**ARDL MODEL**

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(3.14)

Where,

It = Rate of inflation proxied by GDP deflator

Et = Expenditure on education sector (includes both capital and recurrent expenditure by government of Nepal)

Mt = Import expressed in monetary terms

Xt  = Export expressed in monetary terms

Ct = expenditure on communication (includes both capital and recurrent expenditure by government of Nepal)

Tt = expenditure on transportation (includes both capital and recurrent expenditure by government of Nepal)

λ = intercept term

μi = long run coefficients to be estimated

**ARDL Representation of Unrestricted Version**

Following Pesaran, Shin and Smith’s (2001) ARDL representation of unrestricted version is specified below in equation (3.15) :

(3.15)

Where Δ denotes first difference operator, μ is the intercept term, and ut is the usual white noise residuals.

Thus in the ARDL specification (3.15) the coefficients (θ1 to θ7) represent the long-run relationship whereas the remaining expressions with summation sign (coefficients ηi, ωi, ϕi, πi, χi, κi, σi) represent the short run dynamics of the model.

**Breusch-Godfrey Serial Correlation LM Test**

When error terms from different time periods are correlated, then the error terms are said to be serially correlated. Serial correlation is found to be occurred in time-series studies when the errors associated with a given time period carry over into future time periods. First-order serial correlation occurs errors in one time period are correlated directly with errors in the previous time period. Though, serial correlation does not affect the unbiasedness or consistency of estimators, it affects their efficiency. With positive serial correlation, the estimates of the standard errors will be smallerthan the true standard errors which lead to the conclusion that the parameter estimates are more precise than they really are. There will be a tendency to reject the null hypothesis when it should not be rejected. This method of detecting the serial correlation is developed by Breusch and Godfrey in 1978.

Consider a linear model as follow

 (3.16)

Suppose the above equation is serially correlated meaning that the residuals might follow an autoregressive scheme as follows

 (3.17)

Then model can be written as

 (3.18)

This is the unrestricted form of the model as error term has not been restricted.

If the equation is estimated as,

 (3.19)

This would be a restrictedform of the equation, since implicit in this form is the restriction that ρ1 = ρ2 = ... =ρp =0.

Now a variable χ2 is defined with h degrees of freedom as;

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Where h is the degree of the freedom, SSRR and SSRU are the sum of squares residuals for the restricted and unrestricted equations respectively and σR2 the estimated variance of the restricted equation.

Further it can be shown that

 (3.20)

Taking TR2 and comparing it with the relevant critical value for χ2 where the degrees of freedom, h, is the order of the autoregressive scheme

Setting the null hypothesis (H0): (There is no serial correlation in the model)

The null hypothesis would be rejected if the LM statistic exceeded the upper α critical value of a chi-squared distribution with p degrees of freedom.

**Ramsey’s RESET Test**

The Ramsey Regression Equation Specification Error Test (RESET) test is a general specification test for the linear regression model proposed by Ramsey (1969). It tests if non-linear combinations of the fitted values help explain the response variable. The intuition behind the test is that if non-linear combinations of the explanatory variables have any power in explaining the response variable, the model is mis-specified. The classical normal linear regression model is specified as:

 (3.21)

Where  the disturbance vector is presumed to follow the multivariate normal distribution .Specification error is an omnibus term which covers any departure from the assumptions of the maintained model. Serial correlation, heteroscedasticity, or non-normality of variables, all violate the assumption that the disturbances are distributed .

RESET is a general test for the following types of specification errors:

* Omitted variables;  does not include all relevant variables
* Incorrect functional form; some or all of the variables in and should be transformed to logs, powers, reciprocals, or in some other way.
* Correlation between and, which may be caused, among other things, by measurement error in, simultaneity, or the presence of lagged values and serially correlated disturbances.

Under such specification errors, LS estimators will be biased and inconsistent, and conventional inference procedures will be invalidated. Ramsey (1969) showed that any or all of these specification errors produce a non-zero mean vector for. Therefore, the null and alternative hypotheses of the RESET test are:

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**Normality Test**

**Heteroscedasticity Test, CUSUM Test**

**CUSUM of Square Test**

**ARDL MODEL**

The neo-classical and endogenous growth model with the Cobb-Douglas production function following the extension of the growth model by Barro (1991) and Barro and Sala-I-Martin (1992). A generic representation of the Barro Regression is;

Yi = βi log yi0 + αi Xi + γ Zi + …………………………...……(3.1)

Where Yi represents output growth and the logyi0 is the technological progress or total factor productivity (TFP) and Xi represent factors of production such as physical capital (K), human capital (H), and labor (L) or population growth suggested by the neoclassical growth model. Zi as shocks in the economy includes those growth determinants that lie outside Solow’s original theory and influences productivity growth of the growth factors and policy factors which can affects overall economic growth.

the reduced form of growth regression developed by Barro (1991) Sala-i-Martin (1997); and applied by Durlauf, Johnson and Temple (2005) in endogenous growth model.

Where, is intercept, = slope parameters (i=1 to 7), ξt = error term which captures the effects that cannot be explained.

**Co-integration Analysis by using Autoregressive Distributed Lag Model**

Following Pesaran, Shin and Smith (1996, 2001), an ARDL representation of equation (3.2) can be written as:

3.4)

Where, is the first difference operator, is drift component. P, q1, q2, q3, q4, q5, q6 are max lags of the variables lnRGDPPC, ln1RGDP, lnGFCF, lnSEC, lnGEDU, lnGHTH, lnGAGRI in ARDL model. The coefficients: δ1, δ2, δ3, δ4, δ5, δ6 and δ7 represent the long-run relationship and γ1, γ2, γ3, γ4, γ5, γ6 and γ7 represent the short-run dynamics of the model.ξt is usual white noise error term which captures the effects that cannot be explained.

The co-integration equation of ARDL model is;

Where, , , , ,and and are the OLS estimators obtained from equation (3.5).

If two variables are co-integrated, there exists long run relationship but may be disequilibrium in the short run and is known as equilibrium error term which can be used to attach the short run behavior of dependent variable to its long run value. The error correction representation of ARDL equation (3.4) is;

(3.6)

In equation the coefficients of the lag variables i.e. give the short-run relation of variables. P, q1, q2, q3, q4, q5, q6 are max lags of the variables lnRGDPPC, ln1RGDP, lnGFCF, lnSEC, lnGEDU, lnGHTH, lnGAGRI in ARDL model. is the speed of adjustment parameter of error correction model (ECM) and demonstrates the divergence or convergence in the direction of the long-run equilibrium. Positive value of points out divergence and negative value points out convergence. ECM is residual which is obtained from the estimated co-integration model of equation (3.5). Thus, the error correction term (ECM) is defined as;

.7)

Where, , , , , are OLS estimators same as equation (3.7).

**Wald Test ,Normality Test**

**Heteroscedasticity Test**

**CUSUM Test, CUSUMSQ Test**