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## Education, Human Capital, and Endogenous Growth Nexus: Time Series Evidence from Pakistan

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### ABSTRACT

*The concept of endogenous growth states that economic growth is caused by variables within the economy rather than external ones. This study's major goal is to demonstrate the link between education, human capital, and endogenous growth in Pakistan. For the period 1990–2021, time series data is used. The stationary is confirmed using the augmented dickey fuller (ADF) method. In this research, the nonlinear autoregressive distributed lag model (NARDL) technique is employed for the empirical analysis. Gross domestic product (GDP), education enrolment, human capital, inflation, trade, and gross fixed capital formation are the factors examined in this study. In the current research, gross domestic product, education enrollment, and human capital are dependent variables, while inflation, trade, gross fixed capital formation and education enrollment are independent variables. Inflation shows an inverse relationship with the gross domestic product, while trade and education enrollment show a positive relationship with the gross domestic product. Gross fixed capital formation shows an inverse relationship with human capital, while education enrollment and inflation also show a negative relationship with human capital. Gross fixed capital formation and trade show a positive impact on education enrollment, while inflation shows a negative impact on education enrollment. It is recommended that the government should decrease inflation to increase gross domestic product (GDP). This study suggests that education enrollment (EDUENROLL), trade (TRADE), and gross fixed capital formation (GFCF) also increase.*

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## 1. Introduction

Education is usually acknowledged as an important factor in promoting economic growth. Particularly crucial is education. For several decades, Pakistan has placed a high value on a society's knowledge, talents, and creative strength. Education benefits individuals as well as the nation's economy for primary and secondary schools, and, more recently, university education. It makes a substantial contribution to the development of human capabilities while also speeding up economic progress. University education is a strategy for boosting the economic growth of a country because progress is essential for the continent's development. Scholars have questioned the link between education and economic growth since ancient Greece. The necessity of investing in human abilities was stressed by Adam Smith and classical economics. The growth accounting approach or the rate of return on human capital was used to measure the contribution of education to economic growth in the beginning (Aziz *et al.* 2008).

It is impossible to overestimate the value of education, human capital, and endogenous growth for a country. A better development program is facilitated by an educated society than by one that is ignorant. Education boosts the national gross domestic product by increasing productivity and prosperity. In 2017, Pakistan's total literacy rate was roughly 59 percent, with women accounting for less than 47 percent of the population and men accounting for more than 71 percent. Human capital is a resource that comprises a person's knowledge and abilities that may be used by a company to meet its goals. Pakistan's Human capital can also be used to boost the economy. According to a 2017 poll, Pakistan's human capital indexes were lower than the regional and socioeconomic group averages. The concept of endogenous growth states that economic growth is caused by variables within the economy rather than external ones (Ozturk, 2008).

Before the nineteenth century, no country considered a systematic human capital investment to be particularly important. In the twentieth century, when science was applied to the production of new goods and more efficient associated forms of investment, education, not on-the-job training, and other types of investment were comparatively low. This began to change substantially during the manufacturing process, initially in the United Kingdom and then in different nations. No country has ever been able to sustain economic growth without significant human capital investment. Different types of human capital accumulation, including basic education, research, training, learning through doing, and potential growth, have been demonstrated to produce significant returns in previous studies. It's critical to think about how education is disseminated. Due to unequal education, the use of acceptable functional form requirements in proportion to the asset has a negative distribution. Spending on human capital has little impact on growth unless individuals can use it, and failing to do so has minor, if not negative, implications. This has an effect on per capita income in the vast majority of countries. Adjusting for the impact of education level on per capita income makes a difference in competitive and open markets. The greater the opportunity to leverage education and skills in these markets, the larger and more competitive they are (Ozturk, 2008).

## 2. Review of the Literature

Ali *et al.* (2018) the relevance of foreign aid in improving Pakistan's human capital quality was examined. From 1980 to 2016, time series data was used to make this estimation. As for Johansen co-integration and Granger causality, they were employed as econometric techniques. Economic growth, the human development index, foreign aid, and human and physical capital were among the variables examined in this study. The world development indicator (WDI) was the primary data source. According to the findings, there was a one-way causal association between economic growth, human

capital, and foreign aid. In Pakistan, Sial *et al.* (2018) looked at education and within-group earnings inequality. The goal of this study was to look at the relationship between education and income inequality within groups. The ordinary least square (OLS) method was utilized. The key variables were primary, secondary, and tertiary. The findings show that within each level of schooling, there was significant variation in the returns. Rahman *et al.* (2018) the impact of human and physical capital on Pakistan's economic growth was investigated. From 1980 to 2016, time series data was used to conduct the analysis. This estimation was done using the econometric techniques augmented dickey fuller (ADF) and Engle Granger co-integration. The gross domestic product (GDP), gross fixed capital formation (GFCF), Per-capita health expenditure, literacy rate, and secondary school enrolment rate were the factors in this study. The Pakistan Economic Survey and the Handbook of Statistics were the primary data sources. According to the findings, all of the variables included in this study had a favorable impact on Pakistan's economic growth.

In Pakistan, Munir and Arshad (2018) looked at the relationship between factor accumulation and economic growth. The time series data were collected between 1973 and 2014. This study employed the autoregressive distributed lag (ARDL) econometric approach. According to the findings of this study, there was a long-term relationship involving factors such as productivity and gross domestic product per worker. Ullah and Yang (2018) investigated the impact of human capital on Pakistan's economic growth. From 1985 to 2016, time series data was used to make this estimation. This study employed the econometric techniques of Johansen co-integration and Granger causality. The gross domestic product, labor force, real interest rate, trade, foreign direct investment, and terrorism were the variables used in this study. Pakistan's bureau of statistics and Pakistan's economic survey were the primary data sources. The study found that all variables had a positive impact on the gross domestic product, but that terrorism had the opposite effect. Alwi *et al.* (2019) the importance of education in terms of human capital, labor productivity, family, national trade, and social equality was investigated through a research scholarship to determine its contribution to Pakistan's economic development. Human capital and learning by doing, as well as formal schooling, were found to be favorable to economic growth in the study.

The impact of human capital on economic growth in Pakistan was investigated by Hafeez and Rahim (2019). Data from 1971 to 2013 was utilized to create a time series. The econometric methodologies of autoregressive regressive distributed lagged model and error correction were used in this study. Primary, secondary, and higher education enrolment, physical capital, and labor force participation rate were the variables considered in this analysis. The economic survey of Pakistan, labor force surveys, and world bank data were the primary data sources. According to the findings, all variables had a positive impact on the economy. Khan *et al.* (2019) the role of female education in Pakistan's national economic development was investigated. From the years 2001 to 2014, time series data were utilized to make this estimate. School enrollment, primary, female (percent gross) designated as PE and primary education, school enrollment, secondary, female (percent gross), and teachers (percent female) were variables included in this calculation. The world development indicators and the world bank were the primary data sources. For this investigation, an econometric approach called ordinary least square (OLS) was applied. The findings suggest that female participation in primary and secondary schools, as well as female teachers, has a positive relationship with Pakistan's economic development.

Ahmad *et al.* (2020) discussed the relationship between education and economic development in Pakistan. The time series data was used for this estimation during the period from 1979 to 2015. An econometric autoregressive distributed lag model (ARDL) was used. The variables used in this study

were variables Unemployment, growth of the population, indirect tax and education. The main data sources were the Handbook of statistics on Pakistan, international financial statistics and the Economic Survey of Pakistan. The research concludes that educations were an optimistic impact on growth. In Ali *et al.* (2020) the concepts of equipment investment, human capital, and economic growth were examined. The goal of this research was to look into the relationship between equipment investment, human capital, and Pakistani economic growth. From 1985 to 2017, time series data was used. Augmented dickey fuller (ADF), co-integration and Max Eigen value tests were used. The main variables of this model were education enrollment, total investment in plants and machinery and gross domestic product. World economic indicators, IMF and reports of the state bank of Pakistan were the main data sources. According to the findings of this study, there is a long-term relationship between trading, human capital investment, and Pakistani economic growth.

Faisal (2020) the impact of improvements in the educational sector on economic growth was investigated. For this estimation, panel data from seven ASEAN member nations was used from 2000 to 2014. The estimation included real gross domestic product (RGDP), Physical Capital as defined by gross fixed capital formation (GFCF), labor force participation rate (LFPR), and education as measured by primary and secondary school enrollment. The World Bank, IMF, and UIS UNESCO statistics were the primary data sources. The study found that primary school attendance had no effect on economic growth, but secondary and tertiary school enrollment had a large but negative influence. The returns to human capital were studied by Ali *et al.* (2021). Data from 1976 to 2019 was utilized to create the time series. In this estimation, the econometric approach known as auto-regressive distribution lag (ARDL) was utilized. Gross domestic product (GDP), education, mortality, unemployment, and age were the variables used in this study. The researchers concluded that as education levels rise, so will economic activity, and the key reason for this is female labor force involvement.

Sarwar *et al.* (2021) In Pakistan, the relationship between economic expansion and educational evolution was investigated. Between 1973 and 2018, time series data was used. The real gross domestic product (RGDP), real gross fixed capital formulation, and the total number of employed people were the variables used in the analysis, and all variables were in logarithmic forms. The main data sources were the Pakistani handbook of statistics, the world development index, and numerous economic surveys. They conclude that expanding education at the primary and secondary levels has a beneficial impact on economic growth. Minhaj (2021) the impact of human capital development on Pakistan's economic growth was investigated. Co integration was applied to data from time series between 1981 and 2017. These were the econometric techniques employed in this estimation. The major factors were gross domestic product (GDP), government expenditure on health, and government expenditure on education. The results of this model revealed that in Pakistan, human capital has a direct impact on economic growth.

Although many studies exist related to education, human capital, and endogenous growth, the analysis of these studies is based on past years. In this study, I will explain the current analysis. Moreover, I will use the latest techniques like the nonlinear autoregressive distributed lag model (NARDL) while previous studies use other techniques. Secondly, the past studies were based on individual analyses like education and human capital, while my study will explain the combined impact of education, and human capital on economic growth. I will also discuss the reasons behind low education and human capital. It is important to know about these reasons and also how we can increase literacy rates, human capital, and endogenous growth. So the current study will answer all these questions.

**3. Data, Methodology, and Model Specification**

The investigation will use time series data from 1990 through 2021. Inflation (INF), trade (TRADE), and gross fixed capital formation (GFCF) are all independent variables, while GDP, education enrollment (EDUENROLL), and human capital (HUMCAP) are all dependent factors.

To test this study, researchers have developed three models, as explained below:

$$GDP_t = \beta_0 - \beta_1INF_t + \beta_2TRADE_t + \beta_3EDUENROLL_t + \mu_t \dots\dots\dots (3.1)$$

Here in our first model gross domestic product (GDP) is a dependent variable while inflation, trade and education enrollment are independent variables.

$$HUMCAP_t = \beta_0 + \beta_1GFCF_t + \beta_2EDUENROLL_t - \beta_3INF_t + \mu_t \dots\dots\dots (3.2)$$

In our second model, human capital is a dependent variable while independent variables are gross fixed capital formation, inflation, and educational enrollment.

$$EDUENROLL_t = \beta_0 + \beta_1GFCF_t + \beta_2TRADE_t - \beta_3INF_t + \mu_t \dots\dots\dots (3.3)$$

In this third model, education enrollment is a dependent variable while independent variables are inflation, gross fixed capital formation, and trade.

In the above models,  $\beta_0$  is considered the intercept, whereas  $\beta_{1,2,3}$  are the slope coefficients.  $\mu_t$  is the error term in the model.

**3.1 Data Sources**

Different major macroeconomic variables are included in our analysis, all of which have a positive or negative relationship with one another. The numerical data for all of the variables considered in this study was gathered from various data sources. The data set as well as the sources of variables must be correct and authentic to conduct accurate research. Only in this manner could the results and conclusion be admirable. Secondary sources were used to compile the data for this study. Overall data for all indicators were gathered from the world development indicator (WDI), whereas the data for education enrollment was gathered from the Handbook of Statistics. The entire study was based on annual time series data from Pakistan from 1990 to 2021. One of the key reasons for choosing this historical period is that it is the most recent. Furthermore, only a few researchers conducted their research during this period. As a result, this research aims to fill that void.

**3.2 Procedure of Estimation**

This section focuses on tests, their interpretation, and estimation conclusions. The data stationery is important. The first three sections present descriptive statistics, while the second section presents a five-part estimation approach. The unit root test was put in the third part of the estimation. NARDL and bound tests were explored in the 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> parts.

**3.2.1 Descriptive Statistical Analysis**

In statistical analysis, we will discuss here the results of descriptive statistics and then the correlation matrix.

**Table 1: Descriptive Estimation 1990-2021**

Variables	Mean	Std. Deviation	Skewness	kurtosis
EDUENROLL	940075.1	461831.7	0.3783	1.7374
HUMCAP	5.5462	1.0850	-0.0791	3.5710
GDP	3.8591	2.1173	-0.1897	2.5997
GFCF	15.6469	1.7987	0.1623	1.9287
TRADE	28.4513	7.4664	-1.5391	4.3977
INF	8.5372	3.9899	0.5353	3.5428

Author's estimations based on E views 9.5

In the statistical analysis, we mostly looked first at the mean value and standard deviation of the variables. Furthermore, skewness and kurtosis are two further methodologies that can be used to measure the probability distribution as well as the moment of distribution in this research. These are the two most common methodologies utilized in any measurement analysis. We'll start by looking at the mean values and standard deviations of each variable. The mean values are education enrollment, human capital, gross domestic product, gross fixed capital formation, trade, and inflation, 940075.1, 5.5462, 3.8591, 15.6469, 28.4513, and 8.5372, respectively. In addition, the standard deviations of all variables such as education enrollment, human capital, gross domestic product, gross fixed capital formation, trade, and inflation seem to be 461831.7, 1.0850, 2.1173, 1.7987, 7.4664, and 3.9899, respectively. After that, we will discuss the results of kurtosis and skewness. If the skewness is zero, the distribution will be symmetric, and if the skewness is greater than zero, the distribution will be asymmetric. In the current study, gross domestic product, gross fixed capital formation, Inflation, human capital, and Education Enrollment have symmetric distributions, whereas trade has an asymmetric distribution. Gross domestic product, human capital, and trade are negatively skewed. On the other hand, the variables of gross fixed capital formation, inflation, and education enrollment are positively skewed. The Kurtosis will now be explained. Kurtosis is divided into two types: leptokurtic and Plato-kurtic. In our opinion, inflation, human capital, and trade are lapto kurtic, whereas gross domestic product, gross fixed capital formation, and enrollment in education are Plato kurtic.

**Table 2: Correlation Matrix of Variables**

Variables	EDUENROLL	HUMCAP	GDP	GFCF	TRADE	INF
EDUENROLL	<b>1</b>					
HUMCAP	-0.1167	<b>1</b>				
GDP	-0.0627	0.2882	<b>1</b>			
GFCF	-0.5882	-0.2285	0.2846	<b>1</b>		
TRADE	-0.4683	0.2380	0.4309	0.4411	<b>1</b>	
INF	-0.0946	-0.4219	-0.3228	0.3029	0.2527	<b>1</b>

Author's estimations based on E views 9.5

The overall correlation level among the model's variables is shown in the table above. All other indicators, such as human capital, gross domestic product, gross fixed capital formation, trade, and inflation, have a negative connection with education enrollment. Human capital, on the other hand, has a negative association with gross fixed capital formation and inflation while having a positive link with gross domestic product and trade. Trade and inflation have a positive association with the gross domestic output. Trade and inflation have a positive association with gross fixed capital formation. Inflation and trade have a favorable association.

**3.2.2 Empirical Analysis**

In this empirical analysis, we will show the results of nonlinear autoregressive distributive lag (NARDL). The bound test values will be shown before the short and long run results.

**Table 3: Bound Test**

	<b>1<sup>st</sup> Model</b>		<b>2<sup>nd</sup> Model</b>		<b>3<sup>rd</sup> Model</b>	
	<b>F-- Statistics =7.097942</b>		<b>F-- Statistics =5.130661</b>		<b>F- Statistics =6.373137</b>	
<b>Significance</b>	<b>I (0)</b>	<b>I (1)</b>	<b>I (0)</b>	<b>I (1)</b>	<b>I (0)</b>	<b>I (1)</b>
<b>10 %</b>	2.2	3.09	2.2	3.09	2.2	3.09
<b>5 %</b>	2.56	3.49	2.56	3.49	2.56	3.49
<b>1 %</b>	3.29	4.37	3.29	4.37	3.29	4.37

Author's estimations based on E views 9.5

The study is put through a bound test to see if the model has co-integration and long-term association. If the f-statistics result of the bound test is less than the upper and lower bounds, the model does not have any long-term relationship or co-integration. Bound testing results meet the condition that the F-test value must demonstrate the presence of a long-term relationship between the dependent and independent variables. As a result, we can say that co-integration occurs here, as well as demonstrate that there is a long-term link between the variables of the study. Here we can easily apply NARDL to such models. The researcher will now give the NARDL short-run and long-run findings.

**Table 4: Estimates for the Short Term**

<b>Estimates for the Short Term</b>			
<b>Variables</b>	<b>1<sup>st</sup> Model</b>	<b>2<sup>nd</sup> Model</b>	<b>3<sup>rd</sup> Model</b>
D(GDP(-1))	0.1792 (0.0848) [1.9361]	.....	.....
D(INF-POS)	0.0376 (0.6280) [0.5015]	.....	.....
D(INF-POS(-1))	0.1840 (0.0516) [2.2428]	.....	.....
D(INF-POS(-2))	0.2894 (0.0127) [3.0999]	.....	.....
D(INF-NEG)	-0.5608 (0.0012) [-4.6531]	.....	.....
D(INF-NEG(-1))	0.20284 (0.1872) [1.4274]	.....	.....
D(TRADE)	0.2345 (0.0014)	.....	-1029.2642 (0.8901)

	[4.5376]		[-0.1401]
D(TRADE(-1))	-0.0173 (0.7828) [-0.2839]	.....	-31257.5875 (0.0097) [-2.8736]
D(TRADE(-2))	-0.1411 (0.0473) [-2.2964]	.....	.....
D(EDUENROLL)	-0.000003 (0.0278) [-2.6204]	-0.000001 (0.0900) [-1.8316]	.....
D(EDUENROLL(-1))	-0.000014 (0.0000) [-8.4230]	0.000002 (0.0060) [3.2748]	-0.7858 (0.0000) [-5.7863]
D(EDUENROLL(-2))	-0.000011 (0.0001) [-6.8004]	0.000001 (0.1511) [1.5253]	-0.5382 (0.0083) [-2.9462]
D(EDUENROLL(-3))	-0.000011 (0.00002) [-6.1277]	.....	.....
D(GFCF-POS)	0.1909 (0.2423) [1.2250]	.....	67338.6016 (0.0787) [1.8582]
D(GFCF-NEG)	-0.6254 (0.0007) [-4.3876]	.....	-46951.8326 (0.1890) [-1.3625]
D(GFCF-NEG(-1))	0.5907 (0.0044) [3.4424]	.....	.....
D(GFCF-NEG(-2))	0.2404 (0.1158) [1.6852]	.....	.....
D(INF)	.....	0.043280 (0.1297) [1.6176]	-14945.6928 (0.0887) [-1.7944]
Coint Eq (-1)	-0.8190	-0.7375	-0.4795

Author's estimations based on E views 9.5

**Note:** values in ( ) show probability, and values in [ ] show t- statistics while without bracket values are coefficient values.

The above table shows the results of the short-run results of NARDL. In these models, variables that show insignificant relationships are because of the short time period. In the long run, these variables will be significant. In the above three models, the condition for co-integration value is fulfilled with the values of -0.8190, -0.7375, and -0.4795, respectively, with the signs of negative and less than 1.

Table 5: Estimates for the Long Run

Estimates for the Long Run			
Variables	1 <sup>st</sup> Model	2 <sup>nd</sup> Model	3 <sup>rd</sup> Model
INF- POS	-0.814607 (0.0064) [-3.5300]	.....	.....
INF-NEG	-0.6085 (0.0272) [-2.6341]	.....	.....
TRADE	0.683781 (0.0185) [2.8693]	.....	90040.1452 (0.0357) [2.2601]
EDUENROLL	0.000010 (0.0600) [2.1502]	-0.000004 (0.0016) [-3.9739]	.....
GFCF-POS	.....	-0.5957 (0.0217) [-2.2668]	147443.5916 (0.0315) [2.3220]
GFCF- NEG	.....	-0.873427 (0.0012) [-4.1379]	-54993.4212 (0.1856) [-1.3734]
INF	.....	-0.0163 (0.8025) [-0.2531]	-34626.8451 (0.1282) [-1.5906]
C	-22.1896	7.0630	-2692600.8182

Author's estimations based on E views 9.5

**Note:** values in ( ) show probability, and values in [ ] show t- statistics while without bracket values are coefficient values.

The gross domestic product (GDP) is a dependent variable and inflation, trade, and education enrollment are independent variables in the first model. Empirical results show that the coefficient of inflation has a negative connection with gross domestic product. The coefficient value of inflation shows a negative and significant impact on gross domestic product. When inflation increases by 1%, then the dependent variable gross domestic product decreased by -0.814607. Inflation's coefficient value likewise has a negative and considerable impact on gross domestic product. A one-percentage-point decrease in inflation implies a 0.68544% decrease in gross domestic product. Inflation can be seen to differ between positive and negative shocks. Positive shocks in inflation show better results as compared to negative shocks. Now let's discuss the reasons behind this negative relationship between inflation and gross domestic product. Inflation means that prices have gone up. Inflation reduces the purchasing power of money, lowering consumption and, as a result, gross domestic product. High inflation can make investment less desirable because it creates uncertainty about the future, and it can also affect the balance of payments by raising the cost of exports. As a result, the gross domestic product continues to decline, and inflation looks to be negatively connected. Mamo (2012) also mentions that inflation and

gross domestic product have a negative relationship. The results are also consistent with those (Gokal and Hanif, 2004).

The trade coefficient value reveals a positive link between gross domestic product and trade. It has a probability value of 0.0185 and is significant statistically. A one-percentage-point increase in trade results in a 0.68-percentage-point increase in gross domestic product. The reason for this positive relationship between trade and the gross domestic product is that the total value of goods and services exported by domestic producers exceeds the total value of goods and services imported by domestic producers, and gross domestic product increases when there is a trade surplus. Bouoiyour (2003) also shows that trade and gross domestic product have a favorable link. These outcomes also match those of (Zestos and Tao, 2002). Education enrollment has a significant and positive impact on gross domestic product. The dependent variable, gross domestic product, will grow by 0.00010 for every unit increase in education enrollment. It means that education enrollment is a source of increased gross domestic product because an educated society has a high level of productive efficiency as well as rapid growth rates. Afzal *et al*, (2011) also state that there is a positive relationship between education enrollment and gross domestic product. This study's empirical findings are consistent with (Afzal *et al*. 2013).

Human Capital is the dependent variable in Model 2, whereas Gross Fixed Capital Formation (GFCF), Education Enrollment (EDUENROLL), as well as Inflation (INF) are the independent variables. In this model, all dependent variables show a negative impact on dependent variables. Positive shocks in gross fixed capital formation show a negative and considerable effect on human capital. When inflation rises by one percent, the dependent variable falls by 0.695754 percent. Due to the negative shock in inflation, the dependent variable will decrease by 0.873427. However, we can easily see the difference between the positive and negative shocks of inflation. Hence, a positive shock in gross fixed capital formation shows better results as compared to a negative shock. The reason for this inverse relationship between gross fixed capital formation and human capital is that when gross fixed capital formation increases its mean investment, job opportunities will increase, and therefore human capital will decrease. Onuoha and Oyeyemi (2019) also discuss the inverse relationship between gross fixed capital formation and human capital. The results are also consistent with those (Lydeka and Karaliute, 2021).

Education enrollment shows a negative and significant impact on human capital. It means one unit increase in education enrollment means the dependent variable human capital will decrease by 0.000004. The reason for this result is that when education enrollment increases, more people will be educated and, due to increased opportunity for jobs, human capital will decrease (Sharif *et al*. 2017; and Clarke 2016). The dependent variable, human capital, will drop by 0.0163994 for every 1% increase in inflation. These results support the Phillips curve, which states that inflation and unemployment have an inverse relationship. Umaru and Zubairu (2012) also show a negative relationship between inflation and human capital.

In model 3, the dependent variable is education enrolment, while the independent variables are gross fixed capital formation (GFCF), trade, and inflation (INF). Gross fixed capital formation Pos shows a positive and significant impact on education enrollment. With a 1% increase in gross fixed capital formation, the dependent variable will rise to 147443.59. Gross fixed capital formation decreased by 1% due to a decrease in the dependent variable to 54992.4212. It demonstrates that gross fixed capital formation has a positive correlation with educational enrollment. The reason for this positive relationship is that gross fixed capital formation means investment, so when there is an increase in investment in terms of new colleges, universities, and schools and highly qualified new

teachers, education enrollment will decrease (Ngwenyama *et al.* 2006; and Jaiyeoba, 2015).

Trade shows a positive and significant impact on education enrollment. If trade grows by 1%, the dependent variable will grow by 90040.145274. The reason behind this positive relationship is that when trade increases, the gross domestic product will increase automatically, and as a result, education enrollment will increase. Sasongko and Huruta (2019) support our results that trade has a positive effect on education enrolment. The results of the current study also match those of (Owen and Wu, 2007). Inflation has an unconstructive and insignificant impact on education enrollment. The dependent variable, education enrollment, will decrease by 34626.84 for every 1% increase in inflation. The reason behind this negative relationship is that when inflation increases, people will face a lot of difficulties with education. Therefore, education enrollment will decrease (Rousseau and Wachtel, 2001; and Afzal *et al.* 2010).

### 3.2.3 Diagnostic Checking

Diagnostic tests are used to examine the models' heteroskedasticity, correlation, and misspecification. The Breusch- Godfrey serial correlation LM tests were used in this work to see if the model had autocorrelation, and the WHITE test was used to discover the problem of heteroskedasticity.

**Table 6: Diagnostic Checking**

Diagnostic Checking			
Tests name	1 <sup>st</sup> Model	2 <sup>nd</sup> Model	3 <sup>rd</sup> Model
	F- Statistics Probability	F- Statistics Probability	F- Statistics Probability
<b>Breusch-Godfrey correlation LM Test</b>	1.1871 (0.3598)	0.3323 (0.7242)	1.0050 (0.3868)
<b>White Test Heteroskedasticity</b>	1.9996 (0.1653)	0.3743 (0.9603)	0.4726 (0.8752)

Author's estimations based on E views 9.5

Two tests are utilized in the diagnostic checking table above. Serial correlation of Breusch-GodfreyLM test F-statistics values is 1.1871, 0.3323, and 1.0050, with probability values of 0.3598, 0.7442, and 0.3868 for three models, respectively. These values are far from 0.05, so there is no serial correlation. The F-statistic values of the White test are 1.9996, 0.3747, and 0.4726 with a probability of 0.1653, 0.9603, and 0.8752, respectively. Our models are free of flaws, according to the diagnostic testing.

## 4. Conclusions and Policy Recommendation

The study examines the education, human capital, and endogenous growth nexus in Pakistan. Nonlinear ARDL (NARDL) analysis was done by using 3 models in which the independent variables were a gross domestic product, human capital, and education enrollment, while the explanatory variables were inflation, trade, and education enrollment and gross fixed capital formation. According to the findings, inflation has a negative and considerable influence on the gross domestic product in the current study, by applying NARDL. Since the researcher used the NARDL technique, the data reveals that negative inflation shocks have a greater impact on a gross domestic product than positive inflation shocks. When inflation increases, then the gross domestic product will automatically decrease because inflation means "high prices," and when prices are high, the purchasing power of people will decrease, and as a result, the gross domestic product will fall. The commercial exchange of products and services

(buying and selling on domestic and international marketplaces) is referred to as trade, and when trade increases, people's purchasing quantities increase, as well as the income of sellers, and overall, the gross domestic product will increase "Education enrollment" means the aggregate of people who are in the learning process or educated. When most people are educated, then they put their share in the progress of the country's economy and also in economy. The current study also explains that when education enrollment increases, the gross domestic product will increase. Trade has a huge and beneficial impact on gross domestic product. Enrollment has a strong and considerable effect on gross domestic product. Human capital has a strong unfavorable impact on gross fixed capital formation. Inflation has a negative, insignificant impact on human capital. Trade has a substantial and constructive impact on education enrollment.

After reviewing numerous studies, the researcher attempts to provide some policy implications for the topic under consideration which may aid in improving the state of many economic components in Pakistan:

- Trade and education enrollment should increase to increase gross domestic product.
- Gross fixed capital formation should be increased to increase education enrollment.
- Education enrollment should increase for an improvement in gross domestic product.
- Inflation should be a top priority for policymakers as it's the main hurdle to increasing gross domestic product.

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