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Examining the Impact of Literacy Rate and Educational Expenditure on Economic Growth of Pakistan

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ABSTRACT

This study investigated the impact of Literacy Rate (LRT), Literacy Rate Male (LRMt), Literacy Rate Female (LRF_f) and Educational Expenditure (EE_i) on (GDPT) of Pakistan's economy for the sample period 2003-04 to 2023-24. Augmented Dickey Fullert (ADF) Test found that tested dependent variable (i.e GDP) is termed as stationary at level I(0) only, whereas the rest of independent variables are termed as stationary after applying 1st differencing. Findings of Ordinary Least Square (OLS) and Auto-regressive distributed model revealed the positive and significant impact of Literacy Rate of Male upon economic growth of Pakistan. Bound test indicated long run association among variables in the model. The value of the Error Correction Value is worked out as -0.71 termed statistically significant revealing convergence status from short run dynamics towards long run adjustments in the model. Variance Inflation Factor (VIF) indicated absence of severe multicollinearity, Heteroscedasticity Test, Lagrange Multiplier (LM) Test, Normality Test, Granger Causality Test and Wald Test confirmed stability of model. The study conclude that literacy rates male and female proportion and its educational expenditure witnessed significant influence on economic growth through reduction of poverty, efficient use of innovation and meaningful participation in the labour market. Educated community being skilled human asset of the economy would be instrumental for driving advance technology in competitive global economy for the promotion of economic growth.

Introduction

Pakistan has altogether ignored literacy and educational status, which is instrumental element for the success story of any nation; which resulted in lowest literacy rate in world ranking 113 in a total of 120 countries. This is indeed alarming situation for the economic growth of country (Rehman et al., 2025).

The study revealed long-run association between education and economic growth when poverty acts as dependent variable aimed at measuring economic growth of Pakistan. The findings provided that educational status does affect growth in the long term but not in short term revealing continuing positive impact on the education of the population (Batul et al., 2019).

The results indicate that poverty is reduced by 0.75 per cent due to one per cent increase in the literacy rate. Moreover, short run relationship between poverty and literacy rate is investigated with VECM and found no relationship in the short run (Ahmad et al., 2019).

Formulation of Literacy and Health Policy was to improve the literacy rate, primary school enrollment rate, and death rate so as to sustain economic growth, especially in the developing nations (Wen, 2024). Highly educated population aimed at reducing income inequality, strengthening economic resilience and help promoting long-term prosperity in Pakistan (Ullah et al., 2025). Apsilyam and Ashrapova (2025) elaborated the significance of integrating digital literacy into educational practices. Improving digital skills is vital for competitiveness, innovation and sustainable economic growth.

Research Question

Cause and effect of Literacy Rate (LR_t), Literacy Rate Male (LRM_t), Literacy Rate Female (LRF_t) and Educational Expenditure (EE_t) upon economic growth.

Research Objective

The present study contained following research objective;

Assess the effectiveness of Literacy Rate (LR_t), Literacy Rate Male (LRM_t), Literacy Rate Female (LRF_t) and Educational Expenditure (EE_t) on economic growth of Pakistan.

Problem Statement

The study will explore findings pertaining to effectiveness of Literacy Rate (LR_t), Literacy Rate Male (LRM_t), Literacy Rate Female (LRF_t) and Educational Expenditure (EE_t) in relationship with economic growth of Pakistan over period of time 2003-04 to 2023-24.

Methodology

The impact of Literacy Rate (LR_t), Literacy Rate Male (LRM_t), Literacy Rate Female (LRF_t) and Educational Expenditure (EE_t) on Pakistan's GDP growth rate have been evaluated using time series data sets from 2003-04 to 2023-24 from reliable bases (such as Pakistan Economic Surveys). In this regard, econometric approaches have been utilized such as Augmented Dickey-Fuller (ADF) Test for Unit Root (Dickey and Fuller, 1981), Ordinary Least Square (OLS) Regression also used to describe the link between variables, Autoregressive Distributed lag (ARDL) Model to look into co-integrating relationships between variables, Bounds Test to

examine long run association, Error Correction Mechanism (ECM) for making adjustment from short term dynamics towards long term equilibrium state (Pesaram and Shin, 1998), Variance Inflation Factors (VIF) to confirm the possibility of Multicollinearity, Heteroskedasticity Test to pin point the presence of heterogeneity, Lagrange Multiplier (LM) Test to observe Serial Correlation/ Autocorrelation, Normality test to review whether sample data set to be drawn normally from distributed population or not, Granger Causality Test to verify the efficacy of one factor to forecast another (Perron, 1990: Pesaran and Shin, 1998). At the end, Wald test has also been applied to confirm whether a set of independent variables are individually or in combined manner found significant for a model or not. EViews, being appropriate statistical package was used for such data analysis throughout study.

Model Specification

Model of Ahad (2017) implemented to measure the effectiveness of Literacy Rate (LR_t), Literacy Rate Male (LRM_t), Literacy Rate Female (LRF_t) and Educational Expenditure (EE_t) on GDP growth rate of Pakistan's economy. The empirical log linear model form in the shape of natural logarithmic function is representatively articulated in equation i as;

$$\text{LogGDP}_t = \alpha_0 + \alpha_1 LR_t + \alpha_2 LRM_t + \alpha_3 LRF_t + \alpha_4 EE_t + \epsilon_t \dots\dots\dots(i)$$

Where,

GDP_t = GDP Growth Rate of Pakistan in year t.

α_0 = Intercept

$\alpha_1, \alpha_2, \alpha_3$ and α_4 = Co-efficients

LR_t = Literacy Rate (%) in year t.

LRM_t = Literacy Rate Male (%) in year

LRF_t = Literacy Rate Female (%) in year

EE_t = Educational Expenditure (%) in year

ϵ_t = Error term in year t.

Results and Discussions

Unit Root Test for Variables: Augmented Dickey-Fuller (ADF) Test confirmed that dependent variable ($LGDP_t$) was found stationary at level $I(0)$ sequence of integration, whereas rest of other independent variables (LR_t, LRM_t, LRF_t and EE_t) are termed stationary at 1st difference at level $I(1)$ as reflected in Table-1.

Table 1: Unit Root Test of Variable (LR_t, LRM_t, LRF_t and EE_t)

Variables	ADF(Levels)		ADF with 1 st Differences		Integration order
	Intercept	Intercept and Trend	Intercept	Intercept and Trend	
GDP_t	-3.76	-3.95	-6.80	-6.79	$I(0)$
LR_t	-2.21	-2.81	-5.58	-6.16	$I(1)$
LRM_t	-2.95	-3.88	-6.93	-5.19	$I(1)$
LRF_t	-1.49	-4.58	-6.56	-6.76	$I(1)$
EE_t	-1.22	-1.16	-5.12	-5.49	$I(1)$

Note: Variables with log-linear estimates;

Critical values at 95 percent=-2.98(Non-existence of Intercept & Trend); and

Critical values at 95 percent=-3.60(Existence of Intercept & Trend)

Table 2: Ordinary Least Square of Variable (LR_t , LRM_t , LRF_t and EE_t)

Response Variable: GDP				
Method: OLS				
Sample: 2004 2024				
Included observations: 21				
Variables	Coefficient	Std. Error	t-Statistic	Probability
Literacy Rate (LR)	-0.156	0.597	-0.262	0.796
Literacy Rate Male (LRM)	0.568	0.220	2.579	0.020**
Literacy Rate Female (LRF)	-0.478	0.405	-1.180	0.255
Education Expenditure (EE)	-1.248	1.825	-0.684	0.503
C	-0.860	14.089	-0.061	0.952
R-squared	0.480	Durbin-Watson stat		1.692
Adjusted R-squared	0.351			
F-statistic	3.706			
Probability (F-Stat.)	0.027**			

**Significance level at 5%

The following is the computed econometric equation to evaluate the long-term effects of Literacy Rate (LR_t), Literacy Rate Male (LRM_t), Literacy Rate Female (LRF_t) and Educational Expenditure (EE_t) on Pakistan's GDP Growth Rate:

$$LGDP_t = \alpha_0 - 0.156^* LR_t + 0.568^* LRM_t - 0.478^* LRF_t - 1.248^* EE_t \text{ -----(ii)}$$

Table-2 showed that, from 2003-04 to 2023–24, the GDP Growth Rate of Pakistan ($LGDP_t$) was positively and significantly impacted by Literacy Rate Male (LRM_t). According to Table-2, the R square value is 0.48 indicated that independent variables (LR_t , LRM_t , LRF_t and EE_t) are predicting 48 percent variation in the dependent variable. The calculated F-Stat. value is 3.71 ($P > 0.05$), indicating the model's overall unfitness and total combined effects. Additionally, DW (1.69) falls within the permitted range of 1.5 to 2.5 confirming nonexistence of autocorrelation in the model.

Table 3: Auto-Regressive Distributed Lags Model for Variables (LR_t , LRM_t , LRF_t and EE_t)

Response Variable: Log(GDP)				
Method: ARDL (1, 2, 1, 1, 1)				
Sample data set: 2006 to 2024				
Counted observations after adjustments: 19				
Variable(s)	Coefficient(s)	Stand. Error	t-Stat.	Prob.*
GDP(-1)	-0.031	0.220	-0.143	0.889
LR	-0.630	0.585	-1.076	0.313
LR(-1)	-1.429	0.551	-2.591	0.032**
LR(-2)	-0.903	0.348	-2.592	0.032
LRM	0.672	0.159	4.209	0.003*
LRM(-1)	0.284	0.210	1.352	0.213
LRF	0.542	0.653	0.830	0.430
LRF(-1)	0.966	0.522	1.848	0.101***
EE	1.059	2.245	0.471	0.649
EE(-1)	-3.037	2.135	-1.422	0.192
C	42.93	19.528	2.198	0.059

R ²	0.838	Durbin Watson Stat. (DW)	1.449
Adjusted R ²	0.635		
F-Statistics	4.140		
Probability(F-stat)	0.027**		

*Significance level at 1%

**Significance level at 5%

***Significance level at 10%

Perusal of Table-3 revealed that probability value of Literacy Rate Male and lag values of Literacy Rate Female impacted positive and significant influence, whereas lag values of Literacy Rate impacted GDP Growth Rate of Pakistan negatively and significantly. Hence, ARDL confirmed examination of co-integrating link between variables (LR_t , LRM_t , LRF_t and EE_t) in the model.

Table 4: Bound Test for the estimation of long run relationships of Variables (LR_t , LRM_t , LRF_t and EE_t)

ARDL Bounds Test		
Sample: 2006 2024		
Included observations: 19		
HO: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	6.076581	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

HO= Non-Existence of Long Run Relationships between variables

HI = Existence of Long Run Relationships between variables

Table-4 revealed results of Bound Test wherein that value of F statistics is worked out 6.1, greater than the 5% significance value upper bound limit, hence the variables in the model are termed as significant.

Table 5: Error Correction Mechanism for short run relationships and long run adjustment of Variables (LR_t , LRM_t , LRF_t and EE_t)

Dependent Variable: D(GDP)				
Method: Least Squares				
Sample (adjusted): 2005-2024				
Included observations: 20 after adjustments				
Variable	Coefficient	Std. Error	t-Stat.	Prob.
C	-0.043	0.411	-0.104	0.918
D(LR)	0.924	0.427	2.164	0.048**
D(LRM)	0.411	0.122	3.347	0.004*
D(LRF)	-1.164	0.459	-2.532	0.023**
D(EE)	-0.380	2.392	-0.159	0.875
ECT(-1)	-0.710	0.234	-3.034	0.008*
R	0.7540	Durbin-Watson		1.566

Adjusted R ²	0.666	statistics	
F-stat.	8.584		
Prob(F-stat.)	0.000*		

*Significance level at 1%

**Significance level at 5%

According to Table-5, the co-integrating equation value is found negative (-0.71) and statistically significant revealing convergence from short-term dynamics to long-term equilibrium.

Table 6: Variance Inflation Factors for perusing the presence of Multicollinearity for variables (LR_t , LRM_t , LRF_t and EE_t)

Variance Inflation Factors			
Sample: 2004 2024			
Included observations: 20			
Variables	Co-efficient Variance	Un-centered VIF	Centered VIF
C	0.168971	1.185572	NA
D(LR)	0.182466	3.623765	3.433999
D(LRM)	0.015089	1.234490	1.233090
D(LRF)	0.211329	3.509718	3.027966
D(EE)	5.724047	1.124545	1.120529
ECT(-1)	0.054776	1.172960	1.171100

Table 6 provided that Centered VIF values of all variables (LR_t , LRM_t , LRF_t and EE_t) are found less than 10 confirming nonexistence of severe multicollinearity in the model.

Table 7: Heteroskedasticity Test for variable (LR_t , LRM_t , LRF_t and EE_t)

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.411571	Prob. F(5,14)	0.8329
Obs*R-squared	2.563050	Prob. Chi-Square(5)	0.7670
Scaled explained SS	0.836385	Prob. Chi-Square(5)	0.9747

Null Hypothesis: No Heteroscedasticity

Alternate Hypothesis: Heteroscedasticity

Table-7 provided that P value of F-Statistics and Chi-square are found greater than 5% significance level, hence HO Hypothesis is accepted revealing existence of homoskedasticity in the model.

Table 8: Lagrange Multiplier (LM) Test for checking Serial Correlation/ Autocorrelation of variables (LR_t , LRM_t , LRF_t and EE_t)

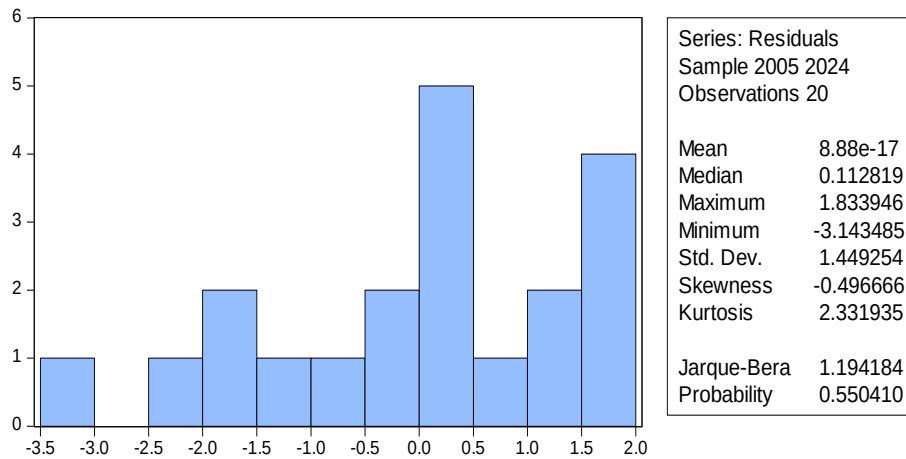
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.741796	Prob. F(2,12)	0.4969
Obs*R-squared	2.200590	Prob. Chi-Square(2)	0.3328

HO: No serial correlation between variables

H1: Serial correlation between variables

Since the P values of all tested variables (LR_t , LRM_t , LRF_t and EE_t) are found greater than 5% significance level in Table-8, hence HO is accepted revealing absence of serial correlation in the model.

Figure 1: Normality Test for variables (LR_t , LRM_t , LRF_t and EE_t)



HO: Sample data drawn from normally distributed population

HI: Sample data not drawn from normally distributed population

Since the P value of Normality Test (0.60) was found greater than 5% significance level as reflected in Figure-1, hence Null Hypothesis is accepted, confirming normal distribution in the model.

Table 9: Granger Causality Test for variables (LR_t , LRM_t , LRF_t and EE_t)

Granger Causality Test			
Sample: 2004 -2024			
Lags: 2			
HO:	Observations	F-Stat.	Probability
LR did not Granger Cause GDP	19	2.63642	0.1067
GDP did not Granger Cause LR		1.39387	0.2805
LRM did not Granger Cause GDP	19	1.48326	0.2605
GDP did not Granger Cause LRM		5.06182	0.0222**
LRF did not Granger Cause GDP	19	1.67433	0.2229
GDP did not Granger Cause LRF		0.24576	0.7854
EE did not Granger Cause GDP	19	0.56281	0.5820
GDP did not Granger Cause EE		2.17701	0.1502
LRM did not Granger Cause LR	19	0.05278	0.9488
LR did not Granger Cause LRM		1.24736	0.3173
LRF did not Granger Cause LR	19	1.26702	0.3121
LR did not Granger Cause LRF		0.59842	0.5631
EE did not Granger Cause LR	19	1.37487	0.2850
LR did not Granger Cause EE		0.25537	0.7782
LRF did not Granger Cause LRM	19	1.58762	0.2391
LRM did not Granger Cause LRF		0.08953	0.9149
EE did not Granger Cause LRM	19	1.47221	0.2629
LRM did not Granger Cause EE		0.70070	0.5128
EE did not Granger Cause LRF	19	0.05533	0.9464
LRF did not Granger Cause EE		0.40560	0.6742

**Significant at 5%

Table 9 confirmed uni-directional causal association between GDP and Literacy Rate Male ($P < 0.05$), whereas nonexistence of causality witnessed between rests of paired variables in the model.

Table 10: Wald Test for variables (LR_t , LRM_t , LRF_t and EE_t)

Wald Test:			
Test Statistics	Value(s)	df	Prob.
F-statistic	3.706424	(4, 16)	0.0255**
Chi-square	14.82570	4	0.0051*
HO: C(1)=0,C(2)=0,C(3)=0,C(4)=0			
HO Summary:			
Normalized Restriction (=0)	Value(s)	Standard Error	
C(1)	-0.156801	0.597330	
C(2)	0.568373	0.220344	
C(3)	-0.478971	0.405887	
C(4)	-1.248774	1.825171	
Restrictions are linear in coefficients.			

*Significance level at 1%

**Significance level at 5%

Wald Test results indicated the P values at F-test and Chi-Square were found less than 5% significance level as shown in Table-10, it means HO of assuming the values of explanatory variables is zero (0) is rejected, confirming significant status of independent variables in a model.

Conclusion

The study arrived at logical conclusion that literacy rates in respect of male significantly contributing more as compared to female proportion and its educational expenditure witnessed insignificant influence on economic growth, which may need to be expanded so necessary for accelerating aggregate demand and for promotion of economic growth in Pakistan's economy. It has been proved that educated community members being skilled human asset of the economy, will play vital role in sustaining economic growth through effective implementation of advanced technology in such a competitive and dynamic world economy.

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