CHAPTER 6

CAUSALITY BETWEEN EXPENDITURE ON EDUCATION AND ECONOMIC GROWTH

6.1 Introduction

This chapter is an attempt which deals with different models adopted in the study in order to examine the causal relationship between educational expenditure and economic growth. The study starts with unit root/ stationarity test to check whether the series taken are stationary or not. And then after conforming the stationarity it moves to Cointegration test and a Vector Auto Regressive (VAR) model to check the association among variables.

6.2 Unit root test

The study anticipates a VAR model in which it is desirable that the variables may be non-stationary at level but, after first or second difference they should become stationary. This study uses Augmented Dickey Fuller (ADF) test to examine whether the series got unit root or not. The variables are taken in the natural log form and tested at level, at first difference and at second difference. And in each stage variables are tested for three criteria: only intercept, intercept with trend, no trend no intercept.

Hypothesis for ADF test are:

H0: variable got unit root or not stationary

H1: variable is stationary

With the following assumption, the null hypothesis i.e. variable got unit root is rejected

i) Absolute value of test statistics should be more than critical value at 5% level of significance.
ii) P- Value should be significant at 5% level.

6.2.1 Unit root at level

In order to check and make the variable as stationary it is the first step to examine whether the variables at level got unit root or not.

Table No. 6.1 ADF test at level

Variable	GSDP			EDU		
ADF model	Intercept	Intercept with trend	No trend and intercept	Intercept	Intercept with trend	No trend and intercept
Test statistics	0.428	-1.782	5.788	0.271	-1.374	5.946
p-value	0.673	0.089	0.000	0.789	0.184	0.000
5% critical value	-3.000	-3.600	-1.950	-3.000	-3.600	-1.950

Source: *Calculated by Author using STATA 13*

Table No. 6.1 shows the result of ADF test at level. Analysing GSDP, the test statistics at three different models; intercept, intercept with trend, no trend and intercept are; 0.428, -1.782 & 5.788 respectively which are less than the 5% critical value (except no trend & intercept).

Analysing EDU, the test statistics at three different models; intercept, intercept with trend, no trend and intercept are; 0.271, -1.374, & 5.946 respectively which are less than the 5% critical value (except no trend & intercept).

The results indicate that the null hypothesis cannot be rejected which means variables got unit root or are non-stationary at level.

6.2.2 Unit root at first difference

In the first step, the variables got unit root or are non-stationary. So, to make them stationary this is the second step i.e. unit root at first difference.

Table No. 6.2 ADF test at first difference						
Variable	GSDP			EDU		
ADF model	Intercept	Intercept with trend	No trend and intercept	Intercept	Intercept with trend	No trend and intercept
Test statistics	-5.554	-5.730	-2.783	-3.144	-3.123	-1.688
p-value	0.000	0.000	0.011	0.005	0.005	0.105
5% critical value	-3.000	-3.600	-1.950	-3.000	-3.600	-1.950

Source: *Calculated by Author using STATA 13*

Table No. 6.2 shows the result of ADF test at first difference. Analysing GSDP, the test statistics at three different models; intercept, intercept with trend, no trend & intercept are; -5.544, -5.730 and -2.783 respectively which are more than the 5% critical value.

Analysing EDU, the test statistics at three different models; intercept, intercept with trend, no trend & intercept are; -3.144, -3.123, and -1.688 respectively which are less than the 5% critical value (except intercept)

The results indicate that the null hypothesis cannot be rejected which means variables still got unit root or are non-stationary at first difference.

6.2.3 Unit root at second difference

In the second step, the variables still got unit root or are non-stationary. So, to make them stationary this is the third step i.e. unit root at second difference.

Table No. 6.3 ADF test at second difference						
Variable	GSDP			EDU		
ADF model	Intercept	Intercept with trend	No trend and intercept	Intercept	Intercept with trend	No trend and intercept
Test statistics	-10.564	-10.326	-10.836	-5.227	-5.141	-5.349

p-value	0.000	0.000	0.000	0.000	0.000	0.000
5% critical value	-3.000	-3.600	-1.950	-3.000	-3.600	-1.950

Source: *Calculated by Author using STATA 13*

Table No. 6.3 shows the result of ADF test at second difference. Analysing GSDP, the test statistics at three different models; intercept, intercept with trend, no trend & intercept are; -10.564, -10.326 and -10.836 respectively which are more than the 5% critical value.

Analysing EDU, the test statistics at three different models; intercept, intercept with trend, no trend & intercept are; -5.227, -5.141 and -5.349 respectively which are more than the 5% critical value.

The p-value for all the model of GSDP as well as EDU are less than 5 % level, which shows the significance of the model.

The results indicate that the null hypothesis is rejected which means variables still got no unit root or are stationary at second difference which is desirable for further test of VAR or VECM.

6.3 Lag order selection test

Table No. 6.4 Lag order selection test

Lag	p-value	LL	LR	FPE	AIC	HQIC	SBIC
0		-438.956		1.2e+23	58.7942	58.7932	58.8886
1	0.000	-396.963	83.987	7.5e+20	53.7284	53.7254	54.0116
2	0.387	-394.893	4.141	1.0e+21	53.9857	53.9806	54.4577
3	0.053	-390.219	9.3467	1.0e+21	53.8959	53.8889	54.5567
4	0.009	-383.414	13.61	8.7e+20	53.5219	53.5129	54.3716
5	0.001	-374.33	18.17	6.9e+20	52.8439	52.8329	53.8824
6	0.000	-356.693	35.274	3.0e+20*	51.0257	51.0126	52.253
7	0.000	487.98	1689.3		-61.064*	-61.079*	-59.6479*

8		447.336	-81.287		-55.6448	-55.6599	-54.2287
9	0.000	483.609	72.546*		-60.4812	-60.4963	-59.0651
10		482.997	-1.2247		-60.3996	-60.4146	-58.9835

Source: *Calculated by Author using STATA 13*

This test is one of the vital test in this study as it decides the maximum lag to be taken in our model.

In Table No. 6.4 FPE (Final Prediction Error) criteria is suggesting to take lag 6 and LR suggesting 9 while all other three criteria; AIC (Akaike Information Criterion), HQIC (Hanan-Quinn Information Criterion), SBIC (Schwarz Information Criterion) are suggesting to take maximum lag of 7 which are denoted with star (*) in the above table. So, the maximum lags to be used for this study is seven.

6.4 Johansen Co-integration test

The mission is to determine in a bivariate framework whether or not expenditure on education (EDUEXP) and (GSDP) variables have association in long-run and the pre-condition is the variables are having unit roots at level and no unit root at first or second difference. The variables are taken with their natural log with the following hypothesis.

Hypothesis for Johansen Co-integration test is:

H0: There is no co-integration among variables

H1: There is cointegration among variables

Table No. 6.5 Johansen Co-integration test

	Trace statistics			**Max eigen value statistics**		
Maximum rank	Eigen value	Trace statsistics	5% critical value	Eigen value	max statsistics	5% critical value
0	-	38.8023	15.41	-	37.1484	14.07

1	0.87303	1.6539*	3.76	0.87303	1.6539*	3.76
2	0.08779	-	-	0.8779	-	-

Source: *Calculated by Author using STATA 13*

In Table No. 6.5 The trace statistics and maximum eigen value statistics suggest that null hypothesis can be rejected i.e. GSDP and EDU are cointegrated and have no long-run association.

The value of trace statistics 38.8023 and max statistics 37.1484 are more than the 5% critical value at maximum rank zero and 1.6539 for both trace statistics and max statistics which is less than 5% critical value at maximum rank 1. So, the model suggests that null hypothesis can be rejected meaning variables are cointegrated with each other i.e. GSDP and EDU have long run association.

6.5. Granger Causality test

The granger causality test helps in determine the directional causality i.e. whether the one variable with lags jointly can cause the other variable or not. This test will also help in determine one of the two hypotheses of the study i.e. whether there is bi-directional causality between variables or not.

Hypothesis for Granger Causality test are:

H0: all the GSDP lagged variable does not cause EDU

H0: all the EDU lagged variable does not cause GSDP

Table No. 6.6 Granger Causality test					
Null	**Equation**	**excluded**	**Chi 2**	**P-value**	**Decision**
EDU does not Granger cause GSDP	lnGSDP	EDU	15.754	0.008	Reject
		ALL	15.754	0.008	
GSDP does not Granger cause EDU	lnEDU	GSDP	32.763	0.000	Reject
		ALL	32.763	0.000	

Source: *Calculated by Author using STATA 13*

As shown in the above Table No. 6.6 the null hypothesis is rejected as the p-values are less than the 5% level. The results suggest that there is bi-directional causality between GSDP and EDU. i.e. causality runs from EDU to GSDP as well as from GSDP to EDU.

6.6 Vector Error Correction Model (VECM)

We have already seen our two variable GSDP and EDU are cointegrated so it is clear that there is long run association between variable. Therefore, to check short run causality and the speed of convergence or divergence towards equilibrium the study tests the Vector Error Correction Model.

Table No. 6.7 VECM estimation for GSDP AND EDU				
Variables		**Statistics**		
	Independent variable	**Coefficient**	**Standard error**	**p-value**
Dependent variable = GSDP	Ce 1 L1	**-.0573964**	.243739	0.814
	EDU L1	-.0130109	.115066	0.910
	EDU L2	-.0586639	.1369286	0.668
	EDU L3	-.1874557	.1198328	0.118
	EDU L4	-.1583167	.117433	0.178

	Independent variable	Coefficient	Standard error	p-value
Dependent variable = EDU	Ce 1 L1	**.9746606**	.4440117	0.028
	GSDP L1	.4440117	.6987905	0.195
	GSDP L2	-.9371199	.6346489	0.140
	GSDP L3	-1.167209	.6203342	0.060
	GSDP L4	.562933	.6064213	0.353

Source: *Calculated by Author using STATA 13*

Table No. 6.7 shows coefficient of error correction term, standard error, and p-value of variables at different lag. As shown above the p-values for all the variables are more than 5% level which shows the insignificancy off model. And the negative sign of error correction term of GSDP as independent variable shows there exist a long run causality and at a speed of 5.73 % it is going to be converge towards equilibrium in future. And the positive error correction term confirms there is no long-run causality running from GSDP to EDU.

6.6.1 Post estimation- Testing of linear hypothesis (short-run causality)

This test examines whether there is any short run causality running from variables by testing the linear hypothesis i.e. coefficient with all lags in specific equation are zero.

H0: There is no short-run causality running from EDU (with all lags) to GSDP

CHI^2	6.77
P-value	0.1486

Null hypothesis cannot be rejected as p value is more than 5% value.

Hence the test confirms that only long run causality is running from EDU to GSDP and no short run causality is running in the same direction.

H0: There is no short-run causality running from GSDP (with all lags) to EDU

CHI^2	11.30
P-value	0.0234

Null hypothesis is rejected as p value is less than 5% level.

Hence, the test confirms that only short-run causality is running from GSDP to EDU and no long-run causality is running in the same direction.

6.7 Diagnostic checking of VECM

6.7.1 LM test for autocorrelation

Table No. 6.8 LM test for autocorrelation

Lag	Chi 2	P-value
1	0.2708	0.99162
2	3.6234	0.45936
3	5.8498	0.21065
4	9.2765	0.05455
5	3.9691	0.41020

Source: *Calculated by Author using STATA 13*

H0: there is no auto correlation at lag order

In Table No. 6.8 P-values for all the lag order are more than 5% level, means we cannot reject the null hypothesis. Hence it is concluded that there is no autocorrelation.

6.7.2 Jarque bera Test for Normality

Table No. 6.9 Jarque- Bera test

Equation	Chi 2	P-value
lnGSDP	0.283	0.86804
lnEDU	0.104	0.94940

ALL	0.387	0.98354

Source: *Calculated by Author using STATA 13*

HO: residuals are normally distributed

In Table No. 6.9 P-values for all the models are more than 5% level. So, null hypothesis cannot be rejected. Hence it is concluded that the model as a whole, residuals are normally distributed.

6.6 Testing of Hypothesis:

- H0: there exists no long run relationship between GDP and EDU in Odisha.

H0 is rejected as Johansen Cointegration Model proved that variables cointegrated, which means there is long run relation between GSDP and EDU.