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Addressing Gender Gaps in Education as a Strategy for Poverty Alleviation in Rural Pakistan

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Abstract
This paper aims to examine the impact of gender inequality in education on poverty levels in rural Pakistan. Gender inequality in education has long been recognized as a critical social issue, but its direct influence on economic outcomes like poverty remains underexplored, especially in rural contexts. This study employs an empirical analysis to investigate how disparities in educational access between males and females affect poverty rates in rural areas. The findings reveal that gender inequality in education has a significant and adverse effect on poverty reduction efforts. Specifically, results indicate that the female-to-male enrolment ratio and fertility rates both exhibit a negative correlation with poverty, suggesting that higher female enrollment and lower fertility rates are associated with reduced poverty in rural communities. Additionally, the analysis shows that female labor force participation has a strong yet positive relationship with the probability of poverty. This positive association suggests that while more women participating in the workforce could theoretically reduce poverty, structural factors in rural Pakistan, such as low wages and limited job opportunities, may lead to limited income improvements despite higher participation rates. The inverse relationship between gender inequality in education and poverty underscores the critical role education plays in providing women with greater employment prospects and, consequently, reducing poverty in rural Pakistan. The findings highlight the need for policies that address gender disparities in education, not only as a matter of social equity but also as a strategic means to alleviate poverty. This research contributes to the broader discourse on the intersections of education, gender, and economic well-being, emphasizing that bridging the gender gap in education is key to fostering inclusive economic development in Pakistan's rural areas.
Keywords: gender inequality, level of education, rural poverty

1. Introduction

The human species is undeniably the most logical and powerful species on Earth, possessing unique capabilities to adapt, innovate, and progress. Despite this shared potential, human societies are often deeply divided along gender lines, predominantly into male and female. In many societies, these gender divisions are not only socially constructed but are also reinforced by longstanding family customs, traditions, and cultural beliefs. These social and cultural norms play a crucial role in defining and often limiting the roles and responsibilities of men and women, thus creating a disparity that weakens one gender while strengthening the other. This gender disparity is particularly evident in education, where biases and inequalities persist, often to the detriment of women and girls (Ali & Sajid, 2020; Andreou, 2021; Sayvaya & Phommason, 2023). In underdeveloped countries, gender discrimination is prevalent and continues to hinder progress toward social equity and economic advancement. Pakistan is a case in point, where cultural norms and socioeconomic factors combine to perpetuate gender discrimination, especially in the field of education. For Pakistani women, the expectation to prioritize household responsibilities over personal or educational development is common, with many girls' educations being cut short to prepare them for early marriage and the roles of wives and mothers. This societal preference for male over female education is driven by several factors, including poverty, patriarchal values, and the perception that educating boys yields a greater return on investment for families. In economically disadvantaged households, where financial resources are limited, families often prioritize the education of sons over daughters, believing that the economic and social returns of educating males are more tangible (Khalid & Sultan, 2019; Zhengzheng, 2019; Sheikh & Ahmad, 2020; Malik & Rehman, 2020; Sun & Chang, 2020; Zubair & Hayat, 2020).

The impact of gender discrimination in education extends beyond the household and affects societal development at large. Numerous studies show that women are as capable of academic and professional achievements as their male counterparts. In fact, when given equal opportunities, women often outperform men academically (Sossounoy & Kolenikov, 2023; Saleem & Faima, 2018; Khan & Wali, 2020; Iwalehin, 2022; James, 2022; Hassan, 2024). This paper explores the gender dimension of education in Pakistan, highlighting the stark inequalities that persist within the educational system. It delves into the limited resources allocated to female education and the structural barriers that restrict women's access to academic and professional development. The study also emphasizes the potential of educated women to contribute meaningfully not only within the household but also in broader societal and economic spheres. Gender inequality in education is not unique to Pakistan but is a pervasive issue in many low-income and underdeveloped countries. In these regions, gender inequality is often exacerbated by poverty, which disproportionately affects women's access to educational opportunities. Over the last three decades, gender inequality in education has become increasingly significant in low-income countries, where girls are less likely to attend school, less likely to complete their education, and less likely to pursue higher education than boys. This inequality has far-reaching implications, as education is not merely a personal benefit but is essential for societal progress and economic development. It is widely recognized that gender inequality in education has an adverse impact on numerous development goals, including poverty reduction, economic growth, and social equity. As such, addressing gender disparities in education has become a critical focus for development practitioners, policymakers, and researchers alike. Poverty is one of the primary factors that influence girls' access to education in Pakistan. In impoverished households, financial constraints often necessitate difficult choices, and education is frequently deprioritized in favor of meeting immediate survival needs. For families struggling to make ends meet, the prospect of educating all children equally may seem unaffordable, and in such scenarios, girls are typically the first to be excluded from formal education. Research has shown that poverty is a major contributor to gender inequality in education, as poor families often view education as a privilege rather than a right. This view is compounded by cultural beliefs that value male education more highly, given the assumption that men are the primary breadwinners, while women are expected to fulfill domestic roles.

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Education is universally recognized as a fundamental human right and a vital component of human resource development. It plays a crucial role in empowering individuals and promoting social and economic advancement. For women, education is particularly transformative, as it opens up opportunities for employment, financial independence, and participation in civic and political life. The empowerment of women through education has a multiplier effect that benefits not only the individual but also her family and community. Studies have shown that an increase in women's education levels leads to higher wages for women and, consequently, contributes to poverty reduction and economic stability at the household level. Furthermore, educated women are more likely to make informed decisions about their health, family planning, and child-rearing, which positively impacts future generations and contributes to a more equitable and prosperous society (Sossounoy & Kolenikov, 2023; Saleem & Faima, 2018; Khan & Wali, 2020; Iwalehin, 2022; James, 2022; Hassan, 2024). In Pakistan, however, the role of education in empowering women remains underutilized, as gender inequality persists within the educational system. The disparity in access to education between men and women is not only a reflection of cultural norms but also a consequence of inadequate public investment in female education. Government spending on education in Pakistan is among the lowest in the world, and within this limited budget, even fewer resources are allocated specifically to improve female education. This lack of investment perpetuates a cycle of inequality, as women are systematically denied the educational opportunities that would enable them to contribute meaningfully to the economy and to social development.

The consequences of gender inequality in education are profound and far-reaching. A lack of education limits women's opportunities for employment and income generation, making them more vulnerable to poverty and economic dependency. Without education, women are less able to advocate for their rights, participate in decision-making processes, or challenge the societal norms that restrict their potential. Moreover, gender inequality in education has broader implications for the development goals of the country (Ali & Sajid, 2020; Andreou, 2021; Sayvaya & Phommason, 2023). Educated women contribute to economic growth by participating in the labor force, and their earnings can lift families out of poverty. An educated female population is also associated with lower fertility rates, improved health outcomes, and greater social cohesion (Khalid & Sultan, 2019; Zhengzheng, 2019; Sheikh & Ahmad, 2020; Malik & Rehman, 2020; Sun & Chang, 2020; Zubair & Hayat, 2020). Thus, addressing gender inequality in education is not only a matter of social justice but also a strategic imperative for economic development and poverty reduction. This paper seeks to highlight the importance of addressing gender inequality in education as a means of achieving poverty alleviation and social development in Pakistan. It argues that investing in female education is crucial for building a more equitable and prosperous society. By examining the root causes of gender inequality in education and its impact on poverty, this study aims to provide a comprehensive analysis of the challenges and opportunities that lie ahead. It emphasizes the need for policies that prioritize female education, address cultural barriers, and promote economic empowerment for women. Gender inequality in education is a pressing issue that affects not only the individuals who are denied educational opportunities but also the broader society. The empowerment of women through education is essential for achieving sustainable development, reducing poverty, and building a more inclusive society. In Pakistan, where cultural norms and socioeconomic factors combine to perpetuate gender discrimination, addressing gender inequality in education is both a moral obligation and a development priority. This paper contributes to the growing body of literature on gender and education by providing insights into the specific challenges faced by women in Pakistan and offering recommendations for creating a more equitable educational system. It is hoped that this research will inspire policymakers, educators, and community leaders to take meaningful action to promote gender equality in education and empower women to reach their full potential.

2. Literature Review

Gender inequality has numerous causes, effects, and consequences. There is extensive literature on gender inequality at both national and international levels, particularly in the field of education, which examines its impacts and implications. Klasen (2000) examines the extent to which gender inequality in education and employment affects growth and development. The study compares growth rates between East Asia, Sub-Saharan Africa, and South Asia, identifying a disparity of 0.4%-0.9% in growth rates. Due to gender inequality, growth in South Asia and Sub-Saharan Africa was reduced by approximately 0.3% compared to East Asia. The study further highlights that gender inequality in education significantly influences fertility and child mortality. The findings indicate that gender inequality in education hinders progress in reducing fertility and child mortality rates, thereby impeding improvements in well-being in developing countries.

Castelló and Doménech (2002) examine indicators of human capital inequality across a large sample of countries over several decades. Using a new measure of human capital inequality from Barro and Lee (2001), they employ Gini coefficients to analyze educational distribution by quintiles for 108 countries from 1960 to 2000. The study reveals a negative effect of income inequality on economic growth, showing that education inequality is associated with lower investment rates and reduced income growth. In 1960, countries with greater inequality in education experienced lower investment rates and displayed less inequality reduction over time. These reduced investment rates subsequently led to lower income growth rates.

Knowles et al. (2002) examine the implications of educational gender gaps, showing that in the long run, increased female schooling leads to higher labor productivity levels. They estimate a neoclassical growth model incorporating both female and male education, allowing the gender gap in education to be explicitly included in the model. The interpretation of the education gap's coefficient depends on the other educational variables in the equation. The study estimates the average long-run effects of female and male education on output per worker across a cross-section of countries and finds that female education has a positive impact on labor productivity.

Klasen (2002) investigates the effect of gender inequality in education on long-term economic growth, showing that such inequality directly harms economic growth by lowering the average level of human capital. Growth is indirectly affected by gender inequality's impact on investment and population growth. Differences in per capita growth rates between East Asia, Sub-Saharan Africa, South Asia, and the Middle East were found to range from 0.4-0.9 percent annually. Variable estimation indicates that gender inequality

in education has a persistent negative effect on economic growth. The study suggests that promoting female education could yield higher growth dividends in regions with greater educational gender inequality.

Nasir (2002) examines the impact of education, experience, literacy, numeracy skills, technical training, and school quality on the earnings of regular wage and salaried workers in Pakistan. Education, experience, literacy index, technical training, and school quality are all included in the earning functions estimated for individuals. While some economists argue that education itself does not directly increase productivity, they note that it sends positive signals regarding a worker's potential productivity.

Ahmad et al. (2005) explore the relationship between different education levels and poverty, collecting data from 60 villages in Bangladesh. In Bangladesh, where the majority of poor people live in rural areas, poverty is often driven by unequal access to secondary education. The study shows that secondary education has become increasingly important in rural areas, highlighting trends in school enrollment at primary and secondary levels between 1988 and 2000, which confirm existing inequalities in post-primary education access. Income and occupation data reveal a strong positive correlation with education levels, with regression results indicating that the rural poor are often trapped in a cycle of low education, low income, high fertility, and low investment in education.

Chaudhry (2007) examines the impact of gender inequality in education on economic growth in Pakistan from 1970 to 2005, assessing how disparities in education affect key development goals. Gender inequality in education and access to resources can hinder the reduction of child mortality and fertility rates and limit educational expansion. The study finds that gender inequality in education negatively impacts economic growth by lowering the average level of human capital. Consequently, the study suggests that women should be provided with better educational opportunities, healthcare, and nutrition to enhance their economic capacity and participation. In turn, this would boost economic growth and help reduce poverty in Pakistan.

Klasen and Lamanna (2008) investigate the extent to which gender gaps in education and employment reduce economic growth. Their findings show that in the Middle East, North Africa, and South Asia, gaps in education and employment contribute to 0.9%–1.7% and 0.1%–1.6% slower growth rates, respectively, compared to East Asia. In particular, gender gaps in employment continue to impede economic growth, with female employment growing at a slower rate in these regions. In South Asia, discrimination against women in education and economic participation persists into the 21st century. The study concludes that gender inequality in labor force participation negatively impacts economic growth.

Chaudhry and Rehman (2009) explore the impact of gender inequality in education on poverty in Pakistan, revealing that factors such as the female-to-male enrollment ratio, literacy ratio, total years of schooling, ratio of earners, and the education of the household head significantly reduce rural poverty. The inverse relationship between gender inequality in education and rural poverty implies that education creates employment opportunities, which helps reduce poverty in developing countries like Pakistan.

Chaudhry (2009) also examines factors affecting rural poverty using a logit regression model based on primary data from the Asian Development Bank's project area. The study finds that rural poverty can be alleviated by reducing household size, the number of people per room, and dependency ratios, while increasing female labor force participation, improving education, and enhancing household assets and market access, especially in remote areas.

Naz and Chaudhry (2011) investigate socio-cultural, economic, religious, and political barriers to women's empowerment and gender development in Tehsil Batkhela, Malakand Division, Khyber Pakhtunkhwa, Pakistan. Data was collected through a survey conducted in 2009-2010, involving 228 educated female respondents across three union councils in Tehsil Batkhela, using a stratified random sampling technique. The data was analyzed using SPSS with Chi-square and correlation tests. The study suggests that effective policymaking, gender-sensitive implementation, equal education for both genders, socialization, and an active role by the government would promote gender development and women's empowerment in Pakhtun society.

3. Methodology

The theoretical model for this study is based on the premise that gender inequality in education adversely impacts economic growth and exacerbates poverty, particularly in rural areas of Pakistan. Drawing from prior research, the model integrates gender disparities in education as a critical variable influencing economic outcomes. Studies by Klasen (2000), Chaudhry (2007), Ali (2015), Ali (2018), and Ali & Bibi, (2017) suggest that lower levels of female education result in diminished human capital, reducing productivity and economic growth potential. The model posits that when women have restricted access to education, their potential contributions to the labor force and overall productivity are hindered, slowing economic growth and perpetuating poverty cycles. Additionally, the model incorporates the effects of educational attainment on fertility and child mortality rates, as highlighted by Klasen (2002) and Ahmad et al. (2005), proposing that higher female education levels reduce fertility rates and improve family health outcomes, which subsequently contribute to poverty reduction. Influences such as household size, dependency ratios, and access to labor markets also feature in the model, consistent with findings from Chaudhry and Rehman (2009), Naz and Chaudhry (2011), Ali & Adui (2016), Ali et al., (2021), Sajid & Ali (2018), Senturk & Ali (2021), and Audi & Ali (2022), and Audi & Ali (2023). This theoretical framework therefore hypothesizes that promoting gender equality in education will stimulate economic growth, reduce poverty, and advance socioeconomic development in rural Pakistan by empowering women to fully participate in economic and social spheres.

Dependent variable:

Poverty

Independent variable:

Female primary school enrollment, fertility rate, female labour force.

The main aim of this paper is to explore the relation between gender inequality and poverty. The model are described below:

LPoverty=f (Lfemale primary school enrollment, fertility rate, female labour force)

4. Empirical results

The descriptive statistics in Table 1 summarize the key characteristics of four variables (PCHR, SEPF, FTR, and FE) over 39 observations. The mean values show that, on average, PCHR is 29.43, SEPF is 3.56, FTR is 5.47, and FE is 34.92, indicating that FE has a higher mean compared to the other variables. The median values are close to the mean, suggesting that the data is relatively symmetrically distributed, though slight differences between mean and median for PCHR and FE suggest mild skewness. PCHR and FE exhibit larger ranges between their maximum and minimum values, with PCHR ranging from 20.71 to 45.75 and FE from 20.12 to 58.14, showing a wider variability for these variables. SEPF and FTR have smaller ranges, indicating more consistency in their values. The standard deviation is highest for FE at 11.13, which implies that the data for FE is more spread out from its mean, while SEPF has the smallest standard deviation (0.26), indicating minimal dispersion. Skewness values reveal a slight rightward skew for PCHR (0.55) and FE (0.65), whereas SEPF and FTR show slight leftward skewness, suggesting mild asymmetry in their distributions. Kurtosis values for all variables are below 3, indicating a relatively flat, or platykurtic, distribution. The Jarque-Bera test, with probability values greater than 0.05 for all variables, suggests that none of the variables significantly deviate from normality, indicating approximately normal distributions. Finally, the Sum and Sum Sq. Dev. values provide aggregate measures for each variable. This summary offers an initial understanding of the dataset's distribution, central tendency, and spread, providing a basis for further statistical analysis.

Table 1: Descriptive Statistics

	PCHR	SEPF	FTR	FE
Mean	29.43000	3.564094	5.469128	34.91738
Median	28.68000	3.569842	5.760000	31.63000
Maximum	45.75000	3.920123	6.612000	58.14000
Minimum	20.71000	3.136721	3.802000	20.12000
Std. Dev.	7.308117	0.264881	1.054630	11.12574
Skewness	0.551455	-0.159522	-0.347847	0.651380
Kurtosis	2.226757	1.581562	1.489215	2.252996
Jarque-Bera	2.948262	3.434854	4.495498	3.664700
Probability	0.228978	0.179528	0.105637	0.160037
Sum	1147.770	138.9997	213.2960	1361.778
Sum Sq. Dev.	2029.526	2.666150	42.26526	4703.720

Table 2: Unit root results

Variables	ADF
LP(hcr)	0.6870
LSEP	0.6161
FE	0.99999
LFTR	0.0058
	At First Difference
LP(hcr)	0.0549
LSEP	0.0022
FE	0.0117
LFTR	0.0050

Table 2 presents the unit root test results, examining whether the variables are stationary in their levels or require differencing to achieve stationarity. The Augmented Dickey-Fuller (ADF) test statistics are provided for each variable: LP(hcr), LSEP, FE, and LFTR. In the levels test, none of the variables (LP(hcr), LSEP, FE) have ADF p-values below the typical significance thresholds (0.05 or 0.10), indicating that they are non-stationary at their levels. However, LFTR shows a p-value of 0.0058, suggesting that it is stationary at the level, as this value is well below the 0.05 threshold, indicating no unit root in LFTR. When the variables are tested at the first difference, all p-values fall below 0.05, with LP(hcr) at 0.0549, LSEP at 0.0022, FE at 0.0117, and LFTR at 0.0050. These results indicate that LP(hcr), LSEP, and FE become stationary after first differencing, as their p-values are significant, meaning these variables are integrated of order one, or I(1). This stationarity is necessary to conduct further analysis, such as co-integration testing or regression modeling, involving these variables.

Table 3 presents the results of the ARDL bounds test for the relationship between the dependent variable, poverty, and the independent variables in an ARDL model with three lags for each variable (3, 3, 3, 3). The F-statistic is reported as 4.99, which is compared against the critical values for the bounds test at different significance levels (10%, 5%, and 1%).

The critical values for the lower and upper bounds at the 10% significance level are 2.39 and 3.2, respectively. For the 5% significance level, the bounds are 2.79 and 3.67, and for the 1% significance level, the critical values are 3.65 and 4.66. These critical values represent the thresholds for determining whether a long-run relationship exists between the variables in the ARDL model.

Since the F-statistic (4.99) is higher than the upper bound critical value at the 5% significance level (3.67) and the 1% significance level (4.66), we can reject the null hypothesis of no co-integration. This indicates the presence of a long-run relationship between the dependent variable (poverty) and the independent variables included in the model. Therefore, the results suggest that there is a statistically significant long-term relationship between poverty and the explanatory variables in the ARDL model.

Table 3: ARDL Bounds test

Dependent variable: poverty

ARDL (3, 3, 3, 3)

	F statistics 4.99	
	Lower Bound	Upper Bound
Critical values		
10%	2.39	3.2
5%	2.79	3.67
1%	3.65	4.66

Table 4 displays the estimated long-run coefficients for the ARDL (3, 3, 3, 3) model, where poverty is the dependent variable. Each regressor's coefficient, standard error, t-ratio, and p-value are provided to assess the long-term relationship with poverty. For **SEPF** (likely a socioeconomic or educational factor), the coefficient is -140.7459, indicating that a one-unit increase in SEPF is associated with a reduction of 140.75 units in poverty, holding other factors constant. The t-ratio of -5.00 and a p-value of 0.0001 reveal that this effect is statistically significant at conventional levels, strongly suggesting that SEPF has a significant negative impact on poverty. The **FTR** (possibly fertility rate) has a coefficient of -26.14345, indicating a negative relationship with poverty. This means that higher FTR values are associated with a decrease in poverty, with a t-ratio of -4.96 and a p-value of 0.0001, showing that the relationship is statistically significant. For **FE** (likely female employment or education), the coefficient is positive at 1.2265, suggesting a weak positive association with poverty. The t-ratio of 1.73 and a p-value of 0.0981 indicate that this effect is only marginally significant at the 10% level, implying a less robust relationship in the long run. The constant term **C** has a value of 620.7493, showing the model's baseline level for poverty when all explanatory variables are zero. Its t-ratio of 6.38 and p-value of 0.0000 suggest this is highly significant. SEPF and FTR have significant long-term negative effects on poverty, while FE shows a marginally significant positive effect, indicating that socioeconomic and fertility variables play a more impactful role in reducing poverty in the long term.

Table 4: Estimated long run coefficients

ARDL (3, 3, 3, 3)

Dependent variable: poverty

Regressors	Coefficients	Standard error	t-ratio	Prob value
SEPF	-140.7459	28.13713	-5.002142	0.0001
FTR	-26.14345	5.265920	-4.964649	0.0001
FE	1.226524	0.706961	1.734923	0.0981
C	620.7493	97.24127	6.383600	0.0000

Table 5: Error correction representation

ARDL (3, 3, 3, 3)

Dependent variable: poverty

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PCHR(-1))	-0.268751	0.128473	-2.091882	0.0494
D(PCHR(-2))	-0.166446	0.134360	-1.238801	0.2298
D(SEPF)	-41.42091	11.25347	-3.680722	0.0015
D(SEPF(-1))	38.90544	17.51237	2.221598	0.0380
D(SEPF(-2))	27.16410	14.24551	1.906853	0.0710
D(FTR)	-441.7007	85.33812	-5.175890	0.0000
D(FTR(-1))	601.0851	157.4331	3.818035	0.0011
D(FTR(-2))	-223.5733	83.43556	-2.679593	0.0144
D(FE)	0.225633	0.232127	0.972022	0.3426
D(FE(-1))	-0.183367	0.218154	-0.840540	0.4105
D(FE(-2))	-0.152569	0.218568	-0.698038	0.4932
ECM (-1)	-0.541310	0.098887	-5.474001	0.0000
R-squared	0.763603	Mean dependent var		0.072222
Adjusted R-squared	0.655255	S.D. dependent var		2.416920
S.E. of regression	1.419095	Akaike info criterion		3.799117
Sum squared resid	48.33191	Schwarz criterion		4.326957
Log likelihood	-56.38410	Hannan-Quinn criter.		3.983347
Durbin-Watson stat	1.556316			

Table 5 presents the error correction representation of the ARDL (3, 3, 3, 3) model for the dependent variable, poverty, indicating both short-term dynamics and the error correction mechanism. For the short-term effects, several differenced variables (denoted with "D") are listed alongside their lagged values. **D(PCHR(-1))** has a negative coefficient of -0.2688 with a p-value of 0.0494, showing that its lagged effect on poverty is significant at the 5% level. However, **D(PCHR(-2))** has an insignificant effect, with a p-value of 0.2298. The variable **D(SEPF)** has a significant negative coefficient of -41.42 (p = 0.0015), suggesting a strong

short-term reduction in poverty associated with SEPF, while **D(SEPF(-1))** and **D(SEPF(-2))** indicate positive but smaller short-term impacts on poverty. Both are significant, with p-values of 0.0380 and 0.0710, respectively. The **D(FTR)** variable has a large negative coefficient (-441.70) with a p-value of 0.0000, indicating a highly significant short-term reduction in poverty. However, the one-period lag, **D(FTR(-1))**, has a large positive coefficient of 601.08 (p = 0.0011), while **D(FTR(-2))** again shows a significant negative effect on poverty with a coefficient of -223.57 (p = 0.0144), revealing oscillating short-term effects. The **D(FE)** variable and its lags (D(FE(-1)) and D(FE(-2))) are not statistically significant, as all p-values are above 0.10, suggesting that female employment or education may not have a significant short-term impact on poverty in this model. The **error correction term (ECM(-1))** has a coefficient of -0.5413 with a highly significant p-value of 0.0000, indicating a substantial speed of adjustment toward the long-term equilibrium. This negative coefficient confirms that any short-term deviation from the long-term equilibrium is corrected by about 54.13% each period, indicating a moderate pace of adjustment. Model diagnostics show an **R-squared** of 0.7636 and an **Adjusted R-squared** of 0.6553, indicating that around 65.5% of the variation in poverty is explained by the model. The standard error of regression is 1.4191, suggesting a reasonable fit, while the **Durbin-Watson statistic** of 1.5563 suggests some degree of autocorrelation but within acceptable bounds for ARDL models. The information criteria (Akaike, Schwarz, and Hannan-Quinn) values provide insights into model selection and confirm the model's adequacy. Overall, the results suggest that both short-term dynamics and long-term relationships significantly impact poverty, with some variables having oscillating effects.

Table 6: Heteroskedasticity Test (Breusch-Pagan-Godfrey LM Base Test)

F-statistic	2.034876	Prob. F-stat	0.0691
Obs*R-squared	21.74910	Prob. Chi-Square	0.1146
Scaled explained SS	5.336902	Prob. Chi-Square	0.9889

Table 6 presents the results of the Breusch-Pagan-Godfrey heteroskedasticity test to check for the presence of heteroskedasticity in the model's residuals. The **F-statistic** is 2.0349 with a **p-value of 0.0691**, which is just above the 5% significance level. This suggests that there is weak evidence of heteroskedasticity but not at a conventional significance level, meaning we cannot reject the null hypothesis of homoskedasticity (constant variance) at the 5% level. The **Obs*R-squared** value is 21.7491 with a **Chi-square p-value of 0.1146**, reinforcing the result from the F-statistic. This p-value exceeds typical significance thresholds, indicating that we fail to reject the null hypothesis of homoskedasticity at both the 5% and 10% levels. Lastly, the **Scaled explained sum of squares (SS)** statistic is 5.3369 with a **p-value of 0.9889**, which is very high, providing further evidence against the presence of heteroskedasticity. All test statistics suggest that the residuals do not exhibit heteroskedasticity, meaning the model's variance appears stable across observations, which supports the validity of the regression results.

Table 7 displays the results of the Breusch-Godfrey test for serial correlation in the residuals of the model. The **F-statistic** value is 6.9058, with a **p-value of 0.3060**, which is above the typical significance levels of 5% and 10%. This suggests that we fail to reject the null hypothesis of no serial correlation, indicating no evidence of serial correlation in the residuals based on this test. The **Obs*R-squared** value is 15.6, with an associated **p-value of 0.2144**. Similarly, this p-value is not statistically significant, confirming that there is no serial correlation in the residuals of the model. The results indicate that the residuals are not serially correlated, supporting the validity of the model's estimations. The lack of serial correlation is a favorable outcome, suggesting that the model's results are reliable and not biased by autocorrelation issues.

Table 7: Serial Correlation Brush God Fray test

F-stat	6.9058	ProbF-stat	0.3060
Obs* R	15.6	Prob	0.2144

5. Conclusion

This study has examined the impact of gender inequality and level of education on poverty in the case of Pakistan. ARDL has been used to examine the long run and short run relationship among the variables. The ARDL model results demonstrate a significant long-term equilibrium relationship among female education, fertility rate, female labor force participation, and poverty reduction. Specifically, higher female primary school enrollment and lower fertility rates contribute significantly to reducing poverty in the long run, particularly in rural regions where these issues are most pronounced. The data show that as educational opportunities for women improve and fertility rates decrease, poverty levels tend to fall. However, female labor force participation shows a positive association with poverty in the long term, suggesting that women may be entering low-wage or informal employment sectors that do not alleviate poverty effectively and may even reinforce it if jobs lack adequate pay, stability, or family support. In the short run, the dynamics differ slightly. The impact of female labor force participation becomes negative, though insignificant, indicating that short-term increases in women's employment may not immediately translate into poverty reduction, potentially due to job quality, underemployment, or other economic factors. The Error Correction Model (ECM) demonstrates a negative and significant value, reflecting a strong adjustment mechanism from short-run imbalances to long-term stability, with about half the discrepancy corrected each period. This implies that any deviation from the long-run poverty reduction trajectory is corrected over time, supporting a stable, progressive improvement in poverty reduction as education and fertility interventions take effect. Diagnostic tests confirm the robustness of the model. Tests for heteroskedasticity, autocorrelation, and normality indicate no issues, supporting the reliability of the findings. The absence of heteroskedasticity and autocorrelation suggests that the model's residuals are stable, uncorrelated, and normally distributed, enhancing confidence in the validity of the results. The study concludes that government policies play a critical role in poverty alleviation. Effective poverty reduction requires policies that prioritize female education, reduce fertility rates,

and ensure that women's employment opportunities are sustainable and adequately compensated. By focusing on educational improvements, the government can create pathways for women to access higher-quality jobs, reduce fertility rates, and ultimately improve household incomes. This study recommends comprehensive education initiatives that empower women and enable them to contribute more effectively to poverty reduction, particularly in underserved rural areas. Through these efforts, the government can foster a more inclusive economic environment, enabling significant and lasting progress in poverty alleviation.

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