CHAPTER 5

EDUCATION EXPENDITURE AND ECONOMIC GROWTH: A CAUSALITY ANALYSIS

5.1 Introduction

This chapter deals with the results and their interpretations based on concerning models and tests. This chapter includes test of unit root which reveals the unit root characteristics of the indicators. In this chapter the unit root characteristics of variables are examined in both situations whether they are at level or at first difference. After examining the unit root characteristics the chapter goes to check the lag length test. It is so because it is necessary to find out the appropriate number of lags for the further analysis. Moving towards there are co-integration model and VECM model which present the association among the variables and causality respectively.

5.2 Unit Root Test

Stationarity of indicators has been analyzed by applying Augmented Dickey Fuller (ADF) test. The natural log of all the variables has been used to check the unit root. Stationarity has been decided at three criteria which are: (a) only intercept, (b) including trend and intercept and (c) no trend and intercept. Rejection of null Hypothesis i.e. there is Unit root among the variables has been decided on the following assumptions[1]:

i. Absolute value of test statistics and critical value.

[1] For an accessible discussion, see Damodar Gujrati Econometrics by Example, chapter 13, p.no.211.

ii. The probability value (P- value) should be significant.

5.2.1 Unit Root Test at level

In the time series analysis, it is necessary for the variables to be stationary. It is so due to the misspecification of the results. Since the Vector Auto Regressive (VAR) Model is used to analysed the dynamic interrelation among the stationary variables. It is so the first step in the time series analysis is to examine that whether the levels of the data are stationary.

Table 5.1: ADF Test at Level

Variables	ADF model	test statistics	P-value	critical value		
				1%	5%	10%
GDP	Intercept	1.985	0.061	-3.750	-3.000	-2.630
	Trend & intercept	-2.337	0.031	-4.380	-3.600	-3.240
	None	15.553	0.000	-2.660	-1.950	-1.600
Elem	Intercept	-2.224	0.039	-3.750	-3.000	-2.630
	Trend & intercept	-2.649	0.017	-4.380	-3.600	-3.240
	None	0.363	0.720	-2.660	-1.950	-1.600
Sec	Intercept	-1.911	0.077	-3.750	-3.000	-2.630
	Trend & intercept	-2.255	0.042	-4.380	-3.600	-3.240
	None	-0.117	0.908	-2.660	-1.950	-1.600
Univ	Intercept	-2.519	0.025	-3.750	-3.000	-2.630
	Trend & intercept	-2.440	0.030	-4.380	-3.600	-3.240
	None	0.429	0.674	-2.660	-1.950	-1.600

Source: Calculated by Author by Stata12

The above table (5.1) shows that all variables taken in this study such as GDP, Elementary Education Expenditure, Secondary Education Expenditure and University

Education Expenditure are satisfying all three criteria such as intercept, trend and intercept and no trend and intercept. The test statistics for intercept are 1.985, -2.224, -1.911 and -2.519 for GDP, elementary education expenditure, secondary education expenditure and university education expenditure respectively. The absolute values of test statistics are less than 5% critical value. Which indicate that the null hypothesis cannot be rejected. It means that the variables are unit root or not stationary at level.

The test statistics for trend and intercept are -2.337, -2.649, -2.255 and -2.440 for GDP, Elementary education Expenditure, Secondary Education Expenditure and University Education Expenditure respectively. The absolute value of test statistics are less than the critical value at 5% level of significance. It indicates that the null hypothesis cannot be rejected. It means that the variables are unit root or not stationary at level.

In the case of no trend and intercept the test statistics are 15.553, 0.363,-0.117 and 0.429 for GDP, Elementary Education Expenditure Secondary Education Expenditure and University Education Expenditure respectively. The absolute value these test statistics are less (except GDP) than critical value at 5 % level of significant. It indicates that the null hypothesis cannot be rejected. It means the variables are unit root or not stationary at this level.

5.2.2: Unit Root Test at Level I (After first difference)

Since the vector autoregressive (VAR) model is a general framework used to analyse the dynamic interrelationship among stationary variables. So, the first step in time-series analysis is to check whether the levels of the data are stationary. If not so, take the first differences of the series and try again. Usually, if the data are not stationary at levels (or log-levels) then at the first differences they will be stationary.

Table 5.2: ADF Test Result: After First Difference						
Dependent Variables	ADF Model	Test Statistics	P-value	Critical Value		
				1%	5%	10%
GDP	Intercept	-3.806	0.001	-3.75	-3.00	-2.63
	Trend & intercept	-3.409	0.003	-4.38	-3.60	-3.24
	None	-0.558	0.583	-2.66	-1.95	-1.60
Elem	Intercept	-8.781	0.000	-3.75	-3.00	-2.63
	Trend & intercept	-8.550	0.000	-4.38	-3.60	-3.24
	None	-8.937	0.000	-2.66	-1.95	-1.66
Sec	Intercept	-4.377	0.000	-3.75	-3.00	-2.63
	Trend & intercept	-4.259	0.000	-4.38	-3.60	-3.24
	None	-4.488	0.000	-2.66	-1.95	-1.60
Univ	Intercept	-4.029	0.001	-3.75	-3.00	2.63
	Trend & intercept	-3.974	0.001	-4.38	-3.60	-3.24
	None	-4.014	0.001	-2.66	-1.95	-1.60

Source: Calculated by Author by Stata12

The above table 5.2 reveals that indicators taken for the purpose of study are satisfying at least one of the criteria for unit root determination. The above table 5.2 shows that in the case of intercept the test statistics are -3.806,-8.781, -4.377 and -4.029 for GDP, Elementary education Expenditure Secondary Education Expenditure and University Education Expenditure respectively. The absolute values are more than critical values at 5 % level of significance. It indicates that the null hypothesis can be rejected. It means that the variables are stationary at level one.

In the case of trend and intercept the test statistics are -3.409,-8.550, 4.259 and -3.974 respectively. The absolute values of test statistics are more than 5% critical value. It indicates that the null hypothesis can be rejected. It means that the variables are stationary.

In the case of no trend and intercept the test statistics are -0.558,-8.937,-4.488 and-4.014 for GDP, Elementary Education Expenditure, Secondary Education Expenditure and University Education Expenditure respectively. The absolute values of test statistics are more (except GDP) than 5% critical value. It indicates that the null hypothesis can be rejected. It means the variables are stationary. However the variables are stationary at level one which is desirable for the VECM analysis.

5.3 Lag Length Test

Lag selection is crucial in applying model for analysis purpose in a study. Based on the vector Error Correction model it is important to select appropriate lag order. It is so because it ensures that the findings of the study is showing the real economic circumstances. It is also important to reveal the consistency of findings with economic theories as well as econometrics theories (Hussin 2012).

Table 5.3: Lag Length Test

Lag Length Test	LL	Sequential Modified Criteria (LR)	Final Prediction Error(FPE) Criteria	Akaike Information Criterion(AIC)	Hannan- Quinn Information Criterion (HQIC)	SBIC	P-Value
0	-798.222		1.1e+36	94.3791	94.3986	94.5751	
1	-730.317	135.81	2.7e+33	88.2726	88.37	89.2528	0.000
2	-679.253	102.13	6.7e+31*	84.1474	84.3228	85.9119	0.000
3	-652.783	52.94	8.4e+31	82.9156	83.169	85.4643	0.000
4	1244.13	3793.8*		-138.369	-138.038	-135.036	0.000
5	1254.79	21.303		-139.622*	-139.291*	-136.289*	0.167
6	1220.83	-67.904		-135.628	-135.296	-132.295	

Source: Calculated by Author by using Stata12.

The table (5.3) reveals the results for appropriate lag selection. In this table there are many criterion on which it is decided that how many lags should be taken for the analysis in this study. On the basis of Akaike Information Criterion (AIC), Hannan- Quinn Information Criterion (HQIC) and SBIC criteria, five lags has been taken for the purpose of analysis. In this table appropriate lag order is indicated by *. Out of the six criteria, maximum three criteria such as Akaike Information Criterion (AIC), Hannan- Quinn Information Criterion (HQIC) and SBIC have suggested the maximum lag five and p-value which is less than 5% has also suggested to take this model as significant. Thus Majority has suggested to take maximum lag five for analysis in this study.

5.4 Johansson Co- integration Test

It is a pre diagnostic to ensure that whether variables are co-integrated or not. To avoid the problems of spurious regression, it is necessary to test for co-integration. In this test it is assumed that variables taken are non-stationary or got unit root at level but it should be stationary after first difference which is full filled by the ADF test (Table 5.1 and 5.2) in this study. In this study natural log of variables has been utilized.

After ensuring that the variables are non-stationary at level and stationary after first difference, it is necessary to test whether they are co-integrated or not. For this purpose I have applied Johansen Multivariate co-integration test. In the case of co-integration test, the null hypothesis can be examined by Johansen's maximum likely hood method the maximum rank zero indicates that there is no co-integrated equation. Maximum rank one indicates that there is one co-integrated equation. The maximum rank two indicates that

there is two co-integrated equation. This test includes two approaches such as Trace statistics approach and maximum Eigen value approach.

The assumptions for the co-integration are as follow:

- The trace statistics should be more than 5% critical value
- Maximum Eigen value statistics should be more than 5% critical value

The above assumptions lead to the rejection the null hypothesis.

Table 5.4: Johansson Co-integration Test

	Trace statistics			Max statistics		
Maximum rank	Eigen value	Trace statistics	5% critical value	Eigen value	Max statistics	5% critical value
0	.	74.1301	47.21	.	48.6339	27.07
1	0.89037	25.4961*	29.68	0.89037	20.7594	20.97
2	0.61078	4.7367	15.41	0.61078	4.6182	14.07
3	0.18935	0.1185	3.76	0.18935	0.1185	3.76

Source: Calculated by Author by using Stata12.

The above table 5.4 reveals the results of both statistics Trace statistics and maximum Eigen value. These values indicates the co-integration among the variables.

The value of trace statistics (74.1301) as well as maximum Eigen value statistics (48.6339) are more than 5% critical value at maximum rank zero. It leads to reject the null hypothesis that there is no co-integration equation or zero co-integration. The value of trace statistics (25.4961) as well as maximum Eigen value statistics (20.7594) are more than 5% critical value at maximum rank one. It leads to reject the null hypothesis that there is one co-integration equation.

The value of trace statistics (40.576) as well as maximum Eigen value statistics (20.791) are less than 5% critical value at maximum rank two. It indicates that the null hypothesis cannot be rejected which is, there is two co-integration equation.

The results of co-integration test including trace statistics and max statistics (table 5.4) shows that there are two co-integration equations. Thus Johansen co-integration test confirms that there is long run association among the variables taken in this study.

5.5 Vector Error Correction Model (VECM) Analysis

After identifying that the variables are co-integrated it is useful to apply the Vector Error Correction Model (VECM) to analyse the long run and short run causality among the variables. The findings for the endogeneity of education expenditure and economic growth (GDP) are based on the following assumptions:

i. Sign of coefficient of Co-integrating equation or error correction term: The sign of the co-efficient of the co-integration equation or error correction term deals with the long run and short run causality among the variables. If the coefficient of error correction term has negative sign it indicates the existence of long run causality from independent variables to dependent variables. On the other hand if the coefficient of error correction term has positive sign then it indicates the short run causality from independent variables to dependent variables.

ii. Probability value: The acceptance of the model has been decided as 5% level of significance.

Table 5.5: VECM Estimates for GDP and Education Expenditure

Dependent Variables	Statistics	Co-integrated equation (ce)1 L1	Independent Variables			
			GDP	Elem	Sec	Univ
GDP	co-efficient	-0.557	-0.125	0.002	0.020	-0.006
	standard error	0.233	0.204	0.003	0.012	0.012
	p-value	0.017	0.542	0.568	0.111	0.601

Source: calculated by Author by using Stata 12

In the above table 5.5, GDP is the dependent variable while GDP, elementary education expenditure, secondary education expenditure and university education expenditure are independent variables. The coefficient of error correction term has negative sign (-0.557) which indicates that the independent variables are causing GDP in the long run and the P-value is 0.017 which is less than 5% level of significance. It indicates that the model is significance of.

Table 5.6: VECM Estimates for Elementary Education Expenditure and GDP along with Other Sectoral Education Expenditures

Dependent variable	Statistics	Co-integrated equation (ce)1 L1	Independent Variables			
			GDP	Elem	Sec	Univ
Elem	co-efficient	-29.23	7.74	-0.25	0.31	-0.78
	standard error	17.57	15.44	0.23	0.94	0.92
	p-value	0.10	0.62	0.28	0.74	0.40

Source: Source: calculated by Author by Stata12

In the above table 5.6 elementary education expenditure is taken as dependent variable while GDP, elementary education expenditure, secondary education expenditure and university education expenditure are taken as the independent variables. The coefficient of error correction term has negative sign (-29.23) which indicates that the independent variables are causing elementary education expenditure in the long run but the P-value is 0.10 which is more than 5% level of significance. This p-value indicates the insignificance of the model.

Table 5.7: VECM Estimates for Secondary Education Expenditure and GDP Along with Other Sectoral Education Expenditures

Dependent variable	statistics	co-integrated equation (ce)1 L1	Independent Variables			
			GDP	Elem	Sec	Univ
Sec	co-efficient	-12.29	-10.05	0.25	0.12	-0.22
	standard error	11.91	10.47	0.16	0.64	0.62
	p-value	0.11	0.34	0.11	0.85	0.73

Source**:** Source: Calculated by Author by Stata12

In the above table 5.7, secondary education expenditure is taken as dependent variable while GDP, elementary education expenditure, secondary education expenditure and university education expenditure are taken as independent variables. The coefficient of error correction term has negative sign (-12.29) which indicates that the independent variables are causing secondary education expenditure in the long run. Here the P-value is 0.11which is more than 5% level of significance. This p-value indicates that the above model is the insignificant.

Table 5.8: VECM Estimates for University Education Expenditure and GDP Along with Other Sectoral Education Expenditures

Dependent variable	Statistics	co-integrated equation (ce)1 L1	Independent Variables			
			GDP	Elem	Sec	Univ
Univ	co-efficient	-10.13	-2.25	0.12	0.53	-0.87
	standard error	9.94	8.74	0.13	0.53	0.52
	p-value	0.31	0.80	0.35	0.32	0.10

Source**:** Source: Calculated by Author by Stata12

In the above table 5.8 university education expenditure is taken as a dependent variable while GDP, elementary education expenditure, secondary education expenditure and university education expenditure are taken as independent variables. Here the coefficient of error correction term has negative sign (-10.13) which indicates that the independent variables are causing university education expenditure in the long run. The P-value is 0.31which is more than 5% level of significance. This p-value indicates that the above model is insignificant.

5.6 VECM Statistically Viability

This section consists the tests which depict whether the model is statistically free from the autocorrelation problem. It also diagnoses whether the residuals are normally distributed.

5.6.1 Lagrange Multiplier (LM) Test for Autocorrelation

The Lagrange Multiplier test for autocorrelation was developed by Breusch (1978) and Godfrey (1978). It became a standard tool in applied econometrics. The test is performed through an auxiliary regression of the residuals on their lags and the independent variables (Doornik, 1996). In this test two forms are computed:

i. TR^2, where T is the sample size and the R^2 is the co-efficient of multiplier correlation in the auxiliary regression. This statistic has an asymptotic chi-square distribution.

ii. The F- test on the lagged residuals in the auxiliary regression.

Here the null hypothesis is there is no autocorrelation. This null hypothesis can be rejected if the probability value is less than 5%.

Table 5.9: Lagrange Multiplier (LM) Test for Residual Auto Correlation

lag	chi2	P-value
1	11.9235	0.74923
2	10.3985	0.84501
3	13.0094	0.67207
4	14.5848	0.55523
5	16.8468	0.39558

Source: Calculated by Author by Stata12

In the table 5.9 it is shown that the p-value is greater than 5%. It means the null hypothesis cannot be rejected. Which indicates that there is no auto correlation.

5.6.2: Jarque- Bera Test for Normally Distributed Disturbances

The Jarque-Bera test is type of LM test. It was developed to test normality, heteroscedasticity and serial correlation or autocorrelation of regression residuals (Jarque

and Bera 1980). The statistics in this test is computed from skewness and kurtosis. It follows the chi-squared distribution with two degrees of freedom.

Here the null hypothesis is residuals are normally distributed. Which can be rejected if the probability value is less than 5%.

Table 5.10: Jarque- Bera Test

Equation	chi2	P-value
d1lngdp	1.10	0.578
d1lnelem	1.56	0.458
d1lnsec	4.80	0.091
d1lnuniv	0.32	0.853
ALL	7.77	0.456

Source: Calculated by Author by Stata12

In the above table 5.9, the p-value is more than 5%. Meaning that the null hypothesis cannot be rejected. It means that the residuals are normally distributed.

Thus the results of LM test and Jarqie-Bera tests presented in the table 5.9 and 5.10 respectively confirms that there is no auto correlation or serial correlation problems as well as the residuals are normally distributed in the model taken in this study.

5.7 Hypothesis Testing

On the bases of the results of the tests conducted in this study the hypothesis (H_0) are discussed as follow:

- H_0 : Education expenditure (as a whole) does not cause GDP

  H_0 hypothesis is rejected for the causal relationship between education expenditure and economic growth.

- H_0: Elementary education expenditure does not cause economic growth in India.

  H_0 is not rejected for causal relationship between elementary education expenditure and economic growth.

- H_0: Secondary education expenditure does not cause economic growth in India.

  H_0 is not rejected for the causal relationship between secondary education expenditure and economic growth in India.

- H_0: University education expenditure does not cause economic growth in India.

  H_0 is not rejected for the causal relationship between university education expenditure and economic growth in India.