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Examining Linkages between Poverty Alleviation and Macroeconomic Performance in Pakistan

Muhammad Murtaza[1], Muhammad Ayyoub[2], Aisha Riaz[3], Riaz Ahmed[4]

Abstract

This study undertakes an empirical exploration of the intricate interplay between macroeconomic variables and poverty in Pakistan. By employing an autoregressive distributive lag model, we scrutinize both short- and long-term relationships between these critical factors over a span of 41 years: 1980-2021. Our findings elucidate that in the short-run, GDP, inflation, and education exhibit negative impacts on poverty, while in the long-run, GDP, inflation, interest rates, exchange rates, and education maintain negative associations with poverty. Moreover, imports, exports, and the balance of payments show no significant short-term impact on poverty, but in the long-run, they establish a positive relationship with poverty. These results underscore the imperative of enhancing the education system, particularly in technical education, as a means to combat poverty. Furthermore, improving the ease of doing business to attract foreign investment emerges as a crucial avenue for stimulating economic activity, reducing unemployment, and alleviating poverty.

***Keywords*:** Education, GDP, Inflation, Macroeconomic Performance, Poverty, Unemployment

1. Introduction

Alleviating poverty, both domestically and internationally, poses enduring challenges (Rodríguez-Pose & Hardy, 2015). Governments, nonprofits, and global institutions have come together to find solutions, and developing countries like Pakistan face amplified complexities due to socioeconomic structures, resource constraints, and limited access to essential services. Pakistan, while culturally rich and economically promising, faces deep-seated problems in these areas, hampering progress and equitable distribution of resources (Husain, 2012). These challenges impact not only the economy but also the social fabric, driven by factors such as unequal access to education, healthcare, employment opportunities, gender disparities and regional inequalities. Closing the rural-urban gap, improving infrastructure and promoting access to resources are imperative for marginalized communities (Marmot et al., 2008). While efforts have been made in the past, addressing these issues requires a comprehensive and multifaceted strategy, including inclusive economic growth, quality education, healthcare, equitable access to resources, sustainable development, women and community empowerment. marginalized and specific interventions in vulnerable regions to break the cycle of poverty (Reshi et al., 2022).

The alleviation of poverty is fundamental beyond economic considerations, and profoundly influence social dynamics and various facets of national development (Sundrum, 2003). They are essential to achieve sustainable progress, strengthen social unity and ensure lasting political stability. These goals are inextricably linked, as high levels of poverty and inequality trigger detrimental cascading effects throughout society. They perpetuate cycles of social exclusion, hindering marginalized communities and stifling their prospects for growth. Limited access to quality education and healthcare deepens inequalities, hindering individual potential and hampering collective progress. Furthermore, the connection between poverty, inequality and crime is well established, affecting community safety and the social fabric. Neglecting these issues undermines human development and hinders innovation and social mobility. Recognizing these implications, governments and organizations are integrating poverty reduction and inequality mitigation into their development agendas through a variety of strategies, from social welfare programs to comprehensive policy reforms, to pave the way towards a more just, prosperous and harmonious future (Laukkonen et al., 2009).

Pakistan's journey in this regard has been a complex interplay of triumphs and trials, in which progress has been made alongside persistent challenges (Haq et al., 2019). Over the years, successive governments have demonstrated their commitment to addressing the pressing issues of poverty and inequality by introducing a wide range of poverty alleviation strategies, social safety nets and economic policies. The overall objective has been to extend a helping hand to the most vulnerable segments of society, lifting them out of the clutches of deprivation. In this quest, a spectrum of well-intentioned strategies has been launched, demonstrating the country's determination to make a positive impact. Among these initiatives, conditional monetary transfer programs stand out, which seek to provide direct financial assistance to households that meet certain criteria. These efforts aim not only to alleviate immediate economic burdens but also to empower beneficiaries with the means to access education, healthcare, and other essential services that lay the foundation for long-term development. In addition, vocational training programs have

[1] MPhil Student, Department of Economics, University of Sahiwal, Pakistan
[2] Corresponding Author, Assistant Professor, Department of Economics, University of Sahiwal, Pakistan
[3] Lecturer, Department of Management Sciences, University of Okara, Pakistan
[4] Assistant Professor, Department of Management Sciences, University of Turbat, Pakistan

been implemented to equip people with skills that improve their employability, allowing them to secure sustainable livelihoods and break free from the cycle of poverty. These programs not only close the skills gap but also train participants to contribute effectively to the economic growth of the nation. Microfinance schemes have also played an important role in enabling small entrepreneurs, particularly women, to start and expand their businesses (Wanambisi et al., 2013). By providing access to financial resources that were once out of reach, these initiatives foster economic independence, grassroots innovation, and community development, ultimately contributing to poverty reduction.

Subsidized health services have been another focal point of Pakistan's efforts to address inequality and uplift marginalized communities (Marmot, 2007; Rayan et al., 2022; Rayan & Zafar, 2021). By making essential healthcare more accessible and affordable, these initiatives work to close the gap between those who have access to quality healthcare services and those who do not. This not only addresses a fundamental human rights concern, but also improves the overall well-being of the nation. However, amid these commendable efforts, Pakistan has faced persistent challenges that have at times undermined the full potential of these poverty alleviation efforts. Factors such as corruption, administrative inefficiencies, and inadequate targeting mechanisms have sometimes led to misallocation of resources, preventing intended beneficiaries from reaping the full benefits of these programs. Furthermore, the lack of complete and accurate data has hampered the ability to effectively design, implement and evaluate policies, making it difficult to assess the true impact of various initiatives. To ensure the sustainability and effectiveness of poverty alleviation and inequality reduction measures, there is a pressing need for robust monitoring and evaluation mechanisms, transparent governance and a commitment to addressing systemic issues. By learning from both successes and setbacks, Pakistan can refine its approach, harness its potential and steer its trajectory toward a future where all citizens can participate in the nation's progress. This continued journey requires not only the dedication of policymakers and institutions, but also the commitment of civil society, private sector actors and international partners, all working in harmony to create a more equitable and prosperous Pakistan.

This study aims to comprehensively evaluate the role of macroeconomic variables in poverty alleviation in Pakistan, focusing on their short- and long-run effectiveness in combating poverty. It investigates the intricate relationship between policy intent, real-world impact, governance structures, institutions, and political dynamics, with the goal of identifying opportunities for reform in the battle against poverty and inequality. Furthermore, the research has a dual objective: to examine the connection between education expenditure and poverty eradication and to analyze the influence of macroeconomic variables on poverty in Pakistan. By integrating these dimensions, it contributes to the existing literature by demonstrating the impact of macroeconomic factors such as inflation and GDP on poverty, while highlighting the potential of education in poverty reduction. Employing an ARDL approach, the study discerns short- and long-term effects, offering policymakers a comprehensive perspective. Its novelty lies in merging previously separate areas of research and providing a multidimensional understanding of poverty dynamics, thus pioneering new empirical research on the interconnected impact of education and macroeconomic variables on poverty in Pakistan.

2. Literature Review

Alleviating poverty has long been a critical concern for policymakers, researchers, and international organizations, especially in developing countries like Pakistan (Maimbo & Ratha, 2005). As a nation striving for economic progress and social well-being, Pakistan's fight against poverty and inequality presents a multifaceted challenge that demands thorough research and informed strategies. This review delves into the existing body of literature on poverty alleviation strategies in Pakistan, shedding light on the current discourse, research trends, and gaps in understanding. Pakistan's efforts to address poverty have been characterized by a variety of strategies, from targeted social safety nets to broader economic policies (Ascher & Healy, 1990). The literature highlights the importance of these strategies, evaluating their effectiveness and impact. Notable approaches include microfinance initiatives, conditional cash transfers, and vocational training programs. Scholars such as Shahin et al. (2022), explore the impact of microfinance on poverty reduction, emphasizing its potential to empower marginalized communities through greater financial access. However, criticism also arises, with some studies questioning the sustainability of the impact of microfinance in the long term (Ullah et al., 2017).

Conditional cash transfer programs, such as the Benazir Income Support Program (BISP), have attracted attention for their potential to directly target vulnerable populations. Ahmad and Research (2018), analyzes the effectiveness of the BISP in reducing poverty and improving household well-being. Their findings underline the positive impacts of conditional cash transfers, but also highlight challenges related to the precision of targeting and program implementation. The interplay between macroeconomic factors and poverty dynamics in Pakistan has attracted the attention of researchers. Achi et al. (2022) investigate the impact of economic growth, inflation and exchange rates on poverty, revealing complex, context-dependent relationships. Their findings highlight the need to consider a combination of factors in poverty alleviation strategies.

The origins of economic thought, characterized by classical and neoclassical theories, laid the foundations for understanding the intricate relationship between value, distribution and poverty. Early economists such as Kurz (2010) established the fundamental notion that the value of a good was closely related to the costs incurred in its production. Classical economics provided insight into how these cost explanations translated into the distribution of income among various factors of production. However, this framework failed to delve into the underlying factors that shaped the complex patterns of income and wealth distribution.

Classical theories, with their emphasis on efficient market outcomes and individual decision making, often attributed poverty to personal choices or inherent deficiencies (Fama, 1980). Neoclassical perspectives expanded this perspective by recognizing that circumstances beyond individual control, such as educational barriers, health challenges, and employment inequalities, could lead to poverty. These theories highlighted the role of incentives in influencing human behavior and the interconnection between production and financial results. Consequently, macroeconomic factors such as GDP, inflation, imports, exports and interest rates gained importance as possible contributors to poverty. Furthermore, the classical belief in the transformative power of education continued to influence debates over poverty alleviation.

2.1. Economic Growth and Poverty

In the field of empirical research, the relationship between economic growth and poverty reduction has been a central concern. Studies such as those carried out by Pece et al. (2015) have examined the elastic connection between GDP and poverty. Their findings underscore the nuanced interactions between economic growth, unemployment and poverty. Similarly, Hatami (2022) delved into the complexities of the GDP-unemployment relationship, uncovering unexpected patterns that challenge conventional assumptions.

Christiaensen et al. (2011) contributed by exploring the role of GDP in poverty reduction in different economies, revealing the complex dynamics between these two variables. Lorgelly et al. (2010) expanded the exploration to encompass national income, income inequality, and public health. Their findings highlighted the importance of considering levels of poverty and inequality when assessing the impacts of GDP growth on health indicators. The arrival of the COVID-19 pandemic further boosted research, with studies such as that of Asare and Barfi (2021) investigating the implications of the pandemic for poverty and economic growth, emphasizing the need for comprehensive policy measures.

2.2. Exchange Rate and Poverty

Turning to the influence of exchange rates, researchers have aimed to unravel their impact on poverty rates. Fluctuations in real exchange rates were shown to wield substantial influence on poverty. This realization prompted recommendations for targeted policy interventions to mitigate the adverse effects of exchange rate volatility on vulnerable populations.

2.3. Poverty and Education

Education, long hailed as a key catalyst for poverty reduction, occupies a prominent place in empirical studies. Tiwari (2023) ventured into the association between education and vulnerability to poverty, uncovering the significant role that education plays in shielding individuals from the risk of impoverishment. Guo et al. (2022) expanded this exploration to rural China, establishing the transformative power of basic education in reducing structural poverty. Shi and Qamruzzaman (2022) emphasized the relationship between education and human capital, elucidating how education enhances earning potential and contributes to poverty reduction.

2.4. Interest Rate and Poverty

Monetary policy, particularly interest rates, emerged as a crucial determinant of poverty outcomes. Investigations by Xu et al. (2023) highlighted the multifaceted relationship between monetary policy and poverty alleviation, shedding light on the complex interactions between interest rates, money supply, and poverty in Pakistan.

2.5. Balance of Trade and Poverty

Finally, the balance of trade's impact on poverty has also been scrutinized. Studies such as Adetunji Babatunde et al. (2012) have uncovered how trade, particularly exports, can influence employment and contribute to poverty reduction through job creation.

2.6. Research Gap

In the context of Pakistan, a developing nation facing significant rates of poverty and socio-economic challenges, the research landscape is ripe for further exploration. While the existing literature has provided valuable insights into the individual dimensions of poverty, there is a lack of a comprehensive study that comprehensively examines the intricate interplay between poverty, various macroeconomic indicators, and education. The effort to close this gap and provide a comprehensive understanding of the factors shaping poverty dynamics in Pakistan drives the present study. While the existing literature provides valuable information, certain gaps deserve attention. There is a need to conduct studies that comprehensively analyze the synergy between poverty alleviation strategies and macroeconomic dynamics.

Furthermore, exploring the unintended consequences of poverty reduction policies has not yet been sufficiently explored.

The literature highlights the multifaceted nature of poverty alleviation in Pakistan, emphasizing the importance of comprehensive strategies that address not only economic aspects but also social dimensions such as education and health. The evolving research landscape points to the need for more nuanced and context-specific approaches that consider the intricate interactions between poverty alleviation and macroeconomic factors. As Pakistan continues its path toward socioeconomic progress, research efforts must remain aligned with the goal of designing evidence-based policies that create a more equitable and inclusive society.

3. Econometric Framework

In the current research landscape, there is a growing emphasis on utilizing empirical methods and real-world data to enrich social sciences research. In this research, a quantitative methodology is used with a deductive approach and an applied research philosophy, aligning with the path from general to specific phenomena, as advocated by Rabetino et al. (2021). The conceptual framework of the study involves the use of a deductive approach to measure the impact of major macroeconomic determinants such as GDP, import-export balance of payments, inflation, the interest rate, and spending on education on poverty alleviation. The core of this investigation relies on an econometric model that captures the intricate dynamics between poverty alleviation and macroeconomic factors.

The model considers the natural logarithm of poverty elevation as the dependent variable, with various lagged economic indicators serving as independent variables. The inclusion of lagged variables allows us to assess the short-term effects of past economic changes on poverty levels.

3.1. Short-Run

The proposed model (Equation 1) establishes a link between fluctuations in key economic factors and short-term variations in poverty levels (Johansen & Juselius, 1994). The variables under consideration encompass GDP, exchange rate, inflation, imports, exports, trade balance, interest rate, and education. The lag specifications, denoted as P and q, determine the number of past periods integrated into the model. For parameter estimation, Ordinary Least Squares (OLS) regression techniques could be utilized (Agbeyegbe et al., 2006). This modeling approach offers the potential to shed light on the intricate interplay among macroeconomic determinants and their collective influence on the dynamics of poverty over time. The dependent variable, LNPGt, signifies the natural logarithm of poverty elevation at a specific time, t. The model structure entails several elements. The intercept term, ∅_0, represents the baseline of the dependent variable under the condition of all independent variables being zero. The individual-specific effects or error terms, ∅_it, encapsulate unique influences for each observation. Lagged values of the natural logarithm of poverty elevation, represented by ∅〖PG〗_(t-1), capture the influence of preceding poverty levels on the current state.

The coefficients β_1 through β_8, corresponding to lagged values of independent variables like GDP, exchange rate, inflation, imports, exports, trade balance, interest rate, and education, respectively, depict the impact of these variables' past values on poverty. The equation incorporates an error term, €_t, accounting for unobservable factors impacting the dependent variable. Of particular note, the lag specifications P and q determine the inclusion of past periods for lagged variables, aiding in understanding temporal relationships. In summary, this model provides a framework to comprehend the interrelationship between economic variables and short-term changes in poverty levels. Through statistical analysis, it offers insights into the intricate dynamics underlying poverty fluctuations and their implications for policy considerations.

$$\mathrm{LNPGt} = \emptyset_0 + \emptyset_{it} + \sum_{i=1}^{P} \emptyset \mathrm{PG}_{t-1} + \sum_{t=0}^{q} \beta_1 \mathrm{LNGDP}_{t-1} + \beta_2 \mathrm{LNER}_{t-1} + \beta_3 \mathrm{LNINF}_{t-1} + \beta_4 \mathrm{LNIMP}_{t-1} + \beta_5 \mathrm{LNEXP}_{t-1} + \beta_6 \mathrm{LNBOT}_{t-1} + \beta_7 \mathrm{LNIT}_{t-1} + \beta_8 \mathrm{LNEE}_{t-1} + €_t \ldots\ldots\ldots\ldots (1)$$

3.2. Long-Run

The baseline long-run model (equation 2) is widely used in economics and econometrics to delve into the long-term connections between various variables within a time-series context (Hasan & Nasir, 2008). In equation 2, each term plays a different role in helping us understand the behavior of the dependent variable, which is represented as LNPGt, through the lens of multiple independent variables. The core of the equation begins with the natural logarithm of the dependent variable, LNPGt (Chazan et al., 2008). This could mean a critical economic measure like GDP or stock prices. The equation then takes into account different factors that contribute to the evolution of LNPGt over time. The constant term (∅_0) provides the reference value of LNPGt when all independent variables are zero.

Beyond the baseline, the equation introduces individual-specific effects (∅_it), recognizing that unique factors may affect each entity or individual being studied. The lagged term of the dependent variable itself (∅PG_(t-1)) reflects the past impact of LNPGt on its current value. Moving further, the equation considers a series of lagged independent

variables and their respective coefficients. For example, the coefficient β_1 captures how the past value of real GDP (LNGDP) influences the current LNPGt. Similarly, β_2 to β_8 take into account the impacts of other lagged variables such as exchange rates, inflation, imports, exports, trade balance, investment and energy expenditure on LNPGt.
To cover additional external factors that may not be explicitly taken into account, the equation includes an EC term. Furthermore, the error term (€t) includes all random or unobserved factors that affect LNPGt but are not explicitly represented by the other components of the equation. In essence, the long-run model offers a comprehensive way to explore the intricate web of relationships between various economic variables over a long period of time. By considering the past values of the dependent and independent variables, along with their respective coefficients, the model helps researchers and economists discover how these factors interact and contribute to the evolution of the target variable. This understanding of long-term relationships can provide valuable insights into economic trends, political implications, and more.

$$\mathrm{LNPGt} = \emptyset_0 + \emptyset_{\mathrm{it}} + \sum_{\mathrm{i}=1}^{\mathrm{P}} \emptyset \mathrm{PG}_{\mathrm{t}-1} + \sum_{\mathrm{t}=0}^{\mathrm{q}} \beta_1 \mathrm{LNGDP}_{\mathrm{t}-1} + \beta_2 \mathrm{LNER}_{\mathrm{t}-1} + \beta_3 \mathrm{LNINF}_{\mathrm{t}-1} + \beta_4 \mathrm{LNIMP}_{\mathrm{t}-1} + \beta_5 \mathrm{LNEXP}_{\mathrm{t}-1} + \beta_6 \mathrm{LNBOT}_{\mathrm{t}-1} + \beta_7 \mathrm{LNIT}_{\mathrm{t}-1} + \beta_8 \mathrm{LNEE}_{\mathrm{t}-1} + \mathrm{EC} + €_{\mathrm{t}} \ldots\ldots\ldots\ldots (2)$$

3.3. Regression Model: ARDL (autoregressive distributed lag)

The ARDL (autoregressive distributed lag) model is a prominent statistical technique used in econometrics to analyze variable relationships. It is particularly effective for studying long-term associations between variables with different orders of integration. The ARDL model comprises two key components: the autoregressive element, which represents short-term dynamics, and the distributed lag component, which captures long-term relationships. In situations where variables have different orders of integration, ARDL offers a robust solution. Some variables may be stationary while others are not, making conventional methods such as ordinary least squares (OLS) inadequate. ARDL solves this by estimating model coefficients that consider varying integration orders.
The ARDL model, widely applied in finance, economics, and social sciences, has been used to study connections between macroeconomic variables (e.g., inflation, interest rates, economic growth) and evaluate the impacts of policies on the economy. Its versatility lies in handling variables with different orders of integration, which allows for a precise estimation of the coefficients that respects the characteristics of the variables. As a result, ARDL finds wide application in various research fields. In addition to the ARDL model, several diagnostic tests such as the Augmented Dickey-Fuller (ADF) test and the Durbin-Watson test are utilized to ensure the validity of the data and model assumptions. To refine our analysis, lag specification models, including the Akaike Information Criterion (AIC) and the Hannan-Quinn Criterion (HQC), are utilized. These models aid in determining the optimal lag structure, enhancing the accuracy of our findings.

3.3.1. Stationarity test of data

Before performing a regression analysis in econometrics, it is essential to determine whether the data follow a normal distribution. Unit root tests, specifically the Augmented Dickey Fuller (ADF) test, are commonly employed for this purpose (Hadri, 2000). The ADF test evaluates whether a time series is stationary or not. Stationary time series exhibit consistent statistical properties over time, such as a constant mean and variance. In contrast, non-stationary time series show changing statistical properties. Therefore, unit root tests are vital to confirm the normality of the data before proceeding with regression analysis. The ADF test is a widely used method to determine the stationarity of a time-series.

3.3.2. Autocorrelation test

In regression models, the assumption of a linear relationship between independent variables and regressors can cause problems during hypothesis testing. Autocorrelation arises when the residuals of a model are correlated, which can be detected using methods such as the Durbin Watson test and by analyzing the skewness and kurtosis of the data (Monti, 1994). Detecting and addressing autocorrelation is essential to improving the accuracy and reliability of regression analysis results. The Durbin Watson test is a common technique for detecting autocorrelation, which involves examining residuals for signs of correlation. Analysis of skewness and kurtosis can also reveal deviations from the normal distribution, indicating possible autocorrelation. Ensuring valid and accurate regression analysis relies heavily on effective autocorrelation testing.

3.3.3. Multicollinearity test

Maintaining accurate regression results requires the detection of multicollinearity, which arises when independent variables are strongly correlated. The variance inflation factor (VIF) is a widely used method to identify multicollinearity. Our study employs multiple independent variables to assess their influence on firm performance, requiring an examination of multicollinearity. It is important to note that testing for multiple collinearities should follow confirmation of data normality, as recommended by Farrar et al. (1967). This sequencing avoids erroneous

regression results, ensuring the reliability of the findings. Addressing multicollinearity improves the quality of the regression analysis, strengthening the validity of the conclusions.

3.4. Data

To analyze both short- and long-term relationships between the considered variables over a span of 41 years:1980-2021, the collected secondary data is analyzed by using advanced statistical techniques, primarily focusing on panel data analysis due to the temporal nature of the research. Specifically, the autoregressive distributed lag (ARDL) model is employed to examine both short-term and long-term effects of macroeconomic variables on poverty alleviation in Pakistan.

4. Results and Discussion

This section presents the actual results of the analysis, accompanied by the essential tests to evaluate the assumptions of normality of the data. These tests include the examination of unit roots, multicollinearity, serial correlation, heteroscedasticity and homoscedasticity, aligning with the fundamental assumptions of data normality described in the literature by Paparoditis and Politis (2018). To investigate the relationships between short- and long-term variables, the study employs the autoregressive distributive lag (ARDL) model in line with Hasan and Nasir (2008). Furthermore, the selection of appropriate lags for the ARDL model is facilitated by the Akaike Information Criterion (AIC) and the Hannan-Quinn Information Criterion (HQIC). These metrics measure the goodness of fit of a statistical model to the data and serve as criteria for model selection among a limited set of available models. The main objective of the study lies in empirically examining the impact of various variables, including education (LNEE), gross domestic product (LNGDP), exchange rate (LNER), inflation (LNINF), imports (LNIMP), exports (LNEXP), the balance of payment (LNBOP), and interest rate (LNIR), on poverty (LNPG).

4.1. Descriptive Analysis

In the descriptive Analysis section, a summary of statistics is presented in Table 1, shedding light on the central tendencies, variations, and distributions of the variables under consideration. The variables include LNPG, LNGDP, LNER, LNINF, LNIMP, LNEXP, LNBOP, LNIR, and LNEE. The table provides information on the number of observations (Obs), the mean, standard deviation (Std. Dev.), minimum, maximum, skewness, and kurtosis for each variable. Skewness indicates the degree of asymmetry in the distribution, while kurtosis measures the tail behavior of the distribution. This summary of statistics aids in gaining an initial understanding of the dataset's characteristics, forming the basis for further analysis and interpretation (Ozturk & Acaravci, 2010).

4.2. Correlation Analysis

The correlation coefficient serves as a valuable tool for assessing the strength of relationships between variables. The most commonly utilized correlation coefficient is Pearson's correlation coefficient (r), which ranges from -1 to +1. A coefficient of +1 signifies a perfect positive correlation, indicating that as one variable increases, the other also increases. Conversely, a coefficient of -1 signifies a perfect negative correlation, implying that when one variable increases, the other decreases. A correlation value of 0 indicates the absence of a substantial linear connection between the variables as per the results of Majid and Yusof (2009).

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
LNPG	41	-0.03883	0.140294	-0.52376	0.482757	0.4967	0.0001
LNGDP	41	0.065595	0.077054	-0.10413	0.264216	0.745	0.7974
LNER	41	0.068308	0.059459	-0.03623	0.208299	0.3821	0.3307
LNINF	41	-0.00558	3.91E-01	-1.04E+00	9.82E-01	0.4205	0.0692
LNIMP	41	0.059283	1.29E-01	-1.80E-01	4.02E-01	0.4675	4.35E-01
LNEXP	41	0.057564	9.53E-02	-1.41E-01	2.67E-01	0.5899	5.16E-01
LNBOP	41	0.064641	1.280737	-2.91079	3.309443	0.4581	7.02E-02
LNIR	41	-0.00759	0.128739	-0.33479	0.360455	0.5706	0.127
LNEE	41	1.61E+08	3.57E+08	-7.18E+08	1.07E+09	0.2893	0.1914

Table 2 presents the pairwise correlation statistics, illustrating the associations between dependent and independent variables. Significant values at the 95% confidence interval are denoted by asterisks (*). The analysis reveals that all variables exhibit coefficients lower than 0.5, indicating the absence of significant autocorrelation issues, except for LNIMP, LNGDP, and LNEE. Notably, the association between LNIMP and LNGDP is 0.5817, surpassing the benchmark threshold of 0.5. This can be explained by the notion that imports of raw materials contribute to the manufacturing sector, consequently impacting the country's GDP. Similarly, the strong association between education

expenditure (LNEE) and GDP is also expected, as education spending is commonly considered a percentage of gross national income (GNI) or GDP. It's worth noting that while various researchers suggest different thresholds for autocorrelation (typically under 0.7 to 1), the observed correlations generally adhere to these guidelines.

Table 2: Pairwise Correlation

	LNPG	LNGDP	LNER	LNINF	LNIMP	LNEXP	LNBOP	LNIR	LNE
LNPG	1								
LNGDP	0.1499	1							
LNER	0.0326	-0.5073*	1						
LNINF	-0.1423	0.139	0.0096	1					
LNIMP	0.1458	0.5817*	-0.277	0.2554	1				
LNEXP	0.0564	0.4111*	-0.4199*	0.2244	0.3860*	1			
LNBOP	0.1166	0.2077	-0.1747	-0.0256	0.4731*	0.1475	1		
LNIR	-0.0792	-0.1861	0.3813*	0.2444	0.0727	-0.0395	-0.1843	1	
LNEE	0.2244	0.5256*	-0.3861*	-0.0542	0.4920*	0.0555	0.4599*	-0.3402*	1

4.3. Unit Root Analysis

In the realm of statistical examination, the process of unit root analysis takes center stage, as elaborated in Table 3. This table presents results from both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, which are pivotal tools for assessing the stationarity or non-stationarity of time series data (Petrică et al., 2017). Stationarity is characterized by the constancy of data's variance, mean, and auto-covariance over time. In financial and economic domains, the ADF test holds significance, particularly in scrutinizing time series datasets. By detecting unit roots, which signify non-stationarity, the ADF test unveils whether a dataset is in motion or stationery. If the ADF test confirms the presence of a unit root, the data remains non-stationary.

The mechanics of the ADF test involve comparing the test statistic with critical values from a distribution. If the test statistic is lower than the critical value, it implies stationarity and nullifies the presence of a unit root. Conversely, if the test statistic exceeds the critical threshold, non-stationarity and a unit root are indicated. The ADF test equips researchers with insights into time series dataset characteristics, informing their statistical modeling and forecasting decisions (Khosravi & Ghazani, 2023).

In tandem with the ADF test, the Phillips-Perron (PP) test comes into play (Chandio et al., 2020). This extension of the Dickey-Fuller test is employed not only in econometrics but also across time series analysis. Much like the ADF test, the PP test tackles the determination of a time series dataset's stationarity. A notable advantage of the PP test is its ability to address complexities associated with time series analysis, including autocorrelation and heteroscedasticity. The PP test employs a measure that aligns the observed series with its lagged values, subsequently gauging the significance of unit roots. Interpreting the PP test follows a similar logic to the ADF test (Dong, 2023). When the PP test statistic surpasses the critical threshold at a particular significance level, it signals stationarity and negates the presence of a unit root. Conversely, if the PP test statistic falls below the critical value, non-stationarity and a unit root are suggested.

Remarkably, the analysis reveals that, apart from inflation and the balance of payment, the variables fail to exhibit stationarity at level I (0), where the tau value doesn't lie within the critical region of t-statistics. However, upon applying the unit root test with an integration order of 1, denoted as I (1), all the series transform into stationary. This transformation holds paramount importance as it renders the data suitable for the application of the autoregressive distributive lag (ARDL) test on both time series and panel data, providing a solid foundation for robust analysis.

4.4. Multicollinearity Test

The primary objective of conducting a multicollinearity test is to assess the extent of correlation among independent variables within a regression model (Kalnins, 2018). The presence of high multicollinearity can complicate the interpretation of individual variable effects and the overall stability of the model's results. To determine the degree of multicollinearity, certain thresholds are commonly used. For instance, if the tolerance value drops below 0.10 or the Variance Inflation Factor (VIF) exceeds 10, it suggests a strong correlation between independent variables. Conversely, if the tolerance value exceeds 0.10 and the VIF remains below 10, the likelihood of substantial correlation decreases.

Tolerance value, as a rule of thumb, serves as an indicator of multicollinearity. A value less than 0.10 coupled with a VIF exceeding 10 implies a heightened correlation between independent variables. The VIF, on the other hand, signifies the extent to which the variance of the regression model increases while keeping the R-squared value

constant. Empirical research conducted by Jain (2007) introduced the "rule of 4" as a guideline to assess multicollinearity among independent variables. According to this rule, a VIF value lower than four indicates minimal issues with multicollinearity among variables.

Table 3: ADF and PP tests

Variables	Augmented Dickey Fuller (ADF)		Phillips-Perron (PP)	
	I(0)	I(1)	I(0)	I(1)
LNPG	1.177	-4.858*	1.797	-6.904*
LNGDP	0.103	-5.884*	-0.186	-6.278*
LNER	-1.538	-4.685*	-1.146	-4.938*
LNINF	-2.777	-4.684*	-2.964**	-6.607*
LNIMP	-0.103	-4.581*	-0.186	-5.622*
LNEXP	-0.993	-4.493*	-1.358	-6.462*
LNBOP	-2.899**	-6.849*	-3.631*	-9.536*
LNIR	-2.629***	-4.215*	-2.032	-4.190*
LNEE	0.757	-4.931*	1.292	-3.768**

Note *, **, *** represent 99%, 95%, and 90% CI

Table 4: Variance Inflation Factor

Variable	VIF	1/VIF
LNIMP	2.45	0.408392
LNGDP	2.31	0.433611
LNEE	2.09	0.478477
LNER	1.72	0.580333
LNEXP	1.6	0.626591
LNBOP	1.48	0.674526
LNIR	1.43	0.697046
LNINF	1.19	0.842969
Mean VIF	1.78	

Upon examination of Table 4, it is evident that the variables exhibit tolerance values of less than 1. This observation suggests the absence of significant multicollinearity among the variables. This finding provides assurance that the intercorrelation among independent variables is not substantial and does not threaten the reliability of the regression model's results.

Presented in Table 5 are the outcomes of the Autocorrelation and Serial Correlation Tests, alongside the Breusch-Godfrey LM test results. The Breusch-Godfrey LM test produces a chi-squared statistic of 0.633 with 1 degree of freedom, yielding a probability (Prob) value of 0.4263. This outcome suggests that there is no substantial evidence of serial correlation between the variables, as the probability value is greater than 0.5. Consequently, the null hypothesis, which posits the presence of serial correlation, is rejected. Furthermore, the autocorrelation d-statistic, calculated as 2.148739, signifies the degree of correlation between variables without considering log values. This result is indicative of minimal correlation between the variables under examination.

Table 5: Autocorrelation and Serial Correlation Tests

Breusch-Godfrey LM test	Chi2	Df	Prob
	0.633	1	0.4263
Autocorrelation			
	d-statistic (9, 41)		2.148739

4.5. Autoregressive Distributive Lags Model (ARDL) Analysis for Regression

4.5.1. Short-run analysis

Based on lag classification criteria such as AIC and HQIC, GDP can be examined with two lags. The ARDL results indicate a significant negative relationship between GDP and poverty elevation in Pakistan. This suggests that an increase in gross domestic production leads to a decrease in poverty, implying a negative relationship between GDP and poverty. The results show significant relationships between GDP and lags 0 and 2, while no significant relationship is observed with lag 1. Notably, GDP exhibits a positive coefficient when analyzed with lag 0, attributed to suboptimal policies for poverty eradication in Pakistan. In the short run, GDP's negative association with poverty is explicit. The results imply that a unit increase in GDP corresponds to a poverty reduction of -1.28005. This suggests a modest reduction in poverty over previous years in Pakistan, aligning with findings from previous studies (Liu et al., 2020; Sari et al., 2019)

Table 6 illustrates the impact of the exchange rate on poverty in Pakistan. Our results indicate a significant effect of the exchange rate on poverty reduction. The ARDL short-term analysis demonstrates that the level of poverty in Pakistan is significantly influenced by fluctuations in the real exchange rate's volatility (Degong et al., 2020; Sugiharti et al., 2020). This underscores the potential role of government policies targeting the real exchange rate in reducing poverty, especially if supported by fundamental institutions such as human capital development. However, the impact of the exchange rate on poverty is insignificant when considering lags 2 and 4.

Table 6: ARDL Short-Run Analysis

	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
LNPG	-2.05784	0.329625	-6.24	0.001	-2.8644	-1.25128
LNGDP	-1.28005	0.579649	-2.21	0.069	-2.6984	0.138297
LNER	-2.23035	0.718556	-3.1	0.021	-3.98859	-0.4721
LNINF	-0.16133	0.079848	-2.02	0.009	-0.35671	0.034049
LNINMP	1.569664	0.398307	3.94	0.008	0.595043	2.544286
LNEXP	0.328697	0.341523	0.96	0.373	-0.50698	1.164374
LNBOP	0.108055	0.032851	3.29	0.017	0.027673	0.188438
LNEE	-1.99E-10	8.70E-11	-2.29	0.029	-3.76E-10	-2.20E-11
_cons	-0.72061	0.191085	-3.77	0.009	-1.18818	-0.25304

In the short-run, higher inflation (INF+) tends to worsen living conditions, while lower inflation (INF-) tends to improve them. Several hypotheses explain the observed correlation between rising inflation and increased poverty. First, higher inflation leads to significant shifts in relative price levels, creating economic instability. Second, inflation-driven commodity price hikes reduce purchasing power, straining individuals' ability to meet their needs. Additionally, negative inflation changes may decrease aggregate demand, supply, and unemployment. At a 5% significance level, both positive and negative inflation changes significantly and adversely affect poverty. This aligns with findings from earlier research (Akinbobola & Banking, 2012; Yelwa et al., 2015)

Several studies explore trade's impact on poverty reduction, yielding mixed results due to varying economic conditions (Mendola, 2007; Sutter et al., 2019). Our short-term import analysis yields insignificant results, favoring a 3-lag model based on AIC and HQIC. However, we find that imports positively impact poverty. This implies that increased imports displace domestic production, affecting local employment and exacerbating poverty. Regarding exports and poverty, Table 7 indicates a significant relationship based on AIC's two-lag criterion. Exports' significance decreases when considering AIC in the short term. Export impact on poverty seems insignificant in the short run, where individuals can seek employment without significantly decreasing their earnings. However, the long-term scenario may differ, as literature suggests that exports can alleviate poverty by raising income levels. Similarly, the relationship between balance of payments and poverty is insignificant. Although comparative benefit theorists posit trade's overall benefits aiding the poor, social economists challenge this idea. Research indicates that trade can harm the poor and increase inequality in emerging economies.

Table 7: Lags Selection Criterion

Variables	Lag	Df	P	FPE	AIC	HQIC	SBIC
LNPG	2	1	0.098	.005914*	-2.29261*	-2.27726*	-2.24907*
LNGDP	2	1	0.121	.003383*	-2.85136*	-2.80531	-2.72074
LNINF	3	1	0.451	.160429*	1.00796*	1.02331*	1.0515*
LNIMP	1	1	0.023	.01862*	-1.14568*	-1.13033*	-1.10214*
LNEXP	1	1	0.047	.008596*	-1.91858*	-1.90323*	-1.87504*
LNBOP	3	1	0.084	1.18606*	3.00767*	3.06906*	3.18182
LNIR	2	1	0.097	.016358*	-1.27551*	-1.22946*	-1.14489
LNEE	2	1	0.006	1.1e+17*	42.0926*	42.1386*	42.2232*

In certain scenarios, economic theory can guide the selection of lag periods in AR and ADL models. However, statistical approaches can also aid in determining the appropriate number of lags to include as regressors. The excessive use of lags can lead to inflated standard errors of coefficient estimates, potentially increasing forecast-associated errors. Conversely, omitting necessary lag terms from the model can introduce estimation bias. To test the hypothesis of macroeconomic variables with poverty, we employ the AIC information criterion for lag selection. Our findings suggest that poverty, GDP, interest rate, and education expenditure exhibit optimal results with two lag periods. On the other hand, balance of payments and inflation yield desirable outcomes with three lag periods. Properly selecting lag periods is crucial for accurate model estimation and meaningful economic interpretation.

Table 8: Results of Macroeconomic Variables and Poverty using the Autoregressive Distributed Lag (ARDL) Model

ARDL (2,2,3,1,1,3,2, 2) regression						
Sample: 1980 - 2021			Number of obs	=	41	
			F(30, 6)	=	3.74	
			Prob > F	=	0.052	
			R-squared	=	0.9493	
			Adj R-squared	=	0.6958	
Log likelihood = 73.899926			Root MSE	=	0.0815	
LNPG	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
L1.	-4.35981	0.534359	-8.16	0	-5.66734	-3.05228
LR						
LNGDP	-0.87401	0.354128	-2.47	0.049	-1.74053	-0.00749
LNER	1.794098	0.374258	4.79	0.003	0.878322	2.709874
LNINF	-0.20825	0.060197	-3.46	0.013	-0.35555	-0.06095
LNIMP	0.83306	0.216293	3.85	0.008	0.303811	1.362309
LNEXP	0.301387	0.139705	2.16	0.074	-0.04046	0.643233
LNBOP	0.06309	0.027536	2.29	0.062	-0.00429	0.130468
LNEE	-4.31028	1.582856	-2.72	0.035	-8.18339	-0.43717

4.6. Long-Run ARDL Analysis

The Long-Run ARDL (Autoregressive Distributed Lag) Analysis is a statistical methodology used in econometrics to examine the relationships between variables in a longer time horizon. It is an extension of the traditional ARDL model, which combines autoregressive and distributed lag components to study both short-term and long-term relationships between variables. In the context of the ARDL model, the "long-run" refers to a period where variables have had sufficient time to adjust and reach their equilibrium levels after any shocks or changes. This is in contrast to the "short-

run," which focuses on immediate adjustments to changes in variables. The Long-Run ARDL Analysis seeks to understand how variables interact and influence each other over a more extended period, which can provide valuable insights into the underlying dynamics of an economic system.

4.7. Autoregressive Distributed Lag (ARDL) Model Overview

The Autoregressive Distributed Lag (ARDL) model is a powerful econometric tool designed to examine relationships among multiple time series variables. Particularly applicable to non-stationary variables with changing means and variances over time, the ARDL model integrates the autoregressive (AR) and distributed lag (DL) components. This amalgamation enables the investigation of both short-term and long-term relationships between variables.

4.8. Flexibility in Integration Orders

A notable feature of the ARDL model is its versatility in accommodating different integration orders within both dependent and independent variables. This encompasses variables integrated of order zero (I(0)), integrated of order one (I(1)), or a combination of both. The estimation process involves selecting appropriate lag lengths, choosing from various model specifications, and conducting diagnostic tests to ensure the model's validity.

4.9. Short- and Long-Run Relationships: Poverty and Macroeconomic Variables

In this study, the ARDL model is applied to examine the short- and long-run relationships between poverty and macroeconomic variables. Furthermore, the study evaluates the influence of education on poverty reduction, considering the widely supported belief that education positively impacts living standards.

4.10. Negative Relationship between GDP and Poverty

The results of the study reveal a significant negative relationship between gross domestic product (GDP) and poverty in Pakistan. This implies that an increase in GDP leads to a reduction in poverty, indicating a negative association between these two variables. The long-run analysis supports this finding, suggesting that a unit increase in GDP corresponds to a poverty reduction of -0.8740. These results align with previous research, such as studies by Abadie (2006); Roshaniza and Selvaratnam (2015).

4.11. Exchange Rates and Poverty Reduction

The study delves into the relationship between exchange rates and poverty reduction, providing critical insights for policy formulation. The outcomes underscore the significant impact of exchange rates on poverty reduction. A long-run ARDL analysis reveals that the volatility in the real exchange rate significantly influences the level of poverty in Pakistan. This emphasizes the potential role of government initiatives aimed at managing the real exchange rate in reducing poverty, particularly when aligned with institutions like human capital development.

4.12. Inflation's Complex Relationship with Poverty

Examining the impact of inflation on poverty in both short and long-run contexts, the study reveals a nuanced relationship. Higher inflation tends to exacerbate poverty, while lower inflation tends to alleviate it. Factors contributing to this include price volatility during high inflation, which discourages economic activity, and the erosion of purchasing power. Negative inflation changes also impact aggregate demand, supply, and unemployment. Both positive and negative inflation changes significantly and negatively affect poverty, aligning with earlier research by Amjad and Kemal (1997); Epaulard (2003); Lund et al. (2010).

4.13. Monetary Policy and Poverty Reduction

The study investigates the role of monetary policy in poverty reduction. The findings suggest that increasing the money supply by the central bank may not necessarily lead to a decrease in the poverty rate in Pakistan. This is due to the potential inflationary effects of increased money supply, which can discourage investment. High-interest rates set by the central bank can also impact investment and overall employment. However, adjusting interest rates can influence the money supply as funds move into interest-bearing deposits.

4.14. Exports, Employment, and Poverty

The study explores the relationship between exports, employment generation, and poverty reduction. In the short run, the findings indicate that exports do not significantly reduce poverty. However, in the long run, exports possess the potential to generate substantial employment opportunities and contribute to poverty reduction.

5. Conclusions

The results and discussions reveal the results of statistical analysis, providing insights into the relationships between various macroeconomic variables and poverty in Pakistan. The study uses the Autoregressive Distributed Lag (ARDL) model, incorporating descriptive, correlation, unit root and multicollinearity analyses. The findings indicate significant negative associations between GDP and poverty, underscoring the potential of economic growth for poverty reduction. Exchange rates are also highlighted as influential, with real exchange rate volatility impacting poverty. The intricate relationship between inflation and poverty is observed, with positive and negative inflationary changes affecting poverty levels. Importantly, education spending shows mixed short- and long-term effects, while trade dynamics show that increased imports could contribute to poverty. The study concludes by emphasizing the importance of strategic

policies that promote economic growth, manage inflation, invest in education and balance business dynamics for effective poverty reduction in Pakistan.

5.1. Policy Implication and Limitations

The policy implications derived from this study are essential to address poverty in Pakistan. Education policies must be consistent across districts and focus on technical education to equip young people with vital skills. Improving incentives for vocational education and increasing budget support for education are crucial steps. Improving the educational system is essential to reduce poverty in the country. To stabilize the economy and mitigate the negative effects of inflation on aggregate supply and demand, authorities must maintain transparent and credible stabilization policies. Inclusive growth is vital to prevent the rise of poverty, and strategies that promote job creation, such as tax breaks for manufacturers and a reliable supply of electricity, must be implemented. Furthermore, facilitating domestic credit to the private sector through lower official rates can contribute to poverty reduction efforts. Limitations of the study include the inability of the multilevel modeling technique to address unobservable, time-invariant factors and the absence of the most recent survey data. Future research could explore a three-level multidimensional model for all hierarchical levels and consider models with random intercepts and slopes.

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