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Empirical Analysis of Health Infrastructure, Health Expenditure and Economic Growth: A Case Study of Pakistan

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ABSTRACT

The present study was aimed at investigating empirical analysis of health infrastructure in terms of Hospital (Ht), Dispensary Unit (DUt), Rural Health Centre (RHCt), Health Expenditure and economic growth (GDPt) over a period of time 2003-04 to 2023-24. Augmented Dickey Fullert (ADF) Test found that tested dependent variable (i.e GDPt) was termed as stationary at level I(0) only, whereas the rest of independent variables (Ht, DUt, RHCt and HEt) were termed as stationary after applying 1st differencing. Findings of Ordinary Least Square (OLS) impacted positive influence and Auto-regressive distributed model revealed the positive and significant impact of Health Expenditure, negative impact of Hospital at lag(-2) and positive impact of Rural Health Centre at lag(-1) 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 -0.59 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 and Granger Causality Test termed significance of model. The study concluded that provision of health infrastructure and incurring expenditure significantly boosted economic growth by improving human capital and creation of job opportunities. Investments in health sector leads to maintain skilled and professionally capable workforce, resulting in reducing disruptions and increasing labor force participation.

Introduction

Population dynamics influenced the Pakistan's health, and health expenditures are progressive, though few categories at regional and provincial levels showing regressive flow. In this respect, in the presence of governmental machinery and influence, private sector plays a vital and significant role in provision of health services to the community (Ahmad, 2024).

It is an established fact that public health expenditure and economic development influencing each other positively in South Asian countries, while impact of economic growth to health expenditure is found higher than linking health expenditure to economic growth. This study put forward two way flow of causality running in-between health policy and economic growth, long run sustainable economic growth can be achieved (Waseem et al., 2023).

It has been noticed from existing literature that there is existence of long-run association between health spending and economic growth of African countries. Hence African economies were counseled to accomplish the Abuja target when socio-political and economic factors are efficiently operating in such economies (Piabuo and Tieguhong, 2017).

It has been observed that indicators such as fertility rate, life expectancy and investment on health sectors have affected GDP. The results revealed that Health expenditures witnessed positive but in-significant impact on growth. While there is negative association of infant mortality rate, per head population on economic growth. The fundamental policy implication suggested appropriate level of investment on health sector would help in boosting long lasting economic growth (Raza et al., 2013).

It is evident from past findings that both education expenses at governmental level and incurring health expenditures in relationship with economic growth were termed as positive and statistically significant. While, insignificant influence noticed in case of private health expenditures, inflation and population in relationship with economic growth rate. It was emphasized the need for policymakers to ensure allocation of ample resources to both the health and education sectors so as to meet the aim of sustaining economic growth of economy (Kousar et al., 2020).

Previous findings of literature found long-run relationships between health expenditures and economic growth. As far as South Asian countries are concerned, which have been witnessing uni-directional causality between health expenditures and economic growth, whereas on the other hand, East Asian countries have not been exhibiting any causal relationship between these two variables. Health expenditures impacted positive, but significant influence on economic growth in South Asian countries (Hameed et al., 2025).

Research Question

Cause and effect of Health Infrastructure and Health Expenditure in connection with economic growth of Pakistan.

Research Objective

The present study contained following research objective;

Assess the effectiveness of health infrastructure in terms of Hospital (H_t), Dispensary Unit (DU_t), Rural Health Centre (RHC_t) and Health Expenditure in relationship with economic growth of Pakistan.

Problem Statement

The study will explore findings pertaining to effectiveness of Health Infrastructure and Health Expenditure in relationship with economic growth of Pakistan over period of time 2003-04 to 2023-24.

Methodology

The impact of Hospital (*Ht*), Dispensary Unit (*DUt*), Rural Health Centre (RHC_t) and Health Expenditure (HE_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 t(ADF) Test for Unit Root (Dickey and Fuller, t1981), 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 t(ECM) for making adjustment from short term dynamics towards long term equilibrium state (Pesaram and Shin, t1998), Variance Inflation Factors t(VIF) to confirm the possibility of Multicollinearity, Heteroscedasticity Test to pin point the presence of heterogeneity, Lagrange Multiplier t(LM) Test to observe Serial Correlation/ Autocorrelation, Normality test to review whether sample data set to be drawn normally from distributed population tor not, Granger Causality Test to verify the efficacy of tone factor to forecast another (Perron, 1990: Pesaran and Shin, t1998). EViews, being appropriate statistical package was used for such data analysis throughout study.

Specification of Model:

Model of Ahad (2017) implemented to measure the effectiveness of health infrastructure in terms of Hospital (H_t), Dispensary Unit (DU_t), Rural Health Centre (RHC_t) and Health Expenditure in relationship with economic growth of Pakistan. The empirical log linear model form in the shape of natural logarithmic function is representatively articulated in equation i as;

$$LogGDPt = \alpha 0 + \alpha 1\ Ht + \alpha 2\ DUt + \alpha 3\ RHCt + \alpha 4\ HEt + et \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Where,

GDPt = GDP Growth Rate of Pakistan in year t.

α0 = Intercept

α1, α2, α3 and α4= Co-efficients

Ht = Hospital (Nos.) in year t.

DUt= Dispensary Unit Nos.) in year t.

RHCt= Rural Health Centre (Nos.) in year

HEt= Health Expenditure (%) in year

et = Error term in year t.

Results and Discussion

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 (H_t, DU_t, RHC_t and HE_t) are termed stationary at 1st difference at level I(1) as reflected in Table-1.

Table-1: Unit Root Test of Variable (H_t, DU_t, RHC_t and HE_t)

Variables	ADF(Levels)		ADF with 1st Differences		Integration order
	Intercept	Intercept and Trend	Intercept	Intercept and Trend	
GDP_t	-3.76	-3.95	-6.80	-6.79	I(0)
H_t	-0.69	-1.20	-3.74	-3.67	I(1)
DU_t	-1.15	-0.38	-2.78	-2.95	1(1)
RHC_t	-0.13	-3.32	-5.96	-6.05	1(1)
HE_t	-1.77	-2.99	-6.42	-6.24	1(1)

Note: Variables with log-linear estimates;

Critical values at 95 percent=-3.02(Non-existence of Intercept & Trend); and

Critical values at 95 percent=-3.67(Existence of Intercept & Trend)

Table-2: Ordinary Least Square of Variable (H_t, DU_t, RHC_t and HE_t)

Dependent Variable: GDP				
Method: Least Squares				
Sample: 2004 2024				
Included observations: 21				
Variable(s)	**Coefficient(s)**	**Standard Error**	**t-Statistics**	**Probability**
Hospital (H)	-0.020	0.023	-0.857	0.403
Dispensary Unit (DU)	4.266	5.276	0.808	0.430
Rural Health Centre (RHC)	-0.014	0.019	-0.747	0.465
Health Expenditure (HE)	5.815	3.771	1.542	0.142
C	9.561	9.793	0.976	0.343
R^2	0.287			
Adjusted R^2	0.109			
F-statistics	1.614			
Prob(F-statistics)	0.219	Durbin-Watson Statistics		1.723

Table-2 showed that, from 2003-04 to 2023–24, the GDP Growth Rate of Pakistan ($LGDP_t$) was positively impacted by Dispensary Units and Health Expenditure and negatively influenced by Hospital and Rural Health Centres on economic growth of Pakistan. The value of Durbin Warson worked out as 1.7, which lies in 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 (*H_t, DU_t, RHC_t and HE_t*)

Dependent Variable: GDP				
Method: ARDL (1, 2, 2, 2, 2)				
Sample (adjusted): 2006 2024				
Included observations: 19 after adjustments				
Fixed regressors: C				
Number of models evaluated: 81				
Variable(s)	Coefficient(s)	Std. Error	t-Statistics	Probability*
GDP(-1)	0.464	0.271	1.707	0.148
H	-0.086	0.036	-2.366	0.064***
H(-1)	-0.104	0.056	-1.850	0.123
H(-2)	0.067	0.028	2.346	0.065***
DU	-0.828	6.864	-0.120	0.908
DU(-1)	11.861	10.175	1.165	0.296
DU(-2)	32.151	16.790	1.914	0.113
RHC	0.057	0.031	1.847	0.124
RHC(-1)	0.071	0.028	2.537	0.052***
RHC(-2)	-0.171	0.068	-2.510	0.053***
HE	8.000	3.507	2.280	0.071***
HE(-1)	-2.331	4.493	-0.518	0.626
HE(-2)	-8.925	4.286	-2.082	0.091***
C	-57.057	20.776	-2.746	0.040
R-squared	0.860			
Adjusted R-squared	0.498			
F-statistic	2.373			
Prob(F-statistic)	0.174	Durbin-Watson Stat.		2.131
*Note: p-values and any subsequent tests do not account for model				

****Significant at 10%*

Perusal of Table-3 revealed that Auto-regressive distributed model revealed the positive and significant impact of Health Expenditure, negative impact of Hospital at lag(-2) and positive impact of Rural Health Centre at lag(-1) upon economic growth of Pakistan. Hence, ARDL confirmed examination of co-integrating link between variables (*H_t, DU_t, RHC_t and HE_t*) in the model.

Table-4: Bound Test for the estimation of long run relationships of Variables (*H_t, DU_t, RHC_t and HE_t*)

ARDL Bounds Test		
Sample: 2006 2024		
Included observations: 19		
HO: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	4.336971	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 4.3, 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 (H_t, DU_t, RHC_t and HE_t)

Dependent Variable: D(GDP)				
Method: Least Squares				
Sample (adjusted): 2007 2024				
Included observations: 18 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.049148	0.969061	0.050717	0.9604
D(H)	0.009540	0.035757	0.266812	0.7941
D(DU)	0.796723	8.021376	0.099325	0.9225
D(RHC)	-0.039474	0.031587	-1.249678	0.2352
D(HE)	1.166753	4.497349	0.259431	0.7997
ECT(-1)	-0.593592	0.944682	-0.628352	0.5415
R-squared	0.187975			
Adjusted R-squared	-0.150369			
F-statistic	0.555572			
Prob(F-statistic)	0.732006	Durbin-Watson stat		2.312431

According to Table-5, the co-integrating equation value is found negative (-0.59) and statistically insignificant revealing partial convergence from short-term dynamics towards long-term equilibrium.

Table-6: Variance Inflation Factors for perusing the presence of Multicollinearity for variables (H_t, DU_t, RHC_t and HE_t)

Variance Inflation Factors			
Sample: 2004 2024			
Included observations: 18			
Variable(s)	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.939080	1.660827	NA
D(H)	0.001279	2.904654	2.049720
D(DU)	64.34247	1.643692	1.292476
D(RHC)	0.000998	1.639376	1.358740
D(HE)	20.22615	2.066788	2.049123
ECT(-1)	0.892424	1.017786	1.017371

Table-6 provided that Centered VIF values of all variables (*H_t, DU_t, RHC_t and HE_t*) are found less than 10 confirming non-existence of severe multicollinearity in the model.

Table-7: Heteroskedasticity Test for variable (*H_t, DU_t, RHC_t and HE_t*)

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.534951	Prob. F(5,12)	0.7464
Obs*R-squared	3.280843	Prob. Chi-Square(5)	0.6568
Scaled explained SS	2.866901	Prob. Chi-Square(5)	0.7205

HO: No Heteroscedasticity

H1: 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 (*H_t, DU_t, RHC_t and HE_t*)

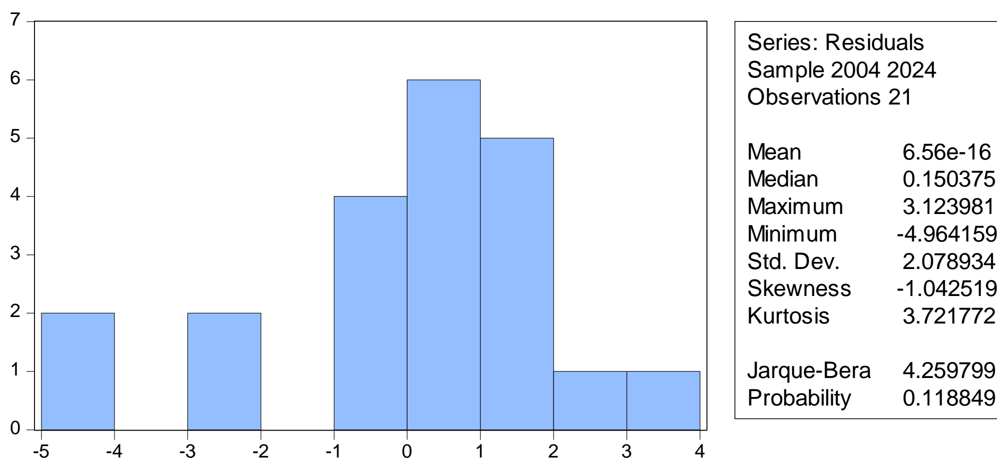
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.945071	Prob. F(2,14)	0.4121
Obs*R-squared	2.497963	Prob. Chi-Square(2)	0.2868

HO: No serial correlation between variables

H1: Serial correlation between variables

Since the P values of all tested variables (*H_t, DU_t, RHC_t and HE_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 (*H_t, DU_t, RHC_t and HE_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 (0.11) 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 (*H_t, DU_t, RHC_t and HE_t*)

Granger Causality Techniques			
Sample: 2004 2024			
Lags: 2			
HO:	Obs	F-Statistic	Prob.
H shall not Granger Causing GDP	19	0.39803	0.6790
GDP shall not Granger Causing H		0.20988	0.8132
DU shall not Granger Causing GDP	19	1.82127	0.1981
GDP shall not Granger Causing DU		0.51301	0.6095
RHC shall not Granger Causing GDP	19	2.38313	0.1286
GDP shall not Granger Causing RHC		1.80342	0.2010
HE shall not Granger Causing use GDP	19	1.12633	0.3519
GDP shall not Granger Causing HE		0.74244	0.4938
DU shall not Granger Causing H	19	8.07297	0.0047*
H shall not Granger Causing DU		1.29871	0.3038
RHC shall not Granger Causing H	19	0.56608	0.5802
H shall not Granger Causing RHC		0.44140	0.6518
HE shall not Granger Causing H	19	10.8765	0.0014*
H shall not Granger Causing HE		3.78665	0.0485**
RHC shall not Granger Causing DU	19	0.05550	0.9462
DU shall not Granger Causing RHC		0.13938	0.8711
HE shall not Granger Causing DU	19	0.74131	0.4943
DU shall not Granger Causing HE		3.78763	0.0484**
HE shall not Granger Causing RHC	19	0.31994	0.7314
RHC shall not Granger Causing HE		3.26556	0.0685***

**Significant at 1%*
***Significant at 5%*
****Significant at 10%*

Table-9 confirmed uni-directional causal association between Dispensary Unit and Hospital (P<0.01), between Dispensary Unit and Health Expenditure (P<0.05) and bi-directional causality running between Health Expenditure and Hospital (P<0.01), whereas non existence of causality witnessed between rests of paired variables in the model.

Conclusion

The study arrived at logical conclusion that infrastructural improvement of Health in terms of standard Hospitals, well functional Dispensary Units and sound operational set up of Rural Health Centres and proper investments on health are positively correlated in relation with its effectiveness upon economic growth. In this regards, productive and skilled manpower as human capital were instrumental in ensuring long lasting economic growth. Additionally, investments made by governmental machinery and private sector in health would help increase health indicators and improve labor force quality services.

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