



Women's Empowerment and Poverty Reduction: Panel Evidence on Labor and Education Dynamics

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In a world where gender dynamics shape economic realities, this study delves into the transformative role of female labor force participation (FLFP) and education in combating poverty. Analyzing panel data from 30 countries spanning 2012 to 2023, it examines the interplay between FLFP, the primary completion rate of females (PCRF), and poverty headcount ration (PHR). The findings reveal that higher FLFP directly boosts household incomes, fostering economic stability, while enhanced PCRF empowers women to access better job opportunities, amplifying poverty reduction. Utilizing advanced econometric techniques, including GMM and quantile regression, this study highlights the untapped potential of women's participation in the workforce and the pivotal role of education in poverty alleviation. Policymakers are urged to prioritize strategies that integrate gender equality in education and employment, ensuring equitable economic growth and a brighter future for all. By weaving together FLFP, education and poverty into a cohesive narrative, this study offers a profound understanding of the mechanisms driving poverty alleviation. It serves as a clarion call for action, emphasizing that empowering women is not just a moral imperative but an economic necessity for sustainable development.



Introduction

Over the last years, in the world more and more women start working. There is a big change compared to the past when women stay home and take care of the family but now women are

doing all kinds of jobs, like doctors, lawyers, construction workers and factory workers. By, (*U.S. Bureau of Labor Statistics*) the pandemic and the ongoing situation of economic have effect families and working people hard, especially women. In July 2023, the percentage of the women in the workforce was 57.4% which is lower than men. Since 2000 the women participation in the workforce has stopped growing. But due to pandemic it's now back to the levels last seen in 1993. In the different part of the world this recovery has experienced differently. The southern Asian and Latin America seen the improvement than Europe and North America. In the Middle East & North seen slightly decrease.

As the same time, the poverty is a major challenge that most of the countries facing. 700 million people who live under an extreme poverty line which is less than \$2.15 per day. This remains in part of sub-Saharan Africa, conflict affected areas and rural area. The low-income countries in 2020-22 have affected most due to the Covid-19 pandemic and other major shocks. In 2022, total 712 million people around the world living in extreme poverty compare to 2019 (*WDI, 2022*). Poverty means that not having required money to get the basic necessities of life like shelter, clothing and food. The affect millions of people around the world that make their life difficult and make their opportunity limited for a better life. As per (*European Commission, 2024*)

“Poverty is hunger. Poverty is lack of shelter. Poverty is being sick and unable to see a doctor. Poverty is not having access to education and not knowing how to read. Poverty is not having a job, fearing the future, living day by day”.

Poverty takes on many faces, changing from place to place and across time, and has been described in many ways. Most often, poverty is a condition people want to escape. Thus, poverty is a call to action for the poor and the wealthy alike a call to change the world so that many more may have enough to eat, adequate shelter, access to education and healthcare, protection from violence, and a voice in what happens in their communities (*Acheampong et al., 2024*).

Past researches shows that the more women when start to work it can help in reducing the poverty and also can boost the economy. Which results in more jobs and opportunity for everyone. Also helps in lifting out poverty as women can support their families and themselves, but education also plays a big role in poverty (*Pujiwati et al., 2024; Shah et al., 2024*). Past studies found that the people who are more educated have better job and earn more money. The women who are educated plays an important role in improving lives of their families and community. According to the global literacy rate, the literacy rate has been increasing from last decades. In 2022 report, men are more literate than women around 90% of men and less than 84% of women are literate. If we look at young literacy rate which aged 15-24 the young male are more literate than young female (*Adu & Denkyirah, 2017*).

From past study shows that women who join workforce can effect on economic development and help in reducing poverty. The higher percentage of women participation in the workforce can become a vital element in reducing poverty since females spend money on their families (*Heintz, 2006*). But past studies did not define the relationship clearly. So, the problem is addresses in this study is need to analyze comprehensively the relation between (FLFP) rate, poverty level & literacy rate. Moreover, we need to find new ways to measure poverty that helps to understand how poor people really are not just how many of them there are (*Oyedele & Haifene, 2024*).

The primary objective of this study is to explore the impact of women joining the workforce on poverty levels in different countries. Additionally, we aim to investigate the role of education in influencing this relationship. Specifically, this study investigates the relationship between FLFP rates, PHR at national poverty lines, and literacy levels. By analyzing these factors, we seek to

understand effective strategies for combating poverty and promoting equality. This study explores how women's empowerment influences poverty reduction through key questions. It examines whether education enhances women's impact on poverty, how FLFP affects poverty levels, the role of literacy rates in relationship and how FLP and literacy together shape poverty dynamics over time. These insights aim to uncover sustainable pathways for reducing poverty.

The significant of the study is to help government make better rules give equal rights and power to those people who are left out and make sure development happened in a way that last long. Make sure that everyone get equal chance to learn and have a great life. This is what exactly the aim of the study. By figuring out the things like women workforce, literacy rate and poverty are all connected we want to contribute through this study to make the life of people a little better in the globe. This study helps to make the world fairer, welcoming and richer place for everyone.

The practical implication of the study is to extend positive change at the ground level to empowering communities and individuals to overcome poverty and achieve sustainable livelihoods. The findings of this study can be used in practical plans and actions that will help in making difference in real lives of the people around the world. The study provides insights that policymaker, government and organization can implement strategies and endeavors that address issues like poverty and gender inequality. These efforts have the ability to bring the positive changes that will lead to a fairer and more thriving society where everyone has equal opportunity to flourish.

This paper is begun with an introduction section that includes background of study, problem statement, objective and outlining a significance of the study. This will follow to the section 2 which consist of comprehensive review of relevant literature, highlight the key concept, theories and empirical findings related to the (FLFP) and (PHR) at national poverty line and role of literacy rate. After that move to the section 3 which is Research methodology based on operationalization, sample, data collection, limitation, theoretical model hypothesis, empirical study and analysis tools and techniques ensuring transparency and rigor in the research process. In section 4 will be Data Analysis and in the last section 5 conclusion and recommendation additionally paper will include then references that acknowledge the content sources.

Literature Review

Poverty is a complex concept which is described in many ways by different authors. Essentially, it refers to state of deprivation in terms of economic and social well-being. (Stephen, 2017) views poverty as lacking in key areas like, education, income, employment, and healthcare, access to food, self-esteem, social status and self-actualization. Similarly, (Roy et al., 2017) defines poor as those who struggle to get enough income, secure suitable employment, own property, or maintain a healthy standard of living. (Abraham et al., 2017; Sheikh et al., 2020) break down poverty into 5 dimensions of deprivation. First, it includes individuals who lack necessities such as shelter, food, healthcare, education & clothing. Second, it incorporates people who need monetary assets like property, capital, pay, and resources. Third, it affects individuals who need social associations and opportunity of social affiliation. Fourth, it concerns people who are denied access to opportunities, information, knowledge, cultural values, and beliefs. Fifth, it includes the people who need political voice and impact in dynamic cycles that influence their lives.

According to (WDI, 2023), poverty is characterized by hunger, illness, homelessness, lack of access to education and healthcare, unemployment, worry about the future, and insufficient income for day-to-day living expenses. They additionally underscore weakness and absence of portrayal as parts of poverty. Similarly, the Human Development Index (HDI) linked poverty to improvements

in living standards as measured by per capita income, life expectancy, and educational attainment. The HDI is used by the (UNDP) to measure poverty in countries. utilizes a pay level of short of what US \$370 each year, or a dollar daily, as benchmark for deciding poverty. This suggests that people's income status, literacy levels, and quality of life are all closely linked to poverty. Further poverty is characterized in view of the (*Poverty, Prosperity, and Planet Report 2024*) viewpoint, which includes hunger, homelessness, illness, lack of access to education, unemployment, fear for the future, and other related challenges. While poverty may be defined differently by various authors, most agree that it involves health deprivation, low income, and limited access to education.

Researchers have consistently shown that an increase in (FLFP) have significant implications on a poverty diminishment. Studies demonstrate that higher FLFP rates are related with lower poverty levels as females contribute to household income and economic growth (Adu & Denkyirah, 2017). Nevertheless, relationship between FLFP and poverty to complex and multifaceted such as according to (Alraee, 2018) highlighting the importance of considering the quality of employment opportunities for females as low-paying and precarious jobs may perpetuate rather than alleviate poverty. Globalization has positive effects on the FLFP rate because international trade and foreign direct investment both improved economic and employment opportunities, particularly for women because foreign firms can be more flexible in hiring women. However, in the long run, it has been discovered that foreign direct investment can also contribute to an increase in gender inequality. This is due to the fact that when there is a significant gender gap in the education levels of the two genders, foreign firms may primarily provide technical expertise to male employees (Beegle & Christiaensen, 2019).

In developing countries, FLFP plays a crucial role in reducing poverty by contributing to economic activities. (Bonnet, 2016) emphasizes an importance of women' employment to improving well-being of both women and their families. Globally, there are more than 4.5 billion people engaged in economic activities, with an estimated 1.5 billion being women. Women constitute 40% of workforce in agriculture, a quarter in trade,& a third in services, (Matandare, 2018). This significant participation of women in various sectors has led to a notable increase in productivity, with Africa experiencing a 20% boost and developed nations seeing a 50% rise. Africa, where subsistence farming and shifting cultivation are prevalent, women are primarily responsible for tasks related to food production. (Tansel, 2015) highlights that women contribute two-thirds or more of all work hours in food production, processing, and marketing on small farms. This underscores the critical role women play in agricultural activities in Africa. Over the past two decades FLFP rates in sub-Saharan Africa have increased by 3.2 %. This rise may be attributed to factors such as the lack of alternative income sources from social protection and persistent poverty. Additionally, limited opportunities for further education or training compel more women to enter the workforce. Persistent male unemployment often results in higher FLFP as women seek to balance for the absence of income in their households. However, it is important to note that such rises in female labor supply are often absorbed among own-account and contributing family workers, as International Labor Organization

Numerous studies have delved into the intricacies of engagement of women in the labor market across various contexts. Economists have explored several theories to elucidate labor force participation, among which the theory of income leisure, stemming from neoclassical theory, posits that individuals or household members enter the labor market to augment income. They continue to work if the benefits outweigh those from household activities. Consequently, supply of labor hinges on factors such as compensation, non-labor income, and the perceived utility between work and leisure. This model suggests that higher wages may induce incumbent workers to

provide more labor time, yet may it also render extra work less attractive. However, those outside labor force may be induced to join due to higher wages, thereby increasing labor participation. Hence, the impact of higher wages on labor participation is variable and contingent on contextual factors. Additionally, theory of modernization posits a positive association between economic development and (FLFP) through changes in occupational structures and increased educational opportunities (Jaumotte, 2003). As countries undergo modernization, characterized by shifts in employment sectors and educational advancements, there's often a decline in female employment in certain sectors, followed by increased participation in others. This dynamic is influenced by evolving demand for labor, societal acceptance of women's roles in education and employment, and demographic shifts such as reduced fertility rates and changing household responsibilities.

However, FLFP also influenced by socio-economic factors, including family and labor market policies, and the prevailing economic environment. For instance, unemployment rates impact female participation: high rates may discourage women from entering the labor force, while male unemployment may stimulate female participation as women seek to compensate for family income losses (Alraee, 2002). Additionally, FLFP is connected to demographic factors like fertility rates. Studies indicate a negative correlation between FLFP and fertility rates, as an increase in female employment frequently coincides with a decrease in fertility (Tamang, 2011). Workforce participation among women is further nuanced by individual and family attributes, including education, conjugal status, and family size. While advanced education levels by and large increment FLFP, conjugal status, and family administration might influence labor force choices (Naqvi & Shahnaz, 2002). Additionally, women's commitment to the workforce is affected by logical factors, for example, the accessibility of formal and informal sector employment opportunities and cultural standards in regards to women's jobs in work. Observational examinations have reported patterns in FLFP over the long run, uncovering expanding support rates driven by variables like changes in fertility, educational attainment, and societal attitudes (Kabir Usman, 2019). Differences in household responsibilities and economic opportunities are blamed for disparities in labor force participation rates between rural and urban areas (Mammen & Paxson, 2000). Moreover, the nature of business, whether formal or informal, impacts women's workforce choices, with education, age, and their household characteristics shapes their occupational decisions (Faridi et al., 2011)

In recent years, more attention has been given to the relation among poverty & (FLFP) and literacy rates. The previous investigations recommend that higher education rates among female can upgrade their employability and acquire potential in this manner decreasing their weakness to poverty (Richards & Gelleny, 2007). Women's access to education and opportunities expands because of literacy skills, which additionally add to contribute to decrease poverty (Kabeer & Mahmud, 2004). Gender discrimination, a lack of education, and limited childcare support are all structural barriers to women's labor and market participation that must be addressed. (Tello, 2015) expand on this idea by highlighting the direct relationship between financial development and education, particularly at higher levels. They contend that education engages workers by equipping them with advanced abilities, accordingly, growing their proficiency and development, which are central drivers of monetary and financial development. Additionally, individuals with higher levels of education have increased opportunities to secure employment, resulting in higher incomes and improved living standards. This, thus, affects poverty decrease. The connection between education and poverty is diverse. The lack of access to high-quality education for many poor individuals exacerbates their financial problems. (Inegbedion & Obadiaru, 2022; Shah et al., 2021) emphasize that education is essential in equipping individuals with the knowledge, abilities, and competencies they require to contribute to national development. Education provides the necessary capital for

sustained economic growth and enables socioeconomic advancement. Moreover, education isn't just a method for obtaining knowledge but also a pathway to getting specific abilities that upgrade individual efficiency.

The (*Poverty, Prosperity, and Planet Report 2024*) empirical evidence indicates the significant impact of education on earnings. The median income of primary school graduates is 1.7 times higher than those who do not possess basic literacy skills. Secondary school graduates acquire 1.6 times more than elementary school graduates, while college graduates acquire roughly multiple times more than educated individuals and 4.5 times more than secondary school graduates. The disparity in profit is a key factor in the development of financial stability. However, despite the clear correlation between education and monetary success, poverty remains unavoidable, particularly in rural areas with limited access to education, for instance, rustic regions in nations such as Nigeria. Education is a key factor in the complex phenomenon of poverty, which is influenced by various factors. (Archibong et al., 2020) contend that poverty is complicated by a lack of education, as people with limited education often struggle to find employment, procure adequate pay, or access to necessities. As a result, poverty perpetuates a vicious cycle of poverty, making it difficult for people to progress in their socioeconomic situation. The relationship among poverty and education highlights the significance of putting resources into educational drives that intend to engage underprivileged people and reduce poverty. (Bloom et al., 2018) literacy contributes altogether to financial development, featuring the significance of education in driving advancement and economic activity. (Bonnet, 2016) argue that literacy may not necessarily in all cases lead to critical economic development. This suggests that other factors can have impact on a relationship between economic development and education. Despite many divergent points of view, there is still general agreement that education is a significant contributor to socioeconomic progress. (Kaufman, 2016) brought light on the nuanced connection between literacy rate, development, and poverty, further investigating how education contributes to economic growth and poverty reduction in Russia and Ukraine.

The lack of research on a connection between FLFP, poverty rates, & literacy rates stem from a number of key research gaps. There's a requirement for a more profound diverse investigation that considers how elements like education, gender, and socio-economic status intersect and impact poverty dynamics. By understanding these convergences, designated intercessions can be created to address the interesting requirements of various groups of females. Additionally, impact of female labor force participation on poverty varies from region to region. These variations are largely shaped by cultural norms, government policies, and economic structures, all of which require further investigation. At last, while past examination has distinguished the significance of female work and education in poverty decrease, there's a gap in making an interpretation of these discoveries into noteworthy strategy and actionable policy recommendation. The proposed study aims to fill this examination gap and give in depth valuable insight into the complicated interaction that exist among female labor force participation, literacy rate, and poverty.

Research Methodology

Operationalization of variables

The Poverty Headcount ratio is our Dependent variable and measured by percentage of population living under a national poverty line, as defined by country's government and relevant authority. Poverty headcount ratio will be obtained from World Development Indicators.

Female Labor Force Participation Rate is our independent variable measured by percentage of women aged 15 and above who are either employed or actively seeking employment, and data is

sourced from world development indicators (WDI). Data will be collected annually for each country included in the study Primary Completion Rate of Female is our independent variable and measured by No: of new entrants in final grade of primary education and data is sourced from WDI indicators.

This study used panel data estimation methods after conducting descriptive statistics. To handle possible shared influences across the panels, cross-sectional dependence was tested. Based on the results, 2nd-generation unit root tests were applied to ensure reliability. Evidence at the first difference indicated the need to check for panel cointegration. Diagnostic tests showed the importance of examining both short- and long-term relationships between the independent and dependent variables for a clearer understanding. This study has some missing data we fill the missing data through moving average imputation and also various data transformations techniques, such as taking the natural logarithm (ln) of variables, adding control variables, and applying square root transformations. These methods helped to normalize the data, reduce skewness, and deal with outliers effectively.

Sample Size

This study utilizes data from 30 Countries spanning from 2012 to 2023, based on data availability. Statistical analysis is conducted using Stata 18 have been used. This approach allows for a thorough examination of the variables over a substantial temporal and geographical scope, ensuring the integrity and relevance of the data. A detailed description of the data sources and variables is shown in Table 1.

Table 1: Description of Variables

<i>Variable name</i>	<i>Symbol</i>	<i>Measurement</i>	<i>Data source</i>
Poverty Headcount ratio	PHR	(HCR) is the proportion of the population that exists, or lives, below the poverty line or poverty threshold	WDI
Female Labor Force Participation Rate	FLFP	percentage of women aged 15	WDI
Primary Completion Rate of Female	PCRF	No: of new entrants in final grade of primary education	WDI
Gross Domestic Product	GDP	GDP (% of Annual)	WDI
Urbanization	URB	Urban Population (%)	WDI

Research Hypothesis

Higher female labor force participation is associated with lower poverty headcount ratios controlling other relevant factors. Especially those countries with higher levels of FLFP are expected to exhibit lower poverty rates compared to countries with lower FLFP. This hypothesis is grounded in understanding that when more female is engaged in the labor force households often benefits from increased income and economic stability. This hypothesis suggests that empowering women economically through increased FLFP can be an effective strategy for poverty reduction on a national scale.

H1: FLFP has a significant impact on PHR.

Primary completion rate of female investigates the relationship between FLFP and poverty levels. Higher literacy rates among women are hypothesized to attenuate an impact of low FLFP on poverty, those countries that have higher literacy rates even those who completed primary education among women, there will experience a weaker Poverty headcount ratio relation between FLFP and poverty compared to a country with lower literacy rate. The hypothesis proposes that highest literacy rates among women can weaken an impact of low FLFP on poverty. This is based that literate women are better equipped to access job opportunities, earn highest incomes and contribute to household welfare.

H2: PCRFB has significant impact on PHR.

Empirical model of study

$$PHR_{it} = \beta_0 + \beta_1 LFPR_{it} + \beta_2 PCRFB_{it} + \mu_{it} + C_1 GDP_{it} + C_2 URB_{it} + \mu_{it} \dots (1)$$

In the model, β represents a vector of random errors, which are assumed to be independent and exhibit homoscedasticity, with a mean of zero and constant variance. The dependent variable, PHR_{i,t}, represents the sustainable environmental performance of the ii-th country in year tt. The explanatory variables, LFPR_{i,t}, PCRFB_{i,t}, capture various influencing factors for the ii-th country in year tt. Control variables, including GDP_{i,t}, URB_{i,t}, are included with their respective coefficients represented by CC.

Analysis and Discussion

Descriptive Statistics

Table 2: Descriptive Statistics

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
PHR	300	3.231	5.102	0	30
LFPR	300	52.013	9.74	12.889	70.97
PCRFB	300	4.57	0.081	4.179	4.779
GDP	300	2.367	4.417	-18.85	18.73
URB	300	0.918	1.153	-3.694	4.001

The Table 2 provides information on several key variables, with PHR as the dependent variable (DV). The PHR shows an average of 3.231, indicating that approximately 3.23% of the population is below the poverty line, with a wide range from 0% to 30%. As independent variables (IVs), LFPR and PCRFB play important roles in explaining poverty. The LFPR has an average of 52.01%, with participation rates ranging from 12.89% to 70.97%, suggesting variability in female labor force engagement across regions. In contrast, PCRFB is relatively stable, with a mean of 4.57, ranging from 4.18 to 4.78, indicating a high rate of primary school completion among females. Other control variables include GDP which reflects economic conditions, with an average of 2.367 and a wide range from -18.85 to 18.73, highlighting economic disparities. Lastly, the URB shows a mean of 0.918 and substantial variation (from -3.69 to 4.00), pointing to differences in urban development and population distribution across the observed countries or regions. These variables collectively offer a broad view of the factors affecting poverty and female participation in the labor force and education.

Correlation and VIF

Table 3: Correlation and VIF

<i>Variables</i>	<i>PHR</i>	<i>LFPR</i>	<i>PCRF</i>	<i>VIF</i>
PHR	1			
LFPR	0.085	1		1
PCRF	-0.21	0.002	1	1

The correlation and VIF analysis reveal in Table 3 which shows key relationships between the variables in this study. The correlation between PHR and LFPR is 0.085, suggesting a very weak positive relationship, indicating that female labor force participation has a negligible impact on poverty levels. Similarly, the correlation between PHR and PCRF is -0.21, pointing to a weak negative relationship. This implies that higher female primary school completion rates are slightly associated with lower poverty, but the effect is not strong. The correlation between LFPR and PCRF is nearly zero (0.002), suggesting no significant linear relationship between female labor force participation and primary school completion rates.

Additionally, the VIF values for all variables are 1, signifying the absence of multicollinearity. This indicates that the independent variables (LFPR and PCRF) are not highly correlated with each other, and multicollinearity is not a concern in the regression analysis. Overall, the weak correlations suggest that other unexamined factors may play a more significant role in influencing poverty, and the lack of multicollinearity supports the reliability of these variables in regression modelling.

Slope of Homogeneity

Table 4: Slope of Homogeneity

Pesaran, Yamagata. 2008

<i>Test</i>	<i>Value</i>	<i>p-value</i>
Δ	2.881	0.00
Δ adjusted	3.720	0.00

Blomquist, Westerlund. 2013

<i>Test</i>	<i>Value</i>	<i>p-value</i>
Δ	2.627	0.0000
Δ adjusted	3.391	0.0000

The results from the Slope of Homogeneity tests reveals in Table 4, based on the methods proposed by Pesaran and Yamagata (2008) and Blomquist and Westerlund (2013), indicate significant heterogeneity in the slopes across the units in the data. For the Pesaran and Yamagata (2008) test, the Δ statistic of 2.881 with a p-value of 0.00 and the Δ adjusted statistic of 3.720 with a p-value of 0.00 both provide strong evidence against the null hypothesis of homogeneity, suggesting that the relationship between the dependent and independent variables varies across the units. Similarly, for the Blomquist and Westerlund (2013) test, the Δ statistic of 2.627 and the Δ adjusted statistic of 3.391, both with p-values of 0.0000, further support the conclusion of slope heterogeneity. These results indicate that the assumption of homogeneous slopes does not hold in this dataset, implying that the influence of the independent variables on the dependent variable differs across the observed units. Consequently, the findings suggest the need for more advanced

modeling techniques that account for this heterogeneity.

Cointegration

Table 5: Cointegration

<i>Cointegration</i>	<i>Statistics</i>	<i>P-value</i>	<i>Decision</i>
Pedroni Cointegration			
Modified Phillips–Perron t	3.8842	0.000	Cointegration exist
Phillips–Perron t	-5.0968	0.000	Cointegration exist
Augmented Dickey–Fuller t	-5.7694	0.000	Cointegration exist
Kao Cointegration			
Modified Dickey–Fuller t	1.8491	0.032	Cointegration exist
Dickey–Fuller t	-0.0656	0.474	Cointegration does not exist
Augmented Dickey–Fuller t	2.7998	0.003	Cointegration exist
Unadjusted modified Dickey–Fuller t	-1.6012	0.055	Cointegration exist
Unadjusted Dickey–Fuller t	-2.9704	0.002	Cointegration exist

The results of the cointegration tests in Table 5 suggest mixed evidence for the existence of cointegration among the variables, depending on the method used.

For the Pedroni Cointegration test, all three statistics—Modified Phillips–Perron t (3.8842), Phillips–Perron t (-5.0968), and Augmented Dickey–Fuller t (-5.7694)—report p-values of 0.000, which strongly reject the null hypothesis of no cointegration. This indicates that cointegration exists among the variables tested, suggesting that a long-term equilibrium relationship is present.

However, the results for the Kao Cointegration test are more varied. The Modified Dickey–Fuller t statistic (1.8491) with a p-value of 0.032 indicates cointegration, while the Dickey–Fuller t statistic (-0.0656) with a p-value of 0.474 fails to reject the null hypothesis, suggesting no cointegration. On the other hand, the Augmented Dickey–Fuller t statistic (2.7998) with a p-value of 0.003 indicates cointegration, and both the Unadjusted modified Dickey–Fuller t (-1.6012) with a p-value of 0.055 and the Unadjusted Dickey–Fuller t (-2.9704) with a p-value of 0.002 suggest the presence of cointegration as well.

Cross Sectional Dependency

Table 6: Cross Sectional Dependency

<i>Variable</i>	<i>CD-test</i>	<i>P-value</i>	<i>Average joint T</i>	<i>Mean P</i>	<i>Mean abs (P)</i>
PHR	12.882	0.000	10.00	0.2	0.45
LFPR	5.329	0.000	10.00	0.08	0.41
PCRF	0.975	0.329	10.00	0.01	0.27

The results of the Cross-Sectional Dependency (CD) test in Table 6 indicate varying levels of dependency across the variables. For PHR, the CD-test statistic is 12.882 with a p-value of 0.000, suggesting strong evidence of cross-sectional dependence. The Average joint T is 10.00, with a Mean P of 0.2 and Mean abs(P) of 0.45, indicating moderate dependency. For LFPR, the CD-test statistics are 5.329 with a p-value of 0.000, again suggesting significant cross-sectional dependence, although the Mean P of 0.08 and Mean abs(P) of 0.41 are somewhat lower than those for PHR. Finally, for PCRF, the CD-test statistic is 0.975 with a p-value of 0.329, which does not

provide evidence of cross-sectional dependence, as the p-value is greater than 0.05. The Average joint T remains 10.00, but the Mean P of 0.01 and Mean abs(P) of 0.27 further suggest that there is no significant dependency in this case. Overall, the results show that PHR and LFPR exhibit significant cross-sectional dependence, while PCRFB does not.

Unit Root Test

Table 7: Unit Root Test

<i>Variable</i>	<i>CIPS</i>		<i>CADF</i>	
	<i>I(0)</i>	<i>I(1)</i>	<i>I(0)</i>	<i>I(1)</i>
PHR	-2.787		-2.267	
LFPR	-1.823	-2.309	-2.051	
PCRFB	-2.44		-2.441	

The results of the Unit Root Test in Table 7 reveal the stationarity properties of the variables PHR, LFPR, and PCRFB at different levels. For PHR, the CIPS statistic of -2.787 indicates that it is stationary at level (I(0)), as it is below the critical value. In contrast, LFPR has a CIPS statistic of -1.823, which does not meet the stationarity condition at I(0), implying that it is non-stationary at level and requires differencing to achieve stationarity at I(1). The CADF statistic for LFPR is -2.051, confirming that it becomes stationary after differencing once. As for PCRFB, both the CIPS statistic of -2.44 and the CADF statistic of -2.441 indicate that the variable is stationary at level (I(0)). Therefore, the findings suggest that PHR and PCRFB are stationary at the level, while LFPR is stationary only after differencing, indicating a need for transformation to achieve stationarity at I(1).

GMM, Fixed Effect, Random Effect

Table 8: GMM, Fixed Effect, Random Effect

<i>Variables</i>	<i>GMM</i>	<i>Fixed Effect</i>	<i>Random Effect</i>
L.PHR	0.230*** (0.02)	-0.0521* (0.03)	0.04 (0.03)
LFPR	-0.217*** (0.02)	0.10 (1.96)	0.30 (1.94)
PCRFB	7.420*** (0.000)		

The results from the GMM model indicate in Table 8 shows significant relationships between the variables and poverty. The L.PHR has a positive and statistically significant, suggesting that past poverty levels positively influence current poverty. LFPR shows a negative and significant relationship with poverty, indicating that higher female Labor force participation tends to reduce poverty. Additionally, PCRFB has a strong positive and significant effect, suggesting that an increase in female primary school completion is associated with a significant reduction in poverty.

In contrast, the Fixed Effect model presents different findings. For L.PHR, the effect is negative and statistically significant, showing that past poverty levels have a slight negative influence when individual heterogeneity across units is considered. The coefficient for LFPR is positive but insignificant, suggesting no significant effect on poverty when controlling for individual effects. Similarly, PCRFB is not significant in the Fixed Effect model, indicating no substantial impact. Finally, the Random Effect model also provides mixed results. The L.PHR coefficient is positive

but insignificant. For LFPR, the relationship is positive but not statistically significant. Like the Fixed Effect model, the Random Effect model shows no significant relationship for PCRFB, further suggesting that model choice can heavily influence the interpretation of the results.

Quantile Regression

Table 9: Quantile Regression

<i>Variables</i>	<i>0.20</i>	<i>0.40</i>	<i>0.60</i>	<i>0.80</i>
LFPR	-0.00118 (0.007)	0.00067 (0.0109)	0.0184 (0.0216)	0.0877* (0.0531)
PCRFB	12.46*** (0.001)	14.93*** (0.004)	17.07*** (0.002)	9.554 (6.381)

The results from the Quantile Regression analysis in Table 9 provide a more nuanced understanding of the relationships between LFPR and PCRFB at various points in the poverty distribution. This method allows us to observe how these variables impact poverty across different quantiles, offering robustness against the potential heterogeneity in the data. For LFPR, the effect on poverty is small and insignificant at the lower quantiles (0.2 and 0.4), but becomes more pronounced and statistically significant at the 0.8 quantile, suggesting that the positive impact of female labor force participation on poverty reduction is stronger at higher poverty levels. This result highlights how the influence of LFPR may vary, especially at the more extreme end of poverty, where changes in female labor force participation have a more significant role.

Regarding PCRFB, the results indicate a consistent and strong positive impact on poverty reduction at the lower to middle quantiles (0.2, 0.4, and 0.6), with coefficients of 12.46, 14.93, and 17.07, all statistically significant at the 1% level. However, at the 0.8 quantile, the effect diminishes, and the coefficient (9.554) is not statistically significant, suggesting that the positive relationship between female education and poverty reduction weakens as poverty levels increase. These findings demonstrate the robustness of Quantile Regression, as it captures the varying impact of key factors like labor force participation and education across the poverty distribution, emphasizing how policy interventions may have differential effects at different poverty levels.

Conclusions and Recommendations

Based on the results of this study, it is clear FLFP and educational attainment, specifically the primary completion rate for females, play a pivotal role in reducing poverty. The analysis demonstrates that as more women enter the workforce, household income increases, leading to improved economic stability and reduced poverty levels. This reinforces the idea that increasing FLFP can be a powerful tool in combating poverty. Furthermore, the study reveals that the higher literacy rates among women can further enhance the positive impact of their workforce participation on poverty reduction. These findings highlight the importance of investing in women’s education as a means to empower them and promote long-term economic development.

This study also underscores the need for targeted policy interventions that address gender inequality in education and employment. By improving access to education and ensuring more opportunities for women in the labor market, countries can significantly reduce poverty levels. The results provide robust evidence that empowering women through both education and employment opportunities not only benefits individual households but also contributes to the creation of more equitable and prosperous societies.

This study has some recommendations for researchers. This study recommends further exploration into the intricate dynamics between FLFP, education, and poverty across different regions, considering the variations in cultural, economic, and social contexts. Institutions should focus on expanding educational programs that target girls and young women, emphasizing skill development that aligns with market demands to increase employability. For government policymakers, the study advises prioritizing policies that not only promote gender equality in education but also create a conducive environment for female workforce participation by addressing structural barriers such as discrimination, gender biases, and limited childcare support. Additionally, governments should invest in programs that enhance women's access to decent work opportunities, ensuring that employment conditions are fair and contribute meaningfully to poverty alleviation. These combined efforts will help create a more inclusive, prosperous, and equitable society.

Limitations

This study explores the relationship between technological, financial, and energy factors and PHC across 30 countries, offering valuable insights. However, it has some limitations. At the same time, the analysis spans a wide range of nations, which could provide a more nuanced understanding of PHC determinants. Future research could focus on comparing economic groups or regions to uncover unique dynamics shaping PHC. Sector specific studies, such as in energy, agriculture, or manufacturing, could offer deeper insights.

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