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Vicious Circle of Health Expenditure: Time Series Evidence from Pakistan

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ABSTRACT

Healthy workers determine the economic growth of a nation like Pakistan. Without healthy workers, nations never gain high productivity. In this study, the term 'Vicious Circle of Health Expenditure" was used. The "vicious circle of health" is a concept that defines a self-reinforcing cycle of deprived health leading to additional negative health consequences and social shortcomings and disadvantages. The major objective of this study, to find, how and why Pakistani workers' productivity low than many developing countries. For this purpose, we used five variables: health expenditure is dependent, while GDP per capita, employment, education expenditure, and trade are independent variables. Time series data was used, and the data range was 1972-2021. The econometric technique ARDL is used for long-run association. Therefore, the current study finds, mostly significant results. Pakistan GDP per capita and employment are statistically significant and have a positive impact on health expenditure. While education expenditure and trade have a statistically negative impact on health expenditure, Therefore, a statistically significant and negative coefficient (-0.98) indicates the short-run equilibrium converges to the long-run equilibrium. The study suggests, government of Pakistan increase the health budget as well as improve access to healthcare and enhance social support systems.

1 Introduction

Pakistan is included in those countries that are facing a number of issues, and indeed, health issues are one of them. The low health expenditure is creating a number of other issues in Pakistan. Pakistan has faced numerous health crises and challenges throughout the period, spanning from the 1970s to pre-Covid-19. Here are a few severe health crises that have occurred in Pakistan during this period: malaria, polio, dengue fever, HIV/AIDS, and tuberculosis (Warraich et al., 2011; Abdullah et al., 2014). COVID-19 shows health issues all over the world, including Pakistan. Therefore, it is also indicated that the world be prepared for these types of pandemics and improve its health activities, facilities, and expenditures. when the world spends billions of dollars on health and protects people from pandemics. Despite this, Pakistan's budget for the fiscal year 2020-2021 only included $151 million for health, which is too low as compared to neighbouring countries. Therefore, according to the projected health budget for 2022-2023 issued by the Pakistani Ministry of Finance in June 2022, PKR 12.7 billion would be allotted to public healthcare services, a drop from the predicted PKR 13.3 billion allotted in the 2021-2022 period (Economics Survey of Pakistan, 2021-2022; 2022-23). The

natural disasters also generate health problems year after year. In Sindh Province, there have been reports of over 44000 malaria cases, 4319 dengue cases, 605839 cases of diarrhoea, and 666370 instances of skin illnesses from January to October 5, 2022 (Kanwal, 2022). Therefore, the National Disaster Management Authority (NDMA) reported on October 5, 2022, that about 2,000 medical institutions, or 10% of the nation's total, have been either damaged or destroyed. As a result, approximately eight million individuals in flood-affected areas require immediate medical help (Mahipala & Lukwiya, 2022). Commonly and theoretically, trade can positively impact health by raising living standards. Trade allows countries to exchange goods and services across borders, facilitating economic growth and development. Thus, it often leads to increased economic activity, which can result in a higher GDP per capita. As countries engage in trade and expand their economies, they generate income and wealth, which can be invested in various sectors, including healthcare. When living standards improve, it tends to have a positive impact on health outcomes. Access to better nutrition, healthcare services, sanitation, and improved living conditions can lead to a decline in mortality rates and an increase in life expectancy (Cyrus, 2018). In the case of Pakistan, health and trade are studied in this aspect. First, as trade increased, income inequality among the classes increased due to increased stress and declining social cohesion. thus, increasing morality rates and decreasing life expectancy (Kawachi, 2000). Second, Pakistan's imports exceed exports due to a decline in GDP per capita, and people do not enjoy proper health facilities (Ahmed & Ahsan, 2011). That the worker (employee) does not access better nutrition Thus, commonly, the productivity of developing countries is lower than that of developed countries. Therefore, education can have a significant impact on health expenditure in several ways: health awareness and behaviour, health literacy, occupation and income, and health promotion and prevention efforts. Similarly, the impact of education on health expenditure can vary depending on several factors, including the socio-economic context, the healthcare system, and the availability of healthcare services (Liu et al., 2021; Lunde et al., 2022). On the other hand, the data set of developed nations has been used in a number of studies that have been reported. Moscone and Tosetti (2010), for instance, looked at the long-term relationship between health care spending and economic growth in 49 US states from 1980 to 2004. The findings proved that there is a connection between economic expansion and health care costs over the long term.

Halici-Tülüce et al. (2016), in the short term, it was discovered that the related variables have a bidirectional relationship. Additionally, there is a one-way causal relationship between economic growth and health expenditures over the long term. According to Dreger and Reimers, (2005), there is a long-term connection between GDP per capita, health spending, and indicators of medical advancement. The study examined the association between health spending and economic expansion in 21 OECD countries between 1975 and 2001.

Objective of this study

The major and significant objective of this study is to investigate the relationship between low health expenditures and their impact on the overall economy. We also tried to find out why Pakistan's workers' productivity is lower than that of many other developing countries.

Statement of the problem

Pakistan has been facing some common issues since inception days and health issue is one of them. The healthcare sector plays a crucial role in the socio-economic development of a country. However, in the case of Pakistan, there is evidence to suggest the existence of a vicious circle in the heath expenditure, whereby escalating health costs leading to inadequate investment in the sector, resulting in deteriorating healthcare services and further escalating heath expense. This study aims to investigate and provide time series evidence of the vicious circle of health.

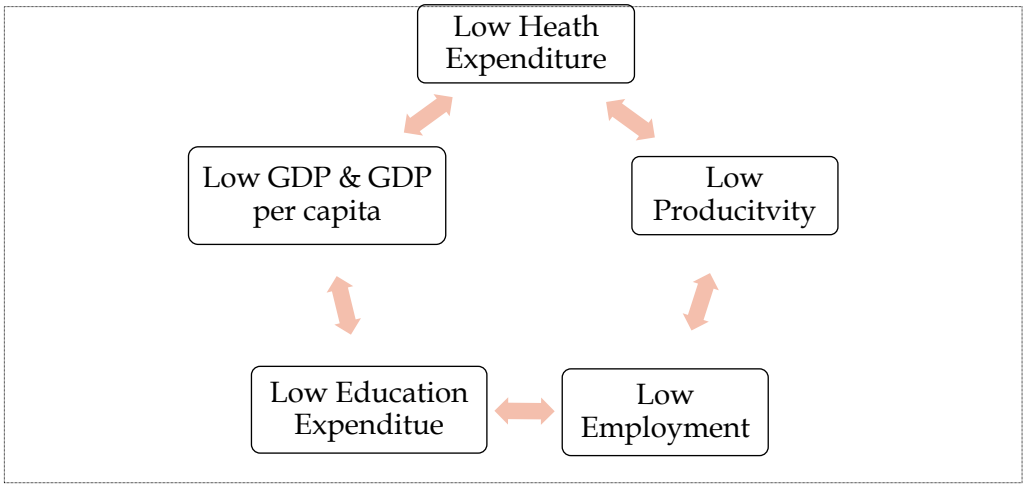

Figure 1
Describe Vicious Circle of Poverty

The aforementioned figure explains the vicious circle of health expenditures. Low health expenditures mean the workers have access to poor nutrition due to their low productivity compared to healthy workers. When the worker's productivity is low, other producers replace it with a healthy worker (if there are no healthy workers available), and as a result, goods and services decline in the market (and economy). Besides, employment is low, which creates socio-economic issues like poverty. The low employment (unemployment) education expenditure is low individually as well as nationally. Because high unemployment means low production, low distribution, low exchange, and low consumption (GDP = C+I+G+NX), low GDP indicates low GDP, and vice versa. The vicious circle of health can be prevalent in developing countries like Pakistan. The circle follows a categorization of procedures: socioeconomic disentanglements, high income and health inequality in a society, adverse health consequences, inter-generational transmission, etc. Breaking the vicious circle of health requires an inclusive approach that addresses the underlying socioeconomic determinants of health. Key interventions may include improving access to healthcare, enhancing social support systems, health promotion and education, and addressing structural inequalities. The "vicious circle of health" is a concept that defines a self-reinforcing cycle of deprived health leading to additional negative health consequences and social shortcomings and disadvantages. It recommends that certain factors, such as poverty, inadequate education, limited access to healthcare, and unhealthy living conditions, can create a downward spiral that perpetuates poor health and exacerbates existing health disparities. This study largely focuses on empirical findings.

2 Literature Review

(Bunyaminu et al., 2022), studied that impact on total health expenditure on life expectancy. The Panel approach used and time period 2000 to 2018. The health spending shortens life expectancy due to the moderating impact of government efficacy. The results showed that health spending has a favorable and considerable impact on life expectancy. However, study also found that economic activity and school enrolment both have a big impact on life expectancy. The healthcare spending is commonly low in underdeveloped economies. The study suggested that, the specific state improve health expenditure and established novel healthcare units.

Numerous developing and developed nations were the subjects of the studies described on the connection between health expenditures and economic growth. (Yang, 2020), for instance, looked at the co-integration and causality of health expenditure and economic growth in developing countries. In number of developing countries, low health expenditure effect long-run growth. The results showed, that health spending is correlated with economic expansion in the short term. Furthermore, there is a long-term correlation between economic expansion and health care costs.

(Khan et al., 2020), investigated that environmental has negative and significant impact on health expenditure. Because, adverse environment impact on workers productivity as well as, low expenditure is also one of the major causes. When the individual worker productivity low, it means low national product thus low export and high imports. The results showed that the environmental activities are topmost caused and negative impact on long run growth.

When economic growth accelerates, the country good and services improves. According to Dincer & Yuksel, (2019), The good health a significant contribute in short and long run growth. Health is an essential issue in the lives of the people. It determines the life quality of the state's people and positive influence on the welfare.

Haseeb et al. (2019) discovered that an increase in the HE might be interpreted as an EG. Even though Europe has a well-developed health care system, Europeans view the COVID-19 pandemics as an anticipated health crisis that will have a significant impact on the health care system and economies in particular regions (Buheji 2020). Numerous microeconomic studies have demonstrated that sick people's work environments are influenced by insurance or HE benefits (Ventelou et al., 2012).

(Atilgan et al., 2017), observed that, the relationship between health care costs and economic expansion and time period from 1975 to 2013. The empirical studies that look at how healthcare spending affects Turkey's economic growth vary. Cointegration and causality directions of health spending and economic growth diverge in the long run and short run, as can be seen from the studies' outcomes. Both the long-term and short-term relationships between the selected variables are evident in these models' outputs.

(Ye and Zhang, 2018), studied that the association between health care spending and economic development in 15 OECD countries. According to the findings, there is no significant correlation between economic expansion and health care expenditures. The contribution of literature, how trade, employment, low education expenditure and GDP per capita impact on health expenditure and low health expenditure on these factors. This phenomenon is called vicious circle of health expenditure.

The literature demonstrates that a number of studies on the connection between economic growth and health expenditures have been reported. There is no common conclusion among studies regarding the existence and direction of causality when evaluating long-term and short-term causality for the purpose of confirming the connection between healthcare spending and economic growth. Variables, country-specific reasons, or methods may be to blame for the divergent outcomes. Therefore, for reliable results, it is essential to employ the appropriate methods and variables for the associated nations.

3 Methodology

Data Sources

Valid data and its sources hold significant importance in any empirical research. In this current study, we utilised time series data from 1971 to 2021. The data taken from different sources Economic Survey of Pakistan (ESP) and World Development Indicator (WDI). There are five specific variables (currently many studies use the term series instead of variable"): health expenditure, GDP per capita, employment, education expenditure, and trade. Health expenditure (HEXP) is a dependent variable, while GDP per capita (GDPpc), employment (EMP), education expenditure (EDUEXP), and trade are independent variables. Health expenditure is defined by lots of health experts. WHO suggests that health expenditure should be considered catastrophic" when it is more than or equal to 40 percent of the volume to be paid (Kawabata et al., 2002). Most scholars commonly define health expenditure as the expenditure of income to spend on healthcare goods and services, i.e., clinics and hospitals. Therefore, WHO defines "the sum[1] of all expenditures made by the public, individuals, and private

[1] GDPpc =country's GDP/total population

units and kinds to produce health and to prevent and cure disease and injury." (Pandey et al., 2018; Aregbeshola and Khan, 2018). GDP per capita is calculated by dividing the country's GDP by its total population (Dritsaki and Dritsaki, 2023). Similarly, stuckler et al. (2009) defined employment as "the number of people who are currently working or are willing and able to work and are actively seeking a job." Craigwell et al. (2012), Education expenditure is the amount of money spent on education by individuals, institutions, or governments, as is health expenditure. Therefore, trade indicates the exchange of goods, services, or resources between individuals, organisations, or countries (Khan et al., 2020).

Model Specification

Mathematical Model

Health expenditure = f (GDP per capita, Employment, Education Expenditure, Trade)

Econometric Model

$$\mathbf{HEXP_t = \beta_0 + \beta_1 GDPpc_t + \beta_2 EMP_t + \beta_3 EDUEXPt + \beta_4 Trade_t + \varepsilon_t \ldots (1)}$$

Estimated Model

$$HEXPt = 47.165794 + 1.009138*GDPpc_t^{2} + 0.135196*EMP_t^{3} - 1.442482*EDUEXPt^{4} - 0.148879Trade_t^{5} + \varepsilon_t \ldots (2)$$

Descriptive Statistics

Descriptive statistics explain the fundamental information about the data in a few words (Sundaram et al., 2014; Altman and Bland, 1995,). The mean is calculated by summing all of the raw values and dividing by the number of available scores. For raw data at the ordinal level, the appropriate measure of central tendency is the middle score, also known as the median. When the frequency distribution is skewed, the median provides a more accurate measure of central tendency than the mean. (Bland, 2015). Although the standard deviation of ranked ordinal data may also be useful in some situations, this common measure of variability is most appropriate when the data are normally distributed. The deviation (x) of each score from the mean of all scores is the basis for the standard deviation. After being squared, these deviation scores are added up (∑X^2). After dividing this sum by N-1, the square root is taken (Morgan et al., 2019). The skewness and kurtosis refer to the distribution's shape. The concepts of skewness and kurtosis were developed by Karl Pearson. The meaning of skewness is "lack of symmetry," or a measured degree of asymmetry in a distribution. It is measured β1. If the value of β1=1 or mean = median = mode, the distribution is symmetric (not skewed). If β1<0 or mean < median < mode is used, the distribution is negatively skewed (skewed to the left). If the value β1>0 or mode < median < mean, the distribution is positively skewed (skewed to the right). If the skewness is >+1.0 or <-1.0, then the distribution is considered skewed (Morgan et al., 2004). Kurtosis shows the peakedness or flatness of the distribution. Kurtosis is measured by β. If the value of β2>3, the curve is high-peaked, and it means leptokurtic. If the value is β2<3, the curve is less peaked, which means Platykurtic. If the value of β2=3, the curve is the normal peak, it is called mesokurtic. To prove a normal univariate distribution, values for asymmetry and kurtosis must fall between -2 and +2 (Field 2000; Gravetter & Wallnau 2004; Trochim & Donnelly, 2006; George, 2010). An absolute skew value > 2 is an indicator of significant divergence from normalcy (West et al., 1995; Kim, 2013). Jarque-Bera

[2] A positive coefficient β1, suggests that an increase in the % of GDP spent on goods and services (GDPpct) is associated with an increase in healthcare expenditure

[3] The positive coefficient β2, suggests that an increase in employment (EMPt) is associated with an increase in healthcare expenditure.

[4] A negative coefficient β3, suggests that an increase in education expenditure (EDUEXPt) is associated with a decrease in healthcare expenditure.

[5] a positive coefficient β4, suggests that an increase in international trade (Tradet) is associated with an increase in healthcare expenditure.

statistics is a test that is used for variable and model normality. If the P-value of Jarque-Bera statistics is exceeded at the 5% (0.05) level of significance, it means accepting the null hypothesis and rejecting the alternative hypothesis.

Correlation

The Pearson-correlation-coefficient value was commonly applied in correlation matrices. According to the Pearson-correlation-coefficient, "If the coefficient value is in the negative range, then that shows the association between the series is negatively correlated, or as one value increases, the other decreases." If the coefficient value is in the positive range, that indicates the relationship between the variables is positively corrected, or both values increase or decrease together." The strong correlation between the variables is defined as the Pearson correlation coefficient value of $r \geq 0.70$, and values ranging between $0.50 \leq r \leq 0.70$ are concluded to be the moderate r between the variables (Haque et al., 2021; Carracedo et al., 2018). In social science, $R \geq 3.5$ or $R \leq -3.5$ is measured as statistically significant (Senthilnathan, 2019). Besides, multicollinearity is also a statistical phenomenon. According to Gujarati (2003), "If the relationship between explanatory variables exceeds o.8, then it becomes a serious problem of multicollinearity. There is another method of defecting multicollinearity: if R-squared is high and there are few significant t-ratios, there is multicollinearity in the model."

-1.0	-0.75	-0.50	-0.25	0.0	+0.25	+0.50	+0.75	+1.0
Perfect -ve	Highly strong -ve	Strong -ve	Weak -ve	Zero	Weak -ve	Strong -ve	Highly strong -ve	Perfect -ve

Fig 2
Correlation Analyses
Lags selection SIC, AIC

The selection criteria are utilised in particular time series analysis to select the suitable number of lags to include in an auto-regressive model. There are five lags selection criteria: AIC, SIC, BIC, HQC, and FPE. Numerous studies used SIC and AIC, and beyond the logic, small sample sizes When the sample size is < 60, then AIC and SIC are suitable criteria (Liew 2004; Asghar & Abdi, 2007).

Unit Root Tests

A unit root test is used to determine whether a time series has a unit root (non-stationary) or not (means stationary or not-unit root). A unit root is a characteristic of a time series where the unit root has a trend, which means that the variance and mean of the series are not constant over time. For this purpose, statisticians and econometricians developed many tests to check the unit-root tests of data. Therefore, finally, Johansen introduced the ADF unit root test in 1988 (Johansen, 1988). There are many unit root tests like ADF, ERS, Ng-Perron, Zovit-Andrew, and KPSS.

ARDL

Basically, cointegration[6] refers to the long-run association among the series. There are many tests used, i.e., Johansen cointegration and VECM. The ARDL (or ARDL-bound test) also concluded. The auto-regressive distributed lag (ARDL) bound test is a test to examine the existence of a long-run relationship between two or more series in time series data. Sometimes referred to as the "bound testing technique for cointegration, Thus, the ARDL bound test is a suitable approach for testing the

[6] If the residuals are stationary, then it can be concluded that there is a long-run relationship between the variables, and they are said to be cointegrated. Cointegration is a statistical property that exists when two or more non-stationary time series are linearly related in such a way that they move together in the long run, despite short-term fluctuations (Clements & Hendry, 1999; Lin & Brannigan, 2003)

presence of cointegration between two or more variables (Afzal et al., 2010; Mehrara, 2011; Nasiru & Usman, 2012). The bound test holds for estimating an ARDL model, which is a regression model containing lag values for the variable of interest and other variables of interest (Nkoro & Uko, 2016). Therefore, the model is estimated using ordinary least squares (OLS) to check the stationarity of the residuals from the model (Kripfganz & Schneider, 2018). If all series are stationary at I (0), then use OSL (or simple regression). If all series are stationary at I (1), use cointegration, while in cases of mixed order, use ARDL.

$$\Delta \mathrm{HEXp} + \beta_0 + \sum_{i=1}^{n1} \beta_{11} \Delta \mathrm{GDPt} - \mathrm{i} + \sum_{i=0}^{n2} \beta_{12} \Delta \mathrm{EMPt} - \mathrm{i} + \sum_{i=0}^{n3} \beta_{13} \Delta \mathrm{EDUEXPt} - \mathrm{i} + \sum_{i=0}^{n4} \beta_{14} \Delta \mathrm{TRADEt} - \mathrm{i} + \eta_{11} \mathrm{HEXPt} - \mathrm{i} + \eta_{12} \mathrm{GDPt} - \mathrm{i} + \eta_{13} \Delta \mathrm{EMPt} - \mathrm{i} + \eta_{14} \Delta \mathrm{EDUEXPt} - \mathrm{i} + \varepsilon_t \ldots (2)$$

where Δ shows I (1) operator; β_0 indicates the constant term (intercept); and $\beta_{11}, \ldots, \beta_{14}$ represent short-term coefficients; $_{11} \ldots, _{14}$ is displaying long-term coefficients; the lag-length refers to the n_1..., n_4 and ε_{t-1} error term of the particular model. The F-statistics $_{\text{calculated-value}}$ is compared with the upper I (1) and lower I (0) critical values reported by Pesaran et al. (2001). If the computed F-$_{\text{statistics-value}}$ is > I (1)[7] and, H_0[8] the of no cointegration is rejected regardless of whether the variable is stationary I (0) or I (1)[9]. As Pesaran et al. (2001), mentioned, once we can establish the existence of cointegration between the variables, we proceed to the estimation of error correction models. The value can be anywhere within these two limits.

1. If F-$_{\text{calculated value}}$<LCB, means no cointegration,
2. If F-$_{\text{calculated value}}$>UCB, means cointegration
3. If LCB<F-$_{\text{calculated value}}$ >UCB, stay in inconclusive region (means do not take a decision).

Error Correction Model ECM

ECM is an econometric approach for estimating the relationship between two or more time series variables that have a long-term equilibrium relationship. ECM is a time series model that describes both short-term dynamics and long-term equilibrium relationships between variables. The term error correction refers to how much disequilibrium is in effect when the current point corrects the disequilibrium of past points (Gul & Khan, 2020). The value of ECT should be negative and significant.

$$\Delta \mathrm{HEXp} + \beta_0 + \sum_{i=1}^{n1} \beta_{11} \Delta \mathrm{GDPt} - \mathrm{i} + \sum_{i=0}^{n2} \beta_{12} \Delta \mathrm{EMPt} - \mathrm{i} + \sum_{i=0}^{n3} \beta_{13} \Delta \mathrm{EDUEXPt} - \mathrm{i} + \sum_{i=0}^{n4} \beta_{14} \Delta \mathrm{TRADEt} - \mathrm{i} + aECT\mathrm{t} - 1 \ldots (3)$$

Diagnostic Test

After testing any econometric technique, check whether the model is valid or not. For this purpose, use diagnostic tests for heteroscedasticity, normality, multicollinearity, and serial correlation. Through diagnostic tests, we check the validity of the model. In other words, whether the essential assumptions of the model are violated or not If assumptions are violated (or any diagnostic tests occur in the model), the model is not reliable. The issue of heteroscedasticity exists in a model, when the variance of the residuals is not constant (Rosopa et al., 2013). Two independent variables are highly correlated with each other, which means the issue of multicollinearity exists (Midi et al., 2010; Dao,

[7] Upper critical value
[8] Null hypothesis
[9] Before stationary on I (0) or I (1), or I (2). It means order of cointegrated (stationary) at level, first and second respectively.

2012). Therefore, through serial correlation, check whether there is a correlation between the residuals at different points in time or between observations in cross-sectional data (LeSage, 1997; Chen, 2016).

Results and Discussion

Table 1

Descriptive Statistics

	HEXP	**GDPPC**	**EMP**	**EDU_EXP**	**TRADE**
Mean[10]	1069.242	1013.358	49.23869	2.396771	31.57594
Median	1061.385	1008.359	49.86000	2.450573	32.60612
Maximum	1558.610	1497.987	55.16000	3.022300	38.49932
Minimum	618.4689	565.0732	31.62000	1.568820	15.82134
Std. Dev.	278.2527	274.7866	4.314644	0.344922	4.235367
Skewness	0.069935	0.046185	-2.422297	-0.279732	-1.023958
Kurtosis	1.973037	1.962052	10.22932	2.421197	5.066349

Before running any econometric model, we first check two things: First, to check it, our variables are stationary or non-stationary, and second, our variables are statistically significant or not. Now we check whether our variables are statistically significant or not. In this study, I have selected 50 annual observations for the time period 1972–2021. Table 4.1 is a descriptive statistics table along with figures (3, 4, 5). The mean value (measured as the average value of the series) of all variables is positive. The average value of HEXP is RS 1069.242, and the standard deviation (which measures the dispersion or spread in the series) is 278.2527. The average value of GDPPC is 1013.358 and the standard deviation is 0.046185; the average value of EMP is 49.23869 and the standard deviation is 4.314644; and the average value of EDUEXP is 2.396771 and the standard deviation is 0.344922. The trade average is 31.57594, with a standard deviation of 4.23536. The maximum (which shows the maximum value of the series in the current sample) value of EEXP is 1558.610, and the minimum (which refers to the minimum value of the series in the current sample) value is 618.4689. Therefore, the maximum values of GDPPC, EMP, EDUEXP, and TRADE are 1497.987, 55.16000, 3.022300, and 38.49932, respectively. The minimum values of GDPPC, EMP, EDUEXP, and TRADE are 565.0732, 31.62000, 1.568820, and 15.82134, respectively. In this study, the HEXP value is 0.069935, which is close to 0, and it is a normal distribution. The skewed value of GDPPC is 0.046185, which is also close to zero. Thus, GDPPC is symmetrically skewed. The skewed value of EMP (-2.422297) is negative, which refers to negative skewedness. The value of EDUEXP is -0.279732, which is less than 0. Thus, EDUEXP is negatively skewed. The trade is negatively skewed because the value of skewness is -1.023958. The outcomes skewness is shown in Table 1. In table 1, HEXP, GDPPC, and EDUCEXP are Platykurtic, while EMP and TRADE are Leptokurtic.

[10] Means or average value: $[\bar{X} = \frac{\sum X}{n}]$

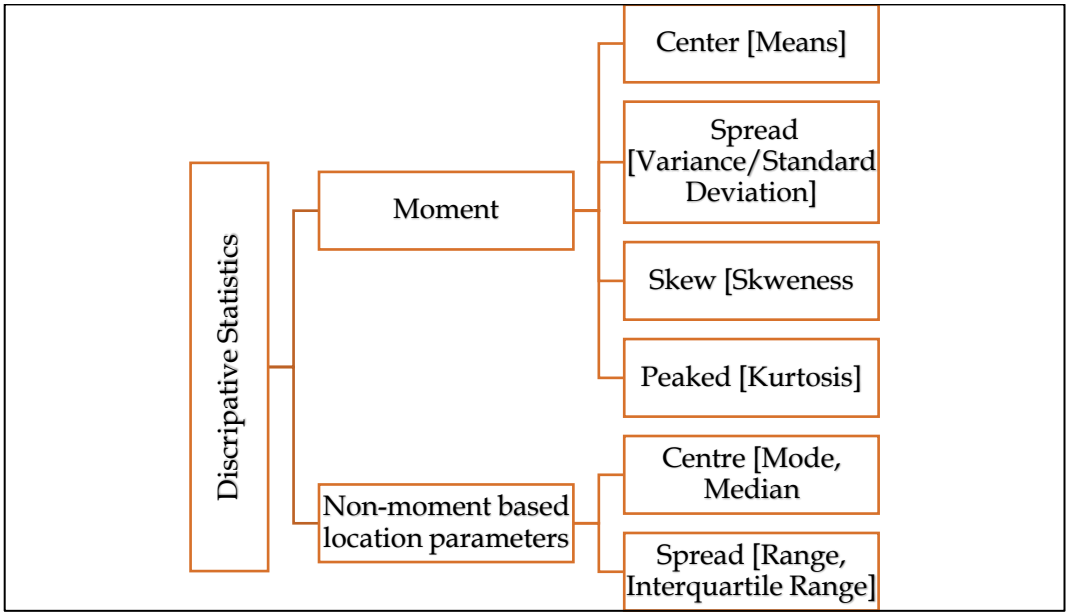

Figure 3
Descriptive Statistics

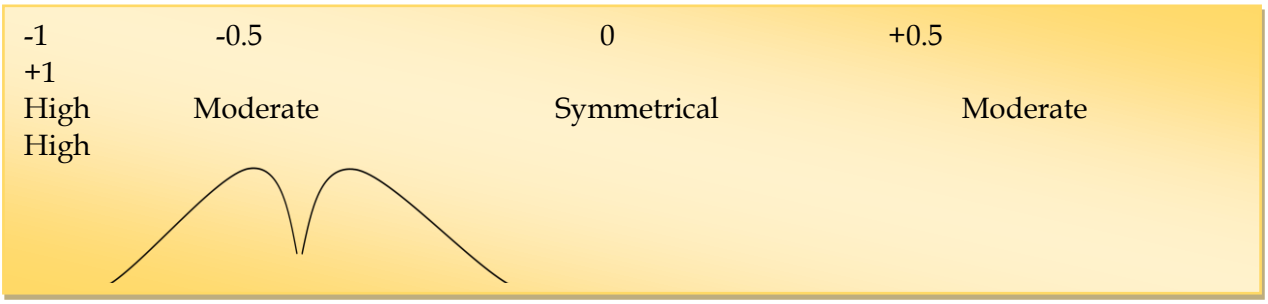

Figure 4
Skewness

Table2
Correlation

	GDPPC	EMP	EDUEXP	TRADE
GDPPC	1			
EMP	(+) 0.564427	1		
EDUEXP	(+) 0).571323	(+) 0.423043	1	
TRADE	(-) 0.192226	(+) 0.396246	(+) 0.214971	1

The correlation describes the association between the variables. The positive sign refers to a positive association between the variables, while the negative sign indicates a negative association. In Table 2, GDPpc is positively associated with education expenditure and employment. Besides, GDP per capita is negatively linked to trade. On the other side, employment is directly associated with trade and education expenditures. There is a weak association between expenditure on education and trade in Pakistan. The other association is acceptable, according to the aforementioned study. Fig. 2 describes the perfect, strong, weak, and zero associations between the variables.

Table 3
KPSS Unit Root Tests

HEXP = $\beta_0 + \beta_1$GDPpc + β_2EMP + β_3EDUEXP + β_4TRADE + e

	LM_{-stat}	$C.V_{at5\%}$	C/ C+T	OI*	LM_{-stat}	$C.V_{at5\%}$	C/ C+T	OI*
EDUEXP	0.14547	0.14600^{S}	C+T	I (0)	-	-	-	-
EMP	0.11066	0.46300^{S}	C+T	I (0)	-	-	-	-
GDPPC	0.08332	0.14600^{S}	C	I (0)	-	-	-	-
HEXP	0.91398	0.46300^{NS}	C	I (0)	0.08518	0.146000^{S}	C+T	I (1)
Trade	0.19034	0.46300^{S}	C+T	I (0)	-	-	-	-

* OI refers to Order of Integration while **C. V indicates critical value.

H_0: Null Hypothesis, H_A**: Alternative Hypothesis**

KPSS unit root test [stationary], $LM_{-statistics} < C.V$, meaning that the variable is stationary; $LM_{-statistics} > C.V$, meaning that the variable is non-stationary

A number of studies used ADF and PP. The stationary conditions of both models are the same. In this current study, we employed KPSS, NG-Perron, ERS test statistics, and the Zivot-Andrew unit root test. Table 3 shows the outcomes of the KPSS (1992) unit root test. The all-specific variables are stationary at I (0) except health expenditure, which is stationary at I (1). In the null hypothesis (H_0) of KPSS, the variable is stationary (not unit root), while in H_A, the variable is non-stationary or unit root. (Kwiatkowski et al., 1992; Nielson, 2005)

Table 4
NG-Perron Test Statistics

		Level				
Variable	**Model**	**MZa [$C.V_{5\%}$]**	**MZt [$C.V_{5\%}$]**	**MSB [$C.V_{5\%}$]**	**MPT $_{C.V5\%}$**	**K**
EDUEXP Non-stationary I (0)	C	-6.541 [-8.100]	-1.775 [-1.980]	0.271 [0.233]	3.857 [3.170]	0
	Analysis	|-6.5419|<|-8.1000|	|-1.7756|<|-1.9800|	|0.27142|>|0.23300|	|3.85753|>|3.17000|	
	outcomes	NS	NS	NS	NS	
	C+T	-14.48 [17.30]	-2.635 [-2.91]	0.181 [0.168]	6.616 [5.480]	0
	Analysis	|-14.4882|<|17.3000|	|-2.63538| <|-2.9100|	|0.18190|<|0.16800|	|6.61636|<|5.48000|	
	outcomes	NS	NS	NS	NS	
EMP Non-stationary I (0)	C	-1.685 [-8.10]	-0.752 [-1.980]	0.446 [0.233]	12.01 [3.170]	1
	Analysis	|-1.68591|<|-8.1000|	|-0.75270|<|-1.98000|	|0.44647|>|0.23300|	|12.0167|>|3.17000|	
	outcomes	NS	NS	NS	NS	
	C+T	-5.566 [-17.30]	-1.664 [-2.910]	0.299 [0.169]	16.36 [5.480]	1
	Analysis	|-5.56619|<|-17.3000|	|-1.66438|<|-2.91000|	|0.29902|>|0.16900|	|16.3611|>|5.48000|	
	outcomes	NS	NS	NS	NS	
GDPPC Stationary I (0)	C	1.269 [-8.100]	1.115 [-1.980]	0.878 [0.233]	8.129 [3.170]	1
	Analysis	|1.26980|<|-8.10000|	|1.11560|<|-1.98000|	|0.87857|>|0.23300|	|8.12938|>|3.17000|	
	outcomes	NS	NS	NS	NS	
	C+T	-20.95 [17.30]	-3.231 [-2.910]	0.154 [0.168]	4.381 [5.480]	1
	Analysis	|-20.9525|>|17.3000|	|-3.23144|>|-2.91000|	|0.15423|<|0.16800|	|4.38120|<|5.48000|	
	outcomes	Stationary	Stationary	Stationary	Stationary	
HEXP Non-stationary	C	1.594 [-8.100]	1.548 [-1.980]	0.971 [0.233]	73.71 [3.170]	1
	Analysis	|1.59409|<|-8.10000|	|1.54824|<|-1.98000|	|0.97124|>|0.23300|	|73.7125|>|3.17000|	
	outcomes	NS	NS	NS	NS	

I (0)	C+T	-15.76 [-17.30]	-2.801 [-2.910]	0.177 [0.168]	5.818 [5.480]	
	Analysis	|-15.7619|<|-17.3000|	|-2.80112|<|-2.91000|	|0.17771|>|0.16800]	|5.81847|>|5.48000]	1
	outcomes	NS	NS	NS	NS	
	C	-13.05^{S} [-8.10]	-2.22^{S} [-1.980]	0.200^{S} [0.233]	2.991^{S} [3.170]	
TEADE Stationary I (0)	Analysis	|-13.05613|>|-8.1000|	|-2.22287|>|-1.98000]	|0.20014<|0.23300]	|2.99194|<|3.17000|	0
	outcomes	Stationary	Stationary	Stationary	Stationary	
	C+T	-18.27^{S} [-17.30]	-3.69^{S} [-2.910]	0.120^{S} [0.168]	4.503^{S} [5.480]	
	Analysis	|-18.27173|>|-17.3000|	|-3.69718|>|-2.91000|	|0.12061|<|0.16800|	|4.50325|<|5.48000|	0
	outcomes	Stationary	Stationary	Stationary	Stationary	
First difference						
	C	-23.80^{SI} [-8.10]	-3.354^{SI} [-1.98]	0.14^{SI} [0.23]	1.34^{SI} [3.17]	
EDUEXP Stationary I (1)	Analysis	|-23.8018|>|-8.10000|	|-3.35414I|>|-1.98000|	|0.14092|<|0.23300|	|1.34795|<|3.17000|	0
	outcomes	Stationary	**Stationary**	Stationary	Stationary	
	C+T	-23.8^{SI} [-17.3]	-3.424^{SI} [-2.91]	0.14^{SI} [0.16]	3.98^{SI} [5.48]	
	Analysis	|-23.8291|>|-17.3000|	|-3.42496I|>|-2.91000|	|0.14373|<|0.16800|	|3.98456|<|5.48000|	0
	outcomes	Stationary	Stationary	Stationary	Stationary	
	C	-9.85^{SI} [-8.10]	-2.21^{SI} [-1.98]	0.22^{SI} [0.23]	2.49^{SI} [3.17]	
EMP Stationary I (1)	Analysis	|-9.85465|>|-8.10000|	|-2.21845|>|-1.98000|	|0.22512|<|0.23300|	|2.49128|<|3.17000|	1
	outcomes	Stationary	Stationary	Stationary	Stationary	
	C+T	-23.9^{SI} [17.3]	-3.44^{SI} [-2.91]	0.14^{SI} [0.16]	3.89^{SI} [5.48]	
	Analysis	|-23.9553|>|17.3000|	|-3.44515|>|-2.91000|	|0.14382|<|0.16800|	|3.89825|<|5.48000|	0
	outcomes	Stationary	Stationary	Stationary	Stationary	
	C	-22.50^{S1} [-8.10]	-3.33^{S1} [-1.980]	0.148^{S1} [0.23]	1.149^{S1} [3.17]	
HEXP Stationary I (1)	Analysis	|-22.5017|>|-8.10000|	|-3.33643|>|-1.98000|	|0.14827|<|0.23300|	|1.14985|<|3.17000	0
	outcomes	Stationary	Stationary	Stationary	Stationary	
	C+T	-22.6^{SI} [17.30]	-3.34^{SI} [-2.91]	0.14^{SI} [0.16]	4.13^{SI} [5.480]	
	Analysis	|-22.6463|>|17.3000|	|-3.34721|>|-2.91000|	|0.14780|<|0.16800|	|4.13112|<|5.48000]	0
	outcomes	Stationary	Stationary	Stationary	Stationary	

S and NS refers to the stationary and non-stationary respectively. therefore, SI represents stationary at 1st difference.

The Ng-perron is a test to check series' stationarity. The test consists of four test statistics (MZa, MZt, MSB, and MPT), which refer to an alternative unit root test. The H_0 of MZa and MZt is like ADF and PP (H_0: Series have a unit (non-stationary), while the H_0 of MSB and MPT tests are resembling the KPSS test (H_0: series have no unit root (stationary). Table 4 displays the outcome of the Ng-Perron-test. The four variables (employment, education, health expenditure, and trade) out of five (5) are stationary at I (1), while GDPpc is stationary at I (0).

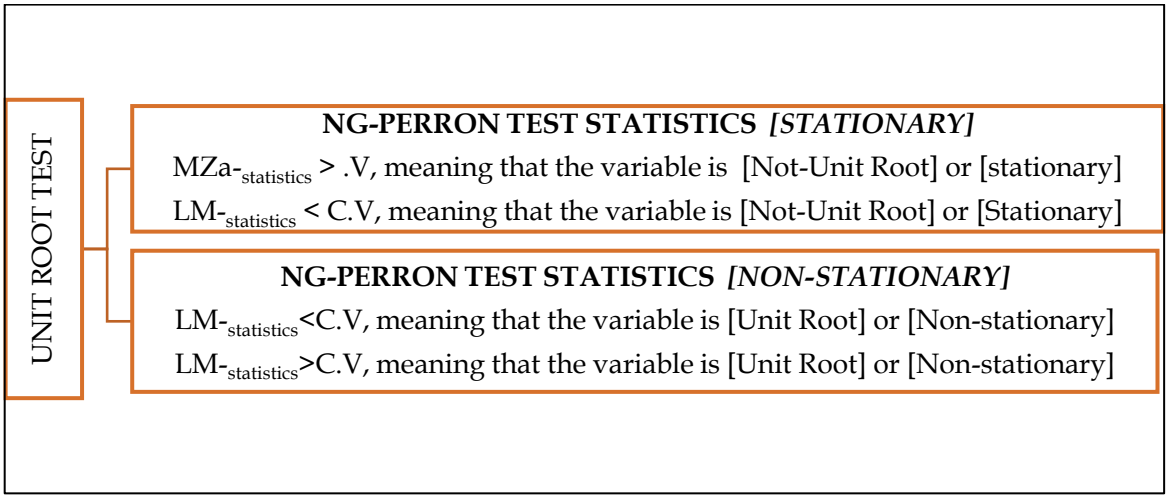

Figure 5
NG Perron Test

Table 5
Zivot Andrew Unit Root Test

Variable	Za_{t-s}	$CV_{value\ of\ Zat-s}$	Prob.	BY*	LL**	Decision	S & NS
Level							
EDUEXP	-4.416851	-4.416851	0.0540	1985	0	IZat-statI< IZa*C. Vat5%I	NS***
EMP	-9.139036	-4.443649	< 0.01	1989	1	IZat-statI> IZa*C. Vat5%I	S****
GDPPC	-1.878745	-4.443649	0.9884	2002	1	IZat-statI< IZa*C. Vat5%I	NS
HEXP	-1.837800	-4.443649	> 0.99	2003	0	IZat-statI< IZa*C. Vat5%I	NS
Trade	-5.828463	-4.443649	< 0.01	2013	0	IZat-statI> IZa*C. Vat5%I	S
First difference							
EDUEXP	-8.224870	-4.443649	< 0.01	2004	0	IZat-statI> IZa*C. Vat5%I	S
	-	-	-	-	-	-	-
GDPPC	-5.753717	-4.443649	< 0.01	2020	0	IZat-statI> IZa*C. Vat5%I	S
HEXP	-5.943689	-4.443649	< 0.01	2020	0	IZat-statI> IZa*C. Vat5%I	S

*, **, ***, and **** refer to Break year, Lag Length, Non-stationary and stationary respectively. Therefore, SIC maxlag for each variable is 10.

Table 5 mentions checking the stationary and structural breaks among the given variables. Definitely, the H0 of employment and trade rejects at I (0), while the H0 of education expenditure, GDP per capita, and health expenditure rejects at I (1) underneath at a 5% significant level. The all-specific series are stationary at I (0) and I (1). The Za-test supports economic, societal, and natural shock phenomena. In definite terms, the result is the theme of the three economic, societal, and natural shocks that had outcomes on health and education expenditures along with economic activities. The novel's shock occurred in 1989. In 1989, many big events occurred in South Asia, i.e., they ended the story of the Afghan War and the Cold War. Pakistan faced severe political instability, which created economic instability. As a result, several economic problems were raised, including unemployment. Unemployment causes poverty. In other words, employment decline caused poverty (Gillani et al., 2009; Meo et al., 2020). Poverty had increased to 33% by the end of the 1990s, up from 18% in 1988–1989 (Husain, 2004). Siddiqui and Kemal (2006) examined the effects of trade liberalisation and shrinking remittances using the 1989–990 input–output analysis with a consistent set of data from

1989 to 1990. Anwar (2002) claims that Pakistan's over-liberalisation of the economy has reduced import tariffs more than the WTO tariff rate, leading to a momentous drop in revenue and a decrease in state outlay on social developmental projects that benefit the poor. During his visit to Pakistan in May 2013, Chinese Premier Li Keqiang emphasised the construction of the CPEC (Tiezzi, 2014). Under the FTA, Pakistan's trade with China increased rapidly from $3.5 to $14.3 billion in 2006 to 2013 respectively. China was 2nd largest importer, about 16.17% of its total imports in 2013 (Irshad & Xin, 2015). Therefore, to encourage trade and exports to ASEAN nations, Pakistan is working towards a free trade agreement. In July 2013, Pakistan and Indonesia entered into a PTA (preferential trade agreement). From approximately $1.1 billion in 2013 to $2.2 billion in 2014, bilateral trade increased dramatically. While Pakistan's imports of services decreased moderately by 7.0 percent to reach US$ 7.8 billion in 2013, its growth in exports of services decreased significantly by 25.8% to reach US$ 4.9 billion. There was a modest deficit of $2.9 billion in trade in services (Irshad et al., 2016). A novel pandemic (COIVD-19) changed the world (Zahra et al., 2020). COVID-19 severely affected Pakistan's economy. The real GDP growth rate is estimated to have decreased from 1.9% in FY2019 to -1.5% in FY2020. GDP growth of Pakistan was approximately 5.8%, which corresponds to a decrease of -4.98 percent (Gul et al., 2020). Besides, the health shock occurred during the same period. The COVID-19 negative effect affected a number of things. On the other hand, almost every state increased health expenditure and improved the structure of health institutions.

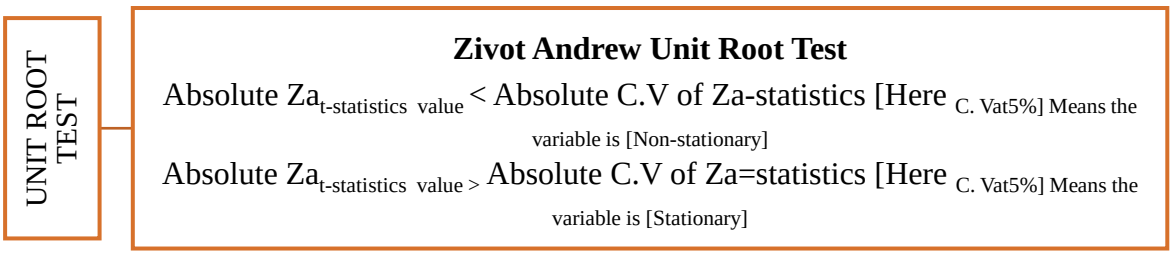

Figure 6
Zivot Andrew Test

Table 6

Elliott, Rothenberg and Stock Test Statistics Outcomes

Variable	Levels	1st-Difference	Levels	1st Difference	Decision
	Intercept Only (C)		Intercept & Trend (C+T)		
EDUEXP	7.589637	0.004309	8.196241	0.001530	I (1)
	7.589637>CV1'2'3	0.004309<CV1'2'3	8.196241>CV4'5'6	0.001530<CV4'5'6	
	Non-stationary	Stationary	Non-stationary	Stationary	
EMP	39.09892	1.115877	38.97704	3.7799834'5'6	I (1)
	39.0989> CV1'2'3	1.115877<CV1'2'3	38.97704>CV4'5'6	3.779983<CV4'5'6	
	Non-stationary	Stationary	Non-stationary	Stationary	
GDPPC	267.0836	-	4.21126461'2'3	-	I (0)
	267.083> CV1'2'3		4.2112646<CV4'5'6		
	Non-stationary		Stationary		
HEXP	572.8536	1.1263941'2'3	11.85194	4.0187334'5'6	I (1)
	572.8536>CV1'2'3	1.1263941'2'3	11.85194> CV4'5'6	4.018733<CV4'5'6	

	Non-stationary	Stationary	Non-stationary	Stationary	
TRADE	20.45930	1.098905[1'2'3]	32.18238	2.838173[4'5'6]	I (1)
	20.4593> CV[1'2'3]	1.098905<CV[1'2'3]	32.18238 > CV[4'5'6]	2.838173<CV[4'5'6]	
	Non-stationary	Stationary	Non-stationary	Stationary	

1'2''3'4'5' and 6 refer the critical value at 1% (1.870000 C^1), 5% (2.970000 C^2), and 10% (3.910000 C^3) at level while the critical value at 1st difference at 1% (4.2200000 $C+T^4$), 5% (5.720000 $C+T^5$) and (6.770000 $C+T^6$) respectively.

Table 6 shows the outcomes of the ERS unit root. The ERS value of education expenditure at the level under intercept is 7.589637, which is >critical value at 1%, 5%, and 10%. The level value of the intercept and trend of the same variable is 8.196241>critical value at 1%, 5%, and 10%. The same variable, stationary I (1), is under intercept, intercept, and trend. Because the values of intercept 0.04309 and 0.001530 are critical values at 1%, 5%, and 10%, respectively. When ERS value > critical value, we cannot reject H0, meaning that if we accept H_0 and H0, the variable is non-stationary. Besides, the ERS value <critical value, so reject H_0 and accept HA, and H_A is stationary. The employment value of ERS at level under intercept 39.09892 and intercept and trend value 38.97704, which are >critical values of 1%, 5%, and 10%, respectively, The ERS value of intercept and trend <critical value at 1%, 5%, and 10% at I(I) Thus, reject H_0 and accept HA, since the variable is stationary. The ERS value for GDP_{pc} at level under intercept is 267.0838 >critical value at 1%, 5%, and 10%. The variable is stationary under intercept and trend at I (0) because the critical value > the value of ERS at 1%, 5%, and 10%. The ERS value of health expenditure at level under intercept is 572.8536, which is >critical value at 1%, 5%, and 10%. At level value, the intercept and trend of the same variable are 11.85194>critical values at 1%, 5%, and 10%. The same variable, stationary I (1), is under intercept, intercept, and trend. Because the values of intercept 1.126394 and 4.018733 < critical values at 1%, 5%, and 10%, respectively. The trade is non-stationary at I (0) under intercept, intercept, and trend, while stationary at I (1) under intercept, intercept, and trend.

UNIT ROOT TEST

ELLIOTT, ROTHENBERG AND STOCK [ERS] (1996)

Null Hypothesis: Series has a unit root [non-stationary]

Alternative Hypothesis: Series has a not-unit root [Stationary]

ERS test statistics value > C.V value at 1%, 5%, and 10%, then we cannot reject H_0. It means that series has a unit root or non-stationary.

ERS test statistics value < C.V value at 1%, 5%, and 10%, then we can reject H_0 and H_a. Our H_a, the series stationary or has not a unit root.

Figure 7
Elliott, Rothenberg and Stock Test

Table 7
Bound-Test

HEXP = β_0 + β_1GDPpc + β_2EMP + β_3EDUEXP + β_4TRADE + e

ARDL (2, 0, 0, 0, 0)

	F-statistic (6.449437)	
Critical Values	I0-Bound	I1-Bound
5%	2.86	4.01

Various studies have applied bound tests (ARDL tests, also called bound tests) to test for the presence of a long-run association. First time used: Pesaran et al. (2001). In this current study, we also study the bound test. The F-statistics calculated $_{value}$ is 6.44, which is greater than I (1) at 1%[11], 2.5%[12], 5%[13], and 10%[14], respectively. But commonly computed at 5%. Thus, if F-statistics-calculated$_{-value}$ > I (1), it means the projected series holds long-run cointegration.

Table 8
Long Run Coefficient

Dependent variable: HEXP			
Selected ARDL Model (2, 0, 0, 0, 0) & Time Period: 1972-2021			
Series	Co-efficient	Std. Error	t. stat (Prob).
GDPPC	1.009138	0.000834	12.101144 (0.0000)
EMP	0.135196	0.067387	2.006271 (0.0515)
EDUEXP	-1.442482	0.635674	-2.269217 (0.0286)
TRADE	-0.148879	0.051352	-2.899214 (0.0060)
C	47.165794	4.291262	10.991125 (0.0000)
R^2	0.783474	Mean dependent var	19.40850
Adj-R^2	0.776011	S.D. dependent var	20.27169
S.E. of regression	3.139775	AIC	5.383699
Sum squared resid.	305.6038	SC	5.979995
Log likelihood	-108.8251	HQ criteria	5.607075
F. stat	13.17741	DW. stat	1.913774
Prob(F-statistic)	0.000000		

Table 8 represents the outcome of the projected model. The 2 lags selected for dependent variables are 0 lags for all independent variables: GDP per capita, employment, education expenditure, and trade. The coefficient of GDP per capita is positive, which indicates that as GDP per capita increases, health expenditure also increases. In other words, if GDP per capita increases by 1 unit, health expenditure increases by 1.09138 units. The employment coefficient is also positive, which means that as employment increases, health expenditure also increases. When employment increases by 1 unit, the health expenditure increases by 0.135196 units. In the case of Pakistan, when education expenditure increases, health expenditure also declines. People get a proper education on how to care for their health due to the decline in health expenditure. Therefore, trade is also negatively associated with health expenditures. When trade increases, health expenditures decline. The empirical study is suitable for developing countries like Pakistan. Pakistan's imports are higher than exports due to the amount of flow from the state. The R_2 value is 0.78, which is higher than 60% and means it is suitable. The P-value of F-statistics is 0.0000 (highly significant), which indicates our whole model is significant. The Durbin-Watson value is also acceptable.

[11] 5.06
[12] 4.49
[13] 4.01
[14] 3.52

Table 9
Short-Run Coefficient

Dependent variable: HEXP			
Regressor	Coefficient	Std. Error	t-Statistic (Prob.)
D (HEXP (-1))	0.022526	0.009224	2.442029 (0.0190)
D(GDPPC)	0.995835	0.009006	110.570333 (0.0000)
D(EMP)	0.133414	0.066434	2.008226 (0.0512)
D(EDUEXP)	-1.423467	0.625725	-2.274907(0.0282)
D(TRADE)	-0.146917	0.050621	-2.902287 (0.0059)
CointEq (-1)	-0.986818	0.008941	-110.371949 (0.0000)

The error correction model is an analysis that is often used in econometrics. This model is used to determine whether there is a long-term and short-term effect of each independent and dependent variable. According to Gujarati in his 2003 book, regression analysis is basically a study of the dependence of a variable (dependent variable and others) called independent variables, which aims to estimate and predict the population value of known variables. An error correction model (ECM) estimates the short-run dynamics as well as the long-term equilibrium relationships that exist between two or more variables. The ECM is employed to model co-integrated time series, which are unit-root series that have a constant long-run association. In the current study, the ECM value is negative (-0.98) and statistically significant. Statistically significant and negative indicates the short-run (SR) converges to the long-run-equilibrium (LR-equilibrium).

Table 10
Diagnostic Tests

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F. stat	3.611855	Prob-F (9,38)	0.0025
Obs*R^2	28.13012	P.χ2 (9)	0.0885
Breusch-Godfrey Serial Correlation LM Test:			
F. stat	0.932211	Prob. F (2,36)	0.4030
Obs*R^2	2.363492	P.χ2 (2)	0.3067

Table 10 shows the outcomes of the diagnostic tests: heteroskedasticity and serial correlation. The P.χ2 value of the Obs*R2 is 0.08 (>0.05), which means accept H_0 and H_0: homoscedasticity. So, the model is free from heteroscedasticity. Under serial correlation, the P.χ2 value is 0.3 (>0.05), which means accept H_0 and H_0: No serial-correlation. The p-value (>0.05) clarified that the specific assumptions were not violated.

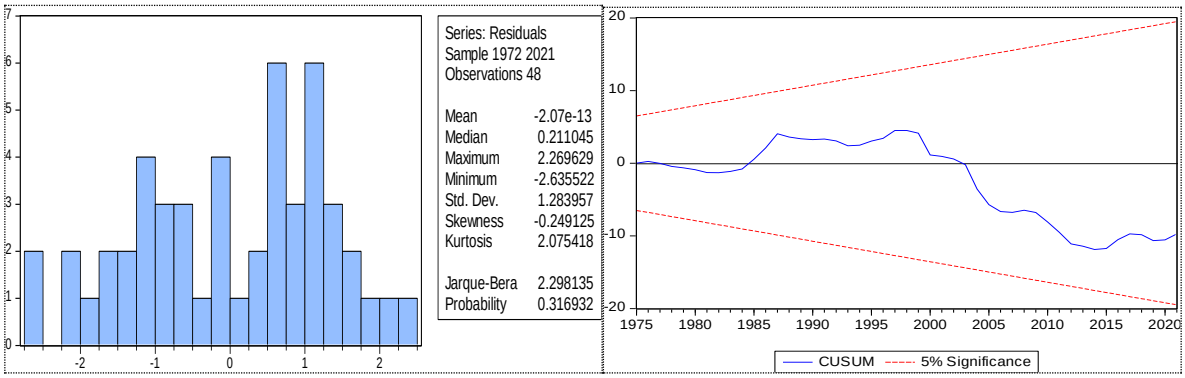

Figure 8
Normality Test & Stability Test

Figure 8 represents the outcomes of the normality test. The normality test is checked through Jarque-Bera (JB) statistics. When the Prob value of the JB_{-stat} is >0.05, accept H_0 and H_0: the model holds normality. In the current figure, the P-value is >0.05 (0.0316932), thus accepting H0. In other words, model normality. Therefore, figure 4 representing the stability of the model (CUSUM test). The blue line within red line means the model stability of the long run exist.

Conclusion and Recommendations

The projected variables performance an important role in the determination of health expenditure in developing countries like Pakistan. Pakistan is one of those economies that is facing a public health crisis due to low health expenditure. The projected series have a significant effect on health expenditures. GDP per capita and employment directly affect Pakistan's health expenditure. As GDP per capita and employment increase, the health expenditure of the masses also increases, and vice versa. In the case of Pakistan, trade has a statistically significant and negative impact on health expenditure. Because Pakistan's imports exceed its exports. Low education expenditures also negatively impact health expenditures. Therefore, the SR-equilibrium convergence is in the LR-equilibrium. The specific variables also have long-run stability. In addition, the model is free of any diagnostic tests. To conclude, higher health expenditures are necessary for long-term growth and development. because it determines the human (education and workers' skills) and physical (trade) capital of a nation. The study suggests the government improve their health expenditures as well as enhance access to healthcare. The government adopts a proper, long-lasting, and permanent policy.

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