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Determinants of Economic Growth in Nepal: A Johansen Cointegration Analysis

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Abstracts: *This research study investigates the determinants of Economic Growth in Nepal. GDP growth is the dependent variable and import, export, exchange rate, foreign exchange reserve; gross capital formation and broad money supply are the explanatory variables. Data since 1965 to 2020 are taken from secondary sources of World Bank to find the relationship between them. Augmented Dickey- Fuller Test is run to test stationary condition in the variables. Result of Johansen Cointegration Test supports the existence of cointegration in the model. The coefficient of VECM is negative and significant expresses the long run relationship and Granger Causality Test indicates the two way causality between LNFER and LNM2 with LNGDP and one way causality from LNIMP and LNEXR to LNGDP but inverse causality is seen from LNGDP to LNEXP. Results confirm the variables are the determinants of economic growth in Nepal. So policy makers should consider on these variables for economic growth of the country.*
Keywords: Cointegration, economic growth, export, import, unit root

1. Introduction

The perpetual long term increase in Gross Domestic Product is taken as economic growth of the country. It is also termed as economic progress, economic welfare and sometimes economic prosperity. Among various theories of growth, the analysis of endogenous growth theory is centered on long term growth which is determined by government policies and other forces where capital is broadened that allows spillover effects. Economic growth can be boosted and diminishing return can be minimized by discovery of new ideas and technological progress Romer, (1994), Lucas (1988).

The determinants of economic growth from endogenous growth model include human capital, technology and public infrastructure. Furthermore Temple, (1999) explained human capital and research, development and other variables as determinants of growth. Again financial globalization, domestic government and macroeconomic policies are included in the extended determinants. In Russia Ledyaeva et al.,(2008) explains the determinants of economic growth are natural resources, investment, initial income, openness and corruption.
In this study GDP Growth is taken as dependent variable and import, export, exchange rate, foreign exchange reserve, gross capital formation and money supply etc are taken as explanatory variables. It explains the relationship between these explanatory variables and GDP Growth of Nepal because these factors have great impact on the country's GDP. GDP estimates the economic performance of the country and its position depends on the impact of these macroeconomic variables.

The economic growth of Nepal is not as higher as other developed country and only a few researches on the relationship between macroeconomic variables and economic growth can be found. But the economic growth of Nepal cannot be ignored so that this research study attempts to answer the question what relationship and impact can be found between macroeconomic variables and GDP Growth of Nepal. Based on this research question the objective of this study is to investigate the determinants of economic growth of Nepal. Johansen Cointegration Test is applied after Augmented Dickety- Fuller unit root test. After

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that VECM and Granger Causality Test are conducted to find out the long run relationship and direction of causality of the variables.

The rest of this paper includes: Literature Review in section (2), Methodology in section (3), in section (4) Econometric Result is presented and Conclusion and Discussion are presented in section (5).

1.2 Literature Review

Determinants of economic growth are explored in different literatures and a lot of variables are found to be the determinants of it. This is an extensive review on related literatures for the purpose of this study.

Adopting VEC and Granger causality models Adhikary, (2011) noted that there is long run relationship between trade openness, FDI, human capital, capital formation and economic growth in Nepal. FDI and trade openness has positive effect on economic growth but capital formation shows negative relationship with growth and human capital is insignificant factor for the relationship.

Explaining the economic growth of Nepal and neighboring countries Bajracharya, (2014) finds poverty of Nepal has come down in fifteen years in spite of lower economic growth. Rate of poverty can be decreased by increasing growth and it can be attained by production and productivity.

In the research study Ghimire et al., (2020) found the macroeconomic variables such as Foreign Direct Investment, Exchange Rate, Export, Gross Fixed Capital Formation as determinants of economic growth. They applied Karl Pearson's Correlation, Multiple Regression and Trend Analysis for the calculation of this study.

Studying cultural and institutional determinants Abrams & Lewis, (1995) present cultural, political, personal freedom and economic arrangements have significant relationship with economic growth. Again they state that other things being equal, lower income earning countries grow faster than higher income earning countries in the world.

Examining 74 Region in Russia during 1996 to 2005 Ledyaeva et al., (2008) find domestic investments, the 1998 financial crisis and initial economic development of the region are the determinants of economic growth. Growths between rich and poor regions are not converging during the period of study.

Benito, (2012) examined the determinants of economic growth with a Bayesian Panel Data Approach and finds that in panel setting the economic growth determinants are the distance to major cities of the world, political right and price of investment.

In the research article Ajide, (2014) shows economic freedom, labour, life expectancy and degree of openness are significant to show the relationship with economic growth in Tanzania and they are taken as determinants. Economic data show that the government has negative effect and freedom to trade shows positive effect on economic growth.

Studying the long- run determinants in South America, Vedia-Jerez & Chasco, (2016) present economic growth is strongly related with physical and human capital. They state sectorial export, institution and policy are also significant to economic growth but macroeconomic disturbances have negative impact on growth. They used two- equation framework for the analysis of historical database.

In the study of V4 countries and Romania's economic growth, Simionescu et al., (2017) investigate that economic growth is promoted by FDI in all countries except Slovak Republic. In Czech Republic the growth is promoted by education and expenditure but expenditure on R & D has positive impact in Romania, Czech Republic and Hungary.

2. Material and Methods Used

2.1 Research Design and Data Sources

This is the study to assess the relationship between economic growth and its determinants in Nepal. Data are extracted from the published sources of World Bank since

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1965 to 2020 A. D. Johansen Cointegration Test is applied after ADF test of Unit Root of entire data then VECM and Granger Causality Models are applied. Descriptive and analytical designs are used for the analysis of data from the secondary source.

2.2 Model formulation

In this study GDP is taken as dependent variables and import, export, exchange rate, foreign exchange reserve, growth capital formation and broad money supply are taken as explanatory variables. The base model showing these dependent and explanatory variables can be expressed as follows:

GDP_t = f (IMPt, EXPt, EXRt, FERt, GCFt, M2) ---------- (1)

The model mentioned above can be written as the regression form below.

$GDP_t = \alpha_0 + \beta_1 IMP_t + \beta_2 EXP_t + \beta_3 EXR_t + \beta_4 FER_t + \beta_5 GCF_t + \beta_6 M2_t + \varepsilon_t$ --- (2)

Where, GDP = Gross Domestic Product; IMP = Import; EXP = Export; EXR = Exchange Rate; FER = Foreign Exchange Reserve; GCF = Gross Capital Formation; M2 = Money Supply; α_0= Constant Term of the model and ε_t = Error Term

It is important to convert the variables in log to reduce heteroskedasticity and the log form of the model can be specified as:

$LNGDP_t = \alpha_0 + \beta_1 LNIMP_t + \beta_2 LNEXP_t + \beta_3 LNEXR_t + \beta_4 LNFER_t + \beta_5 LNGCF_t + \beta_6 LNM2_t + \varepsilon_t$ ---------- (3)

2.3 Testing for Unit Root

Unit Root Test is the way to find about the stationary condition of the variables. In this study Augmented Dickey- Fuller Test is conducted to find out the unit root condition to run Johansen Cointegration Test, VECM and Granger Causality Test. The unit root test is implied after supposing the error terms are correlated to each other. ADF Test uses enough terms to remove the correlation between the error terms. The regression for this test can be run as:

$\Delta LNGDP_t = \beta_1 + \beta_2 t + \delta LNGDP_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LNGDP_{t-1} + \varepsilon_t$ ---------- (4)

Where $\Delta LNGDP_{t-1} = LNGDP_{t-1} - LNGDP_{t-2}$ and t is a trend.

2.4 Johansen Cointegration Model

Spurious regression can be avoided by cointegration model after unit root testing and all variable are integrated in order I(1) so that Johansen Cointegration Model is run after confirming stationary condition of the variables. The model is expressed as follows:

$\Delta GDP_t = A_0 + \pi GDP_{t-1} + \pi_1 \Delta GDP_{t-1} + \varepsilon_t$ ---------- (5)

Johansen test is likelihood test and it can be divided into two test i) Trace Test and ii) Maximum Eigenvalue test.

λ_{trace} (r) = - T $\sum_{i=r+1}^{g} \ln(1 - \lambda_i)$ ---------- (6)

λ_{max} (r) = - T ln (1 - λ_{r+1}) ---------- (7)

2.5 Vector Error Correction Model

Vector Error Correction Model is estimated for long run and short run dynamics of the model. It is calculated for speed of adjustment of the model towards long run equilibrium.

$\Delta LNGDP_t = \alpha_{01} + \lambda e_{t-1} + \sum_{i-1}^{j} bi\Delta LNGDP_{t-1} + \sum_{i=1}^{m} ci\Delta LNIMP_{t-1} + \sum_{i=1}^{n} di\Delta LNEXP_{t-1} + \sum_{i=1}^{p} ei\Delta LNEXR_{t-1} \sum_{i=1}^{q} fi\Delta LNFER_{t-1} + \sum_{i=1}^{r} gi\Delta LNGCF_{t-1} + \sum_{i=1}^{s} hi\Delta LNM2_{t-1} + \varepsilon_t$ --(8)

The error correction term is e_{t-1} and λ is the coefficient that shows the speed of adjustment towards long run equilibrium.

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2.6 Granger Causality Model

Granger Causality assesses the causality between the variables that explains the direction of causation in the model. It is used to identify the direction of influence between GDP Growth and independent variables in Nepal. The test can be used in stationary variables and the models can be expressed as:

$$LNGDP_t = \sum_{i=1}^{p} b1iLNGDP_{t-1} + \sum_{i=1}^{p} ciLNIMP_{t-1} + \sum_{i=1}^{p} d1iLNEXP_{t-1} + \sum_{i=1}^{p} e1iLNEXR_{t-1} \sum_{i=1}^{p} f1iLNFER_{t-1} + \sum_{i=1}^{p} g1iLNGCF_{t-1} + \sum_{i=1}^{p} h1iLNM2_{t-1} + \varepsilon_t \quad \text{---- (9)}$$

$$LNIMP_t = \sum_{i=1}^{p} b1iLNGDP_{t-1} + \sum_{i=1}^{p} ciLNIMP_{t-1} + \sum_{i=1}^{p} d1iLNEXP_{t-1} + \sum_{i=1}^{p} e1iLNEXR_{t-1} \sum_{i=1}^{p} f1iLNFER_{t-1} + \sum_{i=1}^{p} g1iLNGCF_{t-1} \sum_{i=1}^{p} h1iLNM2_{t-1} + \varepsilon_t \quad \text{----(10)}$$

$$LNEXR_t = \sum_{i=1}^{p} b1iLNGDP_{t-1} + \sum_{i=1}^{p} ciLNIMP_{t-1} + \sum_{i=1}^{p} d1iLNEXP_{t-1} + \sum_{i=1}^{p} e1iLNEXR_{t-1} \sum_{i=1}^{p} f1iLNFER_{t-1} + \sum_{i=1}^{p} g1iLNGCF_{t-1} + \sum_{i=1}^{p} h1iLNM2_{t-1} + \varepsilon_t \quad \text{--(11)}$$

2.7 Econometric Results

The results from various tests are presented using the time series data. For unit root test Augmented Dickey Fuller test is conducted for each variables. Johansen Cointegration Test and VECM Models are applied to find the short run and long run relationship and Granger Causality Test is used to find the causality between the variables in the model.

2.8 Unit Root Test Results

Unit root test is used to find the existence of stationary in the data. Augmented Dickey Fuller Test is conducted for the test of unit root that confirms the stationary condition in the variables (LNGDP, LNIMP, LNEXP, LNEXR, LNFER, LNGCF and LNM2). The result of ADF Test is presented in table 1.

Table 1 *Unit Root Test*

Variables	At Level		At First Difference	
	t-Statistics	P-Value	t-Statistics	P-Value
LNGDP	0.486246	0.9848	-7.235130*	0.0000
LNIMP	-0.962253	0.7605	-8.115874*	0.0000
LNEXP	-1.202052	0.6675	-6.531626*	0.0000
LNEXR	-0.961357	0.7606	-5.463808*	0.0000
LNFER	-0.292178	0.9189	-5.722210*	0.0000
LNGCF	-1.796023	0.3787	-9.266812*	0.0000
LNM2	-0.580894	0.8661	-8.749989*	0.0000

*Note. *, ** and *** indicate significant at 1%, 5% and 10%*

Unit Root Test is the tool to avoid the spurious regression and find cointegration between the variables so that Augmented Dickey- Fuller Test is conducted for this purpose. The result of ADF Test is shown in the table. The test confirms all the variables are non-stationary at level but are seen stationary at first difference at 1% level of significance thus integrated in order I(1) indicate the presence of unit roots.

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2.9 Johansen Cointegration Test Results

Cointegration test supports to find the long run equilibrium between the variables that converges over time. All the variables are found integrated in order I(1) indicating unit roots at level that shows the applicability of Johansen Cointegration Test for long run relationship.

Date: 01/12/22 Time: 17:24
Sample (adjusted): 1967 2020
Included observations: 54 after adjustments
Trend assumption: Linear deterministic trend
Series: LNGDP LNIMP LNEXP LNEXR LNFER LNGCF LNM2
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.629344	161.7734	125.6154	0.0001
At most 1 *	0.512572	108.1794	95.75366	0.0053
At most 2	0.396410	69.37439	69.81889	0.0542
At most 3	0.305233	42.11192	47.85613	0.1556
At most 4	0.272942	22.44629	29.79707	0.2743
At most 5	0.080890	5.233864	15.49471	0.7835
At most 6	0.012495	0.678966	3.841466	0.4099

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.629344	53.59400	46.23142	0.0069
At most 1	0.512572	38.80506	40.07757	0.0691
At most 2	0.396410	27.26246	33.87687	0.2496
At most 3	0.305233	19.66563	27.58434	0.3647
At most 4	0.272942	17.21243	21.13162	0.1622
At most 5	0.080890	4.554898	14.26460	0.7966
At most 6	0.012495	0.678966	3.841466	0.4099

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

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Table2.1 *Johansen Cointegration Test*

The results based on Johansen Cointegration Test show both Trace Statistics and Max- Eigen Value support the existence of cointegration in the model. A stable long run relationship is confirmed since the variables are cointegrated. It implies that the dependent variable LNGDP has long run relationship with the regressors (LNIMP, LNEXP, LNEXR, LNFER, LNGCF and LNM2). The null hypothesis is rejected at 5% level of significance indicates all variables are cointegrated and so that VECM and Granger Causality Test can be performed.

2.10 Vector Error Correction Model (VECM)

Vector Error Correction Model represents the model is adjusting towards long run equilibrium with a certain level of speed of adjustment. VECM model is run after confirming the cointegration between the variables from Johansen Cointegration Test procedure. All the variables in the model are cointegrated in the order I(1). The result of VECM is as follows.

Table 3 *Vector Error Correction Model*

Dependent Variable: D(LNGDP)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 01/10/22 Time: 20:39
Sample (adjusted): 1968 2020
Included observations: 53 after adjustments
D(LNGDP) = C(1)*(LNGDP(-1) - 0.245092885236*LNIMP(-1) + 0.531877954997*LNEXP(-1) - 0.228845664428*LNEXR(-1) - 0.4604784633*LNFER(-1) - 1.23729557866*LNGCF(-1) + 0.568126547594*LNM2(-1) - 4.75927305128) + C(2)*D(LNGDP(-1)) + C(3)*D(LNGDP(-2)) + C(4)*D(LNIMP(-1)) + C(5)*D(LNIMP(-2)) + C(6) *D(LNEXP(-1)) + C(7)*D(LNEXP(-2)) + C(8)*D(LNEXR(-1)) + C(9) *D(LNEXR(-2)) + C(10)*D(LNFER(-1)) + C(11)*D(LNFER(-2)) + C(12) *D(LNGCF(-1)) + C(13)*D(LNGCF(-2)) + C(14)*D(LNM2(-1)) + C(15) *D(LNM2(-2)) + C(16)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.124957	0.055624	-2.246447	0.0307
C(2)	-0.048245	0.179778	-0.268356	0.7899
C(3)	0.244944	0.150125	1.631603	0.1112
C(4)	0.216712	0.124362	1.742597	0.0897
C(5)	-0.269908	0.120758	-2.235112	0.0315
C(6)	-0.260134	0.074453	-3.493943	0.0013
C(7)	-0.021648	0.092425	-0.234222	0.8161
C(8)	-0.617376	0.163881	-3.767223	0.0006
C(9)	0.494748	0.231148	2.140394	0.0390
C(10)	0.078483	0.062779	1.250148	0.2191
C(11)	-0.055626	0.063289	-0.878928	0.3851
C(12)	0.024792	0.102569	0.241712	0.8103
C(13)	0.075101	0.082652	0.908641	0.3694
C(14)	0.006185	0.161616	0.038268	0.9697
C(15)	0.418193	0.143846	2.907221	0.0061
C(16)	0.016390	0.018060	0.907540	0.3700

R-squared	0.678137	Mean dependent var	0.030222
Adjusted R-squared	0.547652	S.D. dependent var	0.037624
S.E. of regression	0.025305	Akaike info criterion	-4.271262
Sum squared resid	0.023692	Schwarz criterion	-3.676457
Log likelihood	129.1884	Hannan-Quinn criter.	-4.042529
F-statistic	5.197048	Durbin-Watson stat	1.963963

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Prob(F-statistic)	0.000022

The result of Vector Error Correction Model is given in Table 3 where R- squared value is the coefficient of determination that shows the variation in explanatory variables. It represents the explanatory power of the model. The model shows R- square is 0.6781 (67.81%) which indicates that the model is perfectly fit and lack of spurious regression. The coefficient of VECM is negative and significant. The value -0.1249 signifies the speed of adjustment that describes the model is changing towards long run equilibrium by 12.49%. This is the evidence of the existence of long run relationship between economic growth and the independent variables.

2.11 Serial Correlation Test

Breusch-Godfrey LM test is conducted to find the serial correlation in the model and the result of the test is given as follows.

Table 4 *Breusch-Godfrey Serial Correlation LM Test*

F-statistic	0.747324	Prob. F(2,35)	0.4810
Obs*R-squared	2.170629	Prob. Chi-Square(2)	0.3378

Table 4 shows the result of Breusch- Godfrey Serial Correlation LM Test that confirms the presence of autocorrelation in the model. Result indicates the probability of F-statistic and Obs R-squared are greater than 5% level which means null hypothesis of no serial correlation is accepted.

2.12 Heteroskedasticity Test

Bruesch-Pagan-Godfrey Test is the test to find heteroskedasticity which is a problem of econometric regression analysis. The result of this test is given as follows.

Table 5 *Heteroskedasticity Test: Breusch-Pagan-Godfrey*

F-statistic	1.988091	Prob. F(21,31)	0.0401
Obs*R-squared	30.41578	Prob. Chi-Square(21)	0.0839
Scaled explained SS	15.73861	Prob. Chi-Square(21)	0.7842

The result of Breusch- Pagan-Godfrey Heteroskedasticity test is shown in the table 5. Result shows the null hypothesis of there is homoscedasticity is not rejected at 5% level of significance signifies the absence of heteroskedasticity in the model.

2.13 Normality Test

Jarque-Bera test is performed to test the normality condition of the distribution of the variables in the model. Significance of this test confirms the variables are normally distributed. The result of this test is presented below.

Table 6 *Jarque-Bera Normality Test*

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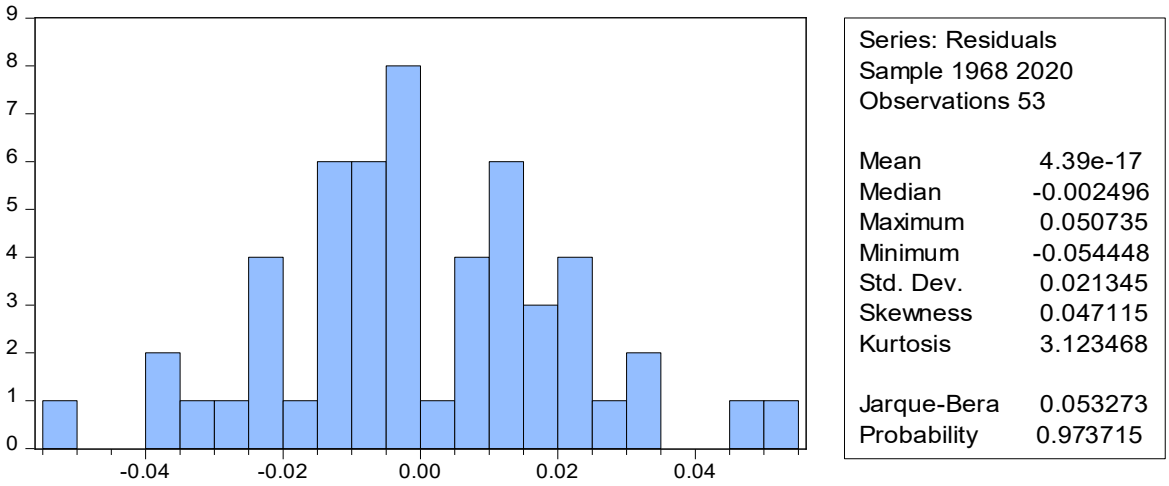

The result of jarque-Bera test shows the probability of this test is greater than 5% level of significance which means the null hypothesis is accepted. The value of Jarque-Bera is 0.053273 and the probability is 0.973715. It signifies the variables in the model are normally distributed.

2.14 Pairwise Granger Causality Test

Granger Causality Test is used to test the causality between the independent variables and dependent variable LNGDP in the Nepalese context. To identify the source of influences the test is conducted and it is important for policy implication.

Table 7 *Granger Causality Test*

Pairwise Granger Causality Tests
Date: 01/10/22 Time: 20:42
Sample: 1965 202
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LNIMP does not Granger Cause LNGDP	54	2.63192	0.0821
LNGDP does not Granger Cause LNIMP		0.50223	0.6083
LNEXP does not Granger Cause LNGDP	54	2.05700	0.1387
LNGDP does not Granger Cause LNEXP		2.50921	0.0917
LNEXR does not Granger Cause LNGDP	54	8.52356	0.0007
LNGDP does not Granger Cause LNEXR		2.08795	0.1348
LNFER does not Granger Cause LNGDP	54	3.74986	0.0305
LNGDP does not Granger Cause LNFER		4.88794	0.0116
LNGCF does not Granger Cause LNGDP	54	1.33429	0.2727
LNGDP does not Granger Cause LNGCF		0.50751	0.6051
LNM2 does not Granger Cause LNGDP	54	5.68710	0.0060
LNGDP does not Granger Cause LNM2		3.75705	0.0303

Table 7 represents the pairwise granger causality between dependent and independent variables in the model. Result shows that there is bidirectional causality between LNFER and LNM2 with LNGDP. The uni-directictional causality between LNIMP to LNGDP; LNEXR

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to LNGDP and from LNGDP to LNEXP shows LNIMP and LNEXR granger cause to LNGDP and LNGDP granger cause to LNEXP but no causality between LNGCF and LNGDP.

3. Conclusion and Discussion

The study uses Johansen Cointegration Test to find the relationship between economic growth and its determinants in Nepal. This test is applied after Augmented Dickey-Fuller Test of unit root that confirms the stationary situation of the variables in the model. VECM is run to find the speed of adjustment from short run towards long run equilibrium then Granger Causality Model helps to find the direction of causality between the variables.

All the variables are integrated in order I(1) so that Johansen methodology can be used. The result shows all the variables are cointegrated that signifies there is long run relationship between GDP Growth and its determinants. The coefficient of VECM is negative and significant (-0.124957) that expresses the speed of adjustment towards long run equilibrium is 12.49%. The result of Granger Causality Test shows there is two way causality between LNFER and LNM2 with LNGDP. One way causality is seen from LNIMP and LNEXR to LNGDP but contrastively one way causality is seen from LNGDP to|LNEXP. It signifies import granger cause GDP of Nepal but not export. The result of various tests prove the independent variables are the determinants of economic growth of Nepal and policy maker should consider these variables for the economic growth of the country.

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