x'x)^{-1}x'(\Sigma \otimes I_T)\, x(x'x)^{-1} \quad (9)$$

Therefore, the PCSE can be obtained by taking the square root of the diagonal elements of this matrix. To further address heteroskedasticity and autocorrelation issues, the FGLS estimator is employed. The FGLS method involves a two-step process: First, an OLS model is estimated to obtain residuals, which are then used to estimate a more comprehensive error covariance matrix than the random effects covariance matrix. The second step uses this estimated covariance matrix to transform the original model and provide more efficient parameter estimates. Finally, the study employs the method of moments quantile regression (MMQR) for robustness testing and to verify the consistency of the results, ensuring the reliability of the findings across different model specifications.

4. Empirical findings and discussion

4.1. Descriptive analysis

Descriptive statistics offer valuable insights into the main characteristics of data across Arab countries, as summarized in Table 2, which presents three models displaying various statistical measures such as mean, standard deviation, maximum, minimum, skewness, kurtosis, Jarque-Bera test, and the number of observations. Notably, GDP consistently exhibits the highest average, maximum value, and standard deviation across all three models. Conversely, institutional quality has the lowest mean values in Models I and III (−0.416 and −0.677, respectively). Model II, which represents high-income Arab countries, highlights poverty with the lowest average value of 6.5%. Poverty also shows the lowest standard deviation in all models, with values of 0.180, 0.053, and 0.138. Further, Model I reveal average values of 42.741 for income inequality and 6.486% for food inflation, while Model II shows 36.612 and 2.345%, and Model III demonstrates 44.275 and 8.340%, respectively. In Model III, rural development displays an average mean value of 6.438 million US dollars, with a standard deviation of 15.903, a maximum value of 143.049, and a minimum value of −0.033. The skewness of all variables in the three models is positive, which indicates a long-right tail, except for income inequality in Model II (−1.123) and institutional quality in Model III (−0.398). Moreover, all variables exhibit a platykurtic distribution, suggesting a relatively small number of data clusters at the tails or peak of the frequency distribution.

Table 2. Descriptive analysis.

	Mean	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Obs
Model I: All Arab countries								
Poverty	0.292	0.703	0.002	0.180	0.293	2.502	6.965**	283
Food inflation	6.486	248.265	−6.415	16.83	10.992	152.890	270620.8***	283
Income inequality	42.741	65.718	25.960	7.814	0.725	3.150	25.089***	283
GDP	113.989	709.601	0.703	151.448	2.178	7.801	495.650***	283
Institutional quality	−0.416	1.400	−1.849	0.709	0.137	2.838	1.188	283
Model II: High-income Arab countries								
Poverty	0.065	0.182	0.002	0.053	0.600	2.232	6.093**	72
Food inflation	2.345	12.336	−3.201	3.094	0.653	3.557	6.046**	72
Income inequality	36.612	40.623	25.960	3.742	−1.123	4.045	18.412***	72
GDP	230.145	709.601	26.036	217.655	1.091	2.800	14.404***	72
Institutional quality	0.386	1.400	−0.359	0.491	0.424	1.896	5.813*	72
Model III: Low-middle-income Arab countries								
Poverty	0.361	0.703	0.187	0.138	0.971	3.096	30.545***	194
Food inflation	8.340	248.265	−6.415	19.939	9.404	110.141	95650.26***	194
Income inequality	44.275	62.826	31.868	7.230	0.400	2.350	8.602**	194
GDP	78.335	425.778	0.778	93.756	1.648	5.466	136.972***	194
Institutional quality	−0.677	0.380	−1.849	0.560	−0.398	2.287	9.229***	194
Rural development	6.438	143.049	−0.033	15.903	6.523	53.307	21832.76***	194

Note: ***, **, and * indicate *p*-values at the 1%, 5%, and 10% levels of significance, respectively.

Table 3. Cross-sectional dependence test outcomes.

Variable	Breusch-Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD
	Model I: All Arab countries			
lnPOV	793.626 [0.000]	36.622 [0.000]	36.093 [0.000]	5.635 [0.065]
FPI	346.560 [0.000]	11.065 [0.000]	10.536 [0.000]	10.433 [0.000]
lnGI	1150.269 [0.000]	57.010 [0.000]	56.481 [0.000]	10.508 [0.000]
lnGDP	2225.797 [0.000]	118.494 [0.000]	117.965 [0.000]	43.314 [0.000]
INQ	361.245 [0.000]	11.905 [0.000]	11.375 [0.000]	3.423 [0.000]
	Model II: High-income Arab countries			
lnPOV	87.766 [0.000]	13.285 [0.000]	13.013 [0.000]	−0.122 [0.902]
FPI	64.924 [0.000]	9.115 [0.000]	8.938 [0.000]	7.791 [0.000]
lnGI	130.353 [0.000]	21.061 [0.000]	20.884 [0.000]	9.101 [0.000]
lnGDP	130.353 [0.000]	21.061 [0.000]	20.884 [0.000]	9.101 [0.000]
INQ	52.274 [0.000]	6.805 [0.000]	6.629 [0.000]	−1.559 [0.119]
	Model III: Low-middle-income Arab countries			
lnPOV	348.253 [0.000]	24.567 [0.000]	24.214 [0.000]	5.898 [0.000]
FPI	129.103 [0.000]	5.492 [0.000]	5.139 [0.000]	4.163 [0.000]
lnGI	515.985 [0.000]	39.166 [0.000]	38.813 [0.000]	2.683 [0.007]
lnGDP	938.400 [0.000]	75.933 [0.000]	75.580 [0.000]	26.770 [0.000]
INQ	127.591 [0.000]	5.361 [0.000]	5.008 [0.000]	4.114 [0.000]
lnRDEV	95.95 [0.011]	2.532 [0.011]	2.179 [0.029]	3.98 [0.001]

Note: The values inside the brackets [...] indicate the corresponding *p*-values.

The Jarque-Bera test results at the 1% and 5% significance levels indicate that all variables deviate from the normal distribution.

4.2. Cross-sectional dependence and heterogeneity tests

The cross-sectional dependence (CSD) between the panels is examined using several tests, including the Breusch and Pagan (1980) LM test, the bias-corrected LM test, the Pesaran (2004) scaled LM test, and the Pesaran (2015) CSD test. The results of these CSD tests for all three models are summarized in Table 3. These tests operate under the assumption of cross-sectional independence. The results from the CSD tests significantly reject the null hypothesis of cross-sectional independence compared to the alternative hypothesis of cross-sectional dependence. This indicates a strong presence of cross-sectional dependence among the variables. Therefore, we conclude that all the variables across the three models exhibit significant cross-sectional dependence, which necessitates the use of econometric techniques that account for this dependence in subsequent analyses.

To assess the homogeneity of the slope coefficients, we employed the Pesaran and Yamagata (2008) test. This test evaluates the homogeneity of slope coefficients by calculating the values of the delta tilde ($\tilde{\Delta}$) and adjusted delta tilde, along with their associated probability values. The findings regarding slope heterogeneity, presented in Table 4, indicate a rejection of the null hypothesis that the coefficient slopes are homogeneous. Specifically, the results from Models I and III demonstrate that the null hypothesis of homogeneous slope coefficients is rejected at a significance level of 1%. Conversely, for Model II, the null hypothesis is not rejected. These results suggest that the slope coefficients in Models I and III exhibit significant variations across different cross-sections. In contrast, the slope coefficients in Model II do not show significant heterogeneity, which implies that they are more consistent across the cross-sections analyzed.

Table 4. Heterogeneity test results.

H_0: coefficient slopes are homogeneous			
	Model I Statistic	Model II Statistic	Model III Statistic
$\tilde{\Delta}$	5.953 [0.000]	0.169 [0.866]	5.219 [0.000]
$\tilde{\Delta}$ Adj.	7.57 [0.000]	0.239 [0.811]	7.064 [0.000]

Note: [...] represent the *p*-values of the $\tilde{\Delta}$ statistic.

4.3. Panel unit root analysis

The integration order and degree of stationarity of the series were examined using panel unit root tests, specifically the Maddala and Wu (1999) Fisher test and the CADF test. As summarized in Table 5, the results reveal

Table 5. Maddala and Wu and CADF tests.

Variables	Maddala and Wu (1999) Fisher		CADF	
	Level	Δ	Level	Δ
lnPOV	52.311**	109.143***	−1.166	−1.573**
FPI	55.365**	251.459***	1.089	−8.124***
lnGI	121.926***	55.728**	−0.323	2.357
lnGDP	85.670***	89.692***	−4.558***	−3.859***
INQ	42.444	154.851***	0.173	−3.403***
lnRDEV	37.365**	120.873***	2.632	NA

Notes: NA signifies not applicable. One period lag was used for both tests. For the Maddala and Wu test, we reported the Chi^2 statistic whereas the CADF we reported the Z[t-bar] statistic.

Table 6. Pedroni and Westerlund cointegration test results.

	Model I Statistic	Model II Statistic	Model III Statistic
Pedroni test for cointegration			
Modified Phillips-Perron t	3.822***	3.154***	3.498***
Phillips-Perron t	−2.847***	−3.455***	−1.955**
Augmented Dickey-Fuller t	−4.188***	−4.485***	−22.239***
Westerlund test for cointegration			
Variance ratio	2.449***	5.207***	0.254

different orders of integration for the variables under study. The Maddala and Wu Fisher test results indicate that all variables, except for institutional quality, are stationary at level. Institutional quality becomes stationary at the first difference. Conversely, the CADF test results show that poverty, food inflation, income inequality, and institutional quality become stationary after the first difference, whereas GDP is stationary at the level. These findings highlight different orders of integration among the variables, with some being stationary at levels (I(0)) and others at the first difference (I(1)). Given these mixed integration orders, our panel unit root tests recommend proceeding with the panel cointegration analysis proposed by Pesaran, Shin, and Smith (1999).

4.4. Panel cointegration tests

The presence of a cointegration relationship between the variables was examined using the Pedroni and Westerlund tests. The results from the cointegration analysis are presented in Table 6. The Pedroni panel cointegration tests indicate that the series are cointegrated for each panel. Specifically, the probability values of the modified Phillips-Perron (PP), PP, and ADF statistics are significant at the 1% level. This suggests that the null hypothesis of no cointegration among the variables is strongly rejected. Additionally, the Westerlund cointegration test results reveal that the variance ratio (VR) statistics are below the 1% significance level, except for Model III, further supporting the rejection of the null hypothesis of no cointegration. These combined results from the Pedroni and Westerlund tests indicate a cointegration relationship between food inflation, income inequality, economic growth, rural development, institutional quality, and poverty.

4.5. Results from the PCSE and FGLS analyses

Table 7 presents the combined results of the PCSE and FGLS analyses. These findings demonstrate the impact of food price inflation, rural development, and institutional quality on poverty across different income groups in Arab countries. Both PCSE and FGLS analyses consistently reveal that food price inflation exacerbates poverty rates. For the entire sample, the PCSE results indicate that a 1% increase in food price inflation leads to a 0.0003% increase in poverty, while the FGLS results present a slightly higher impact, with a 1% increase leading to a 0.0009% increase in poverty. In the low – to middle-income groups, the PCSE analysis reveals that a 1% increase in food price inflation results in a 0.0001% increase in poverty. However, the various approaches concur that food inflation does not drive poverty in high-income Arab countries. These results indicate the substantial effect of rising food prices on poverty across all Arab countries, particularly in low – and middle-income regions. Similarly, both techniques suggest that income inequality contributes to poverty. The PCSE results indicate that a 1% increase in income inequality leads to a 2.077% increase in poverty for the entire sample, a 2.638% increase for high-income Arab countries, and a 1.035% increase for low – to middle-income Arab countries. Similarly, the FGLS results show that a 1% increase in income

Table 7. Results from the PCSE and FGLS.

Variables	PCSE			FGLS		
	Full sample	High-income	Low-middle-income	Full sample	High-income	Low-middle-income
FPI	0.0003**	−0.0040	0.0001***	0.0009**	0.0045	0.0001
	(2.105)	(−1.489)	(3.020)	(2.216)	(0.314)	(0.381)
lnGI	2.077***	2.638**	1.035***	0.370**	1.318	1.169***
	(7.392)	(2.339)	(7.129)	(2.176)	(1.270)	(9.270)
lnGDP	−0.148***	0.142	−0.0507***	−0.131***	0.179	−0.005
	(−10.19)	(0.597)	(−3.541)	(−8.514)	(1.543)	(−0.451)
lnRDEV			0.0016			0.0061
			(1.140)			(1.062)
INQ	−0.148***	0.0798	−0.0494***	−0.310***	−0.248**	−0.120***
	(−5.898)	(0.926)	(−4.954)	(−20.73)	(−1.982)	(−10.86)
Constant	−3.928***	−5.807***	−2.138***	−1.191***	−3.575**	−2.472***
	(−8.403)	(−2.908)	(−8.978)	(−4.080)	(−2.111)	(−11.47)
R^2	0.892	0.492	0.898			
Observations	283	72	185	283	72	185
Countries	18	6	12	18	6	12

inequality results in a 0.370% increase in poverty for the entire sample and a 1.169% increase for low – to middle-income Arab countries. These findings highlight the detrimental effects of income inequality on poverty across different income groups.

On the contrary, economic growth demonstrates a substantial negative impact on poverty across the analyses. The PCSE results unveil that a 1% increase in economic growth leads to a 0.148% decrease in poverty for the entire sample and a 0.0507% decrease for low – to middle-income Arab countries. The FGLS analysis further confirms these findings, indicating that a 1% increase in economic growth results in a 0.131% decrease in poverty for the entire sample. This highlights the importance of economic growth in alleviating poverty, particularly in the broader context of Arab countries. In assessing the effect of rural development on poverty, specifically for low – and middle-income Arab countries, both PCSE and FGLS approaches indicate that rural development has an insignificant impact on poverty. Despite the theoretical importance of rural development in alleviating poverty, the empirical results do not show a statistically significant relationship in this context. Moreover, institutional quality negatively impacts poverty in both PCSE and FGLS analyses, with slight variations across different income groups. According to the PCSE results, a one-unit improvement in institutional quality leads to a 0.148% decrease in poverty for all Arab countries and a 0.0494% decrease for low – to middle-income countries. The FGLS results indicate that a one-unit improvement in institutional quality results in a 0.310% decrease in poverty for all Arab countries, a 0.248% decrease for high-income Arab countries, and a 0.120% decrease for low – to middle-income Arab countries. These findings suggest that enhancing institutional quality can significantly reduce poverty across various economic contexts.

4.6. Results from the method of moments quantile regression

Table 8 provides a summary of the main findings derived from the quantile regression analysis for three categories: the entire sample, high-income Arab countries, and low-middle-income Arab countries. The models specifically examine the 0.25, 0.5 (median), and 0.75 quantiles of the dependent variable (poverty) in each income group. In the full sample, the results indicate that food price inflation is significant at the 0.75th quantile at a 1% significance level. This positive coefficient means that poverty is more affected by an increase in food price inflation at higher poverty levels. Income inequality is statistically significant at the 0.25^{th} quantile at the 1% level and the median quantile at the 5% level. In addition, economic growth is significant at all quantiles, with a 10% significance level at the 0.25^{th} quantile and a 5% significance level at the median and 0.75 quantiles. Additionally, institutional quality is significant at all quantiles with a 1% significance level, which indicates a consistent and significant relationship with poverty.

In high-income Arab countries, food inflation increases poverty, although it is insignificant across the various quantiles. Income inequality exacerbates poverty, which is significant at the 0.75th quantile. Additionally, economic growth is significant at the 0.25^{th} and median quantiles, indicating that economic growth impacts poverty reduction at lower and median poverty levels. Institutional quality is significantly negative at the 0.75th quantile, which presents that improvements in institutional quality reduce poverty at higher levels. For low-income countries, the results indicate that food price inflation is statistically significant at the 0.75th quantile. Both income inequality and institutional quality are statistically significant at all quantiles, which shows a consistent impact on poverty across different levels. Furthermore, economic growth is statistically significant at the 0.25^{th} and 0.75th

Table 8. Simultaneous quantile findings (dependent variable: poverty).

Variables	Full sample			High-income			Low-middle-income		
	0.25	0.50	0.75	0.25	0.50	0.75	0.25	0.50	0.75
FPI	0.0004	0.0005	0.00221***	0.0054	0.0028	0.0016	0.0001	0.0001	0.0007**
	(0.281)	(0.488)	(2.655)	(0.0884)	(0.0872)	(0.463)	(0.503)	(0.168)	(2.039)
lnGI	1.462***	0.818**	0.2430	−3.1130	1.7530	2.480***	1.754***	1.324***	0.359*
	(2.780)	(2.072)	(0.754)	(−0.577)	(0.624)	(8.016)	(11.62)	(4.274)	(1.965)
lnGDP	−0.0732*	−0.0725**	−0.0638**	−0.860*	0.2590	0.286***	0.0440***	−0.0052	−0.0410**
	(−1.657)	(−2.186)	(−2.356)	(−1.794)	(1.038)	(10.41)	(3.198)	(−0.185)	(−2.460)
lnRDEV							0.0067	0.0156	0.0101
							(1.078)	(1.229)	(1.344)
INQ	−0.292***	−0.234***	−0.196***	0.309	−0.374	−0.321***	−0.0843***	−0.0914***	−0.179***
	(−7.555)	(−8.065)	(−8.282)	(0.617)	(−1.433)	(−11.18)	(−7.011)	(−3.701)	(−12.31)
Constant	−3.140***	−1.930***	−0.867	4.759	−4.275	−5.431***	−3.548***	−2.714***	−1.064***
	(−3.494)	(−2.862)	(−1.576)	(0.534)	(−0.921)	(−10.63)	(−13.67)	(−5.093)	(−3.384)
Obs.	283	283	283	72	72	72	185	185	185

quantiles. Overall, the MMQR results suggest that food price inflation and income inequality exacerbate poverty, whereas improvements in economic growth and institutional quality help to reduce poverty.

5. Discussion of the results

Given the Arab countries' high dependency on food imports and vulnerability to global price fluctuations, rising food prices exacerbate poverty levels, especially among the poorest populations. Numerous quantitative studies have explored the relationship between food price inflation and poverty, often arriving at different conclusions. Nevertheless, several studies across various countries and regions align with our findings, such as Shabnam, Aurangzeb, and Riaz (2023) in Pakistan and Faharuddin et al. (2023) in Indonesia. This reinforces our finding that higher food prices increase the cost of living, disproportionately affecting low-income households who spend a larger portion of their income on food. As a result, these households experience greater financial strain and reduced access to essential nutrients, exacerbating poverty and food insecurity. Conversely, some empirical studies contradict our results. For instance, Hodjo, Dalton, and Nakelse (2024), Headey (2018), and Headey and Hirvonen (2023) discovered that food inflation reduces poverty. In regions where a significant portion of the population relies on agriculture for their livelihood, the positive effects of increased revenue for farmers and producers might outweigh the negative impacts on consumers. Conversely, in net food-importing regions or urbanized areas where the majority of people are consumers, rising food prices are more likely to exacerbate poverty.

In the Arab countries, we found that significant income inequality can exacerbate poverty, leading to heightened social and economic instability. Several studies in the literature corroborate our findings that income disparity exacerbates poverty. For instance, Amponsah, Agbola, and Mahmood (2023) in sub-Saharan Africa, Uchechi and Ibrahim (2020) in Nigeria, Barak (2022) in BRICS countries, and Darise in Indonesia all provide evidence that income inequality has a detrimental impact on poverty levels. Conversely, some research presents a different perspective. For example, Soava, Mehedintu, and Sterpu (2020) in the European Union suggest that income inequality can mitigate poverty. Therefore, when income is unevenly distributed, the poorest segments of society are more likely to experience increased financial strain, reduced access to essential services, and diminished opportunities for economic advancement. In the Arab nations, the detrimental effects of income inequality on poverty are particularly significant due to existing socio-economic conditions. Many Arab countries experience high youth unemployment, limited economic diversification, and varying degrees of political instability. These factors can exacerbate the negative impacts of income inequality, making it more challenging to achieve sustainable economic growth and poverty reduction.

Previous studies also reinforce the findings of this study by indicating the significant role of economic growth in mitigating poverty. For instance, Balasubramanian, Burchi, and Malerba (2023) and Amar, Idris Pratama, and Anis (2020) demonstrated this effect in low – and middle-income countries, while Mogess, Eshete, and Alemaw (2023) and Korankye et al. (2020) confirmed it in African countries. The implications for the Arab world are particularly noteworthy. In Arab nations such as Egypt, Jordan, Morocco, and Tunisia, sustained economic growth can play a pivotal role in reducing poverty levels. Economic growth in these countries can create job opportunities, improve income levels, and enhance access to essential services such as education and healthcare, thereby lifting a significant portion of the population out of poverty. For oil-rich countries like Saudi Arabia, Kuwait, and the United Arab Emirates, diversifying the economy beyond oil dependence is crucial. In conflict-affected Arab countries such as Syria, Yemen, Somalia, and Libya, economic growth can be a powerful tool for poverty reduction and rebuilding and stabilizing their economies.

On the other hand, while previous studies have emphasized the crucial role of rural development in mitigating poverty, such as Chowdhury and Ahmed (2015) and Liu, Guo, and Zhou (2018), our findings indicate that rural development does not have a significant effect on poverty reduction in the Arab world. This observation is supported by various contextual factors unique to the region. Firstly, many Arab countries have a high concentration of their populations in urban areas where economic activities are predominantly centered. For instance, in countries like Egypt, Jordan, and Morocco, the urban sectors contribute significantly more to GDP compared to rural areas. This urban-centric economic structure limits the potential impact of rural development on overall poverty reduction. Secondly, the agricultural sector in many Arab countries faces considerable challenges, including water scarcity, land degradation, and a lack of access to modern farming technologies. Thirdly, oil-rich Arab nations such as Saudi Arabia, Kuwait, and the United Arab Emirates have economies heavily dependent on oil revenues. Furthermore, there is a significant reliance on food imports across the Arab world, which diminishes the

role of rural agricultural development in ensuring food security and reducing poverty.

The empirical results also demonstrate that institutional quality is crucial in reducing poverty. This finding aligns with earlier studies, such as those by Singh (2021) in BRICS, Ahmed and Hakim (2023) in ECOWAS countries, and Rizk and Slimane (2018) in a panel of 146 countries. High-quality institutions can create an environment conducive to economic growth by ensuring fair regulations, protecting property rights, and reducing corruption. These factors, in turn, enhance investor confidence, stimulate economic activities, and promote inclusive growth, all contributing to poverty reduction. For example, countries like the United Arab Emirates and Qatar have made substantial progress in improving their institutional frameworks, which has contributed to their economic stability and reduced poverty levels. Conversely, in Arab countries like Somalia, Yemen and Libya, where ongoing conflicts and political instability weaken institutional quality, poverty levels remain high. Additionally, Aracil, Gómez-Bengoechea, and Moreno-de-Tejada (2022) propose that institutional quality amplifies the positive impact of financial inclusion on poverty reduction. This suggests that good governance and effective institutions not only directly reduce poverty but also enhance the effectiveness of other poverty alleviation measures, such as financial inclusion. Conversely, Shair, Tayyab, and Hassan (2024) in Pakistan suggest that while institutional quality positively impacts poverty reduction in the short-run, its long-term effect is statistically insignificant.

6. Concluding remarks and policy guidance

Understanding the diverse elements that contribute to poverty is essential for developing effective policies in the Arab world. This study examines the impact of food inflation, rural development, and institutional quality on poverty in 18 Arab countries, utilizing panel data from 2004 to 2021. Recognizing cross-sectional dependence, we applied advanced panel cointegration methods, specifically the PCSE, FGLS, and MMQR. To determine the integration order of the variables, we employed panel unit root tests, including the Maddala and Wu test and the CADF test, which revealed a mix of stationarity at I(0) and I(1). The long-run cointegration relationships between the variables and poverty were established using Pedroni and Westerlund cointegration tests. The combined results from the PCSE and FGLS analyses consistently display that food price inflation exacerbates poverty rates, particularly in low – and middle-income Arab regions. However, it has a negligible effect on high-income countries. Income inequality is another significant driver of poverty, with both approaches indicating that increased inequality leads to higher poverty levels across all income groups. Conversely, economic growth demonstrates a strong negative impact on poverty, which showcases its crucial role in poverty alleviation. Contrary to theoretical expectations, the findings also reveal that rural development does not significantly affect poverty reduction in low – and middle-income Arab countries. However, institutional quality plays a significant role in reducing poverty, with improvements in institutional quality leading to notable decreases in poverty rates.

Based on the findings, several policy recommendations can be made to address poverty in the Arab world. Beginning with diversifying food import sources and boosting domestic agricultural production, it is crucial to stabilize food prices and enhance food security, reducing the vulnerability of the poorest populations to global price fluctuations. Furthermore, implementing progressive taxation and strengthening social safety nets can mitigate income disparity and provide immediate relief to low-income households, addressing the heightened social and economic instability caused by significant income inequality. Another point to consider is promoting inclusive economic growth and diversification by focusing on sectors with high growth potential, such as technology, manufacturing, and services, to create jobs and reduce dependence on oil revenues. Equally important is enhancing institutional quality and governance to ensure transparency, accountability, and economic stability, particularly in conflict-affected countries like Somalia, Yemen, and Libya, where institutional rebuilding is critical for development. Finally, expanding access to financial services and promoting financial inclusion can enable broader economic participation, empowering marginalized communities through initiatives like mobile banking and microfinance.

This study is subject to several limitations that require careful consideration. First, panel data limits the ability to fully capture the temporal dynamics and causal pathways. Second, while econometric models such as PCSE and FGLS control for heteroscedasticity and autocorrelation, they may not adequately address endogeneity concerns, which could bias the estimated coefficients. Finally, this study does not consider dynamic factors such as political instability, climate change, or regional conflicts, which could significantly affect the outcomes. Furthermore, the generalizability of the results may be limited by differences in socio-economic structures among the sampled countries. Therefore, future research could address these limitations by incorporating more granular data,

exploring the influence of additional contextual factors, and employing dynamic panel and time-series models to capture temporal effects. Additionally, country-specific case studies and the inclusion of policy response variables could provide evidence-based and actionable recommendations for policymakers.

Ethical approval

This study follows all ethical practices during writing. We declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

Author contributions

CRediT: **Abdikafi Hassan Abdi:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing; **Abdullahi Mohamed Nor:** Methodology, Writing – original draft, Writing – review & editing.

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Data availability

The datasets used and/or analyzed during the current study are available from the author on reasonable request.

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