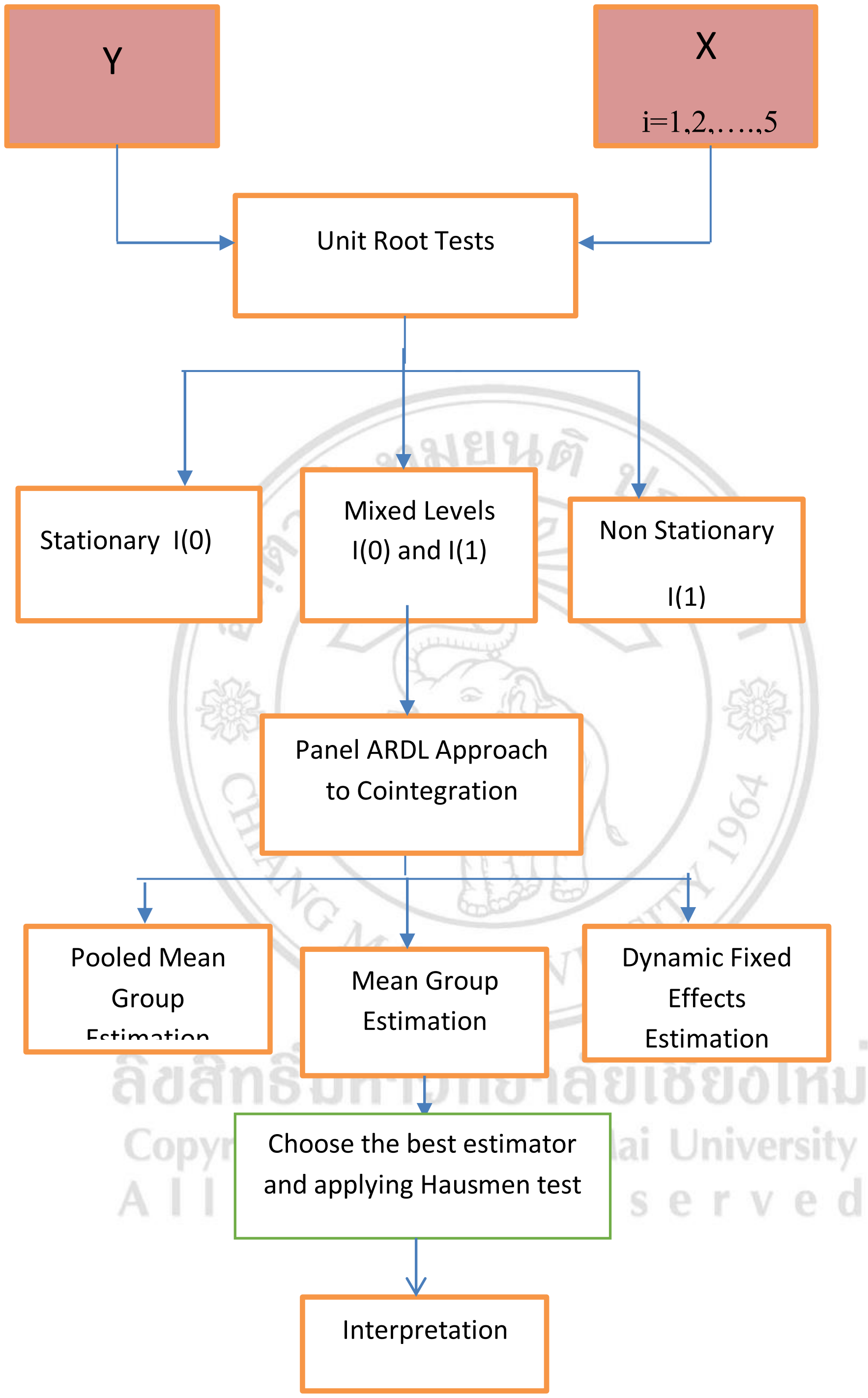
CHAPTER 3

Methodology

3.1 Research Design

In this research, the author used the variables that are available or significant to the model and the methodology. First of all the author collected the secondary data for the period of 1995-2014 to study, that have 260 observation. And then tested the data with panel unit root tests which are Levin-Lin-Chu (LLC 2002), Im – Peasaran (2003) and Maddala (1999). After testing the panel unit root test, the author tries to test the data with different panel data analysis based on the test results. In this section, the author tested by two step. The first step is tested for all the countries in this studies and the second step is separated all the countries in to two groups; Developed Country and Developing Country.

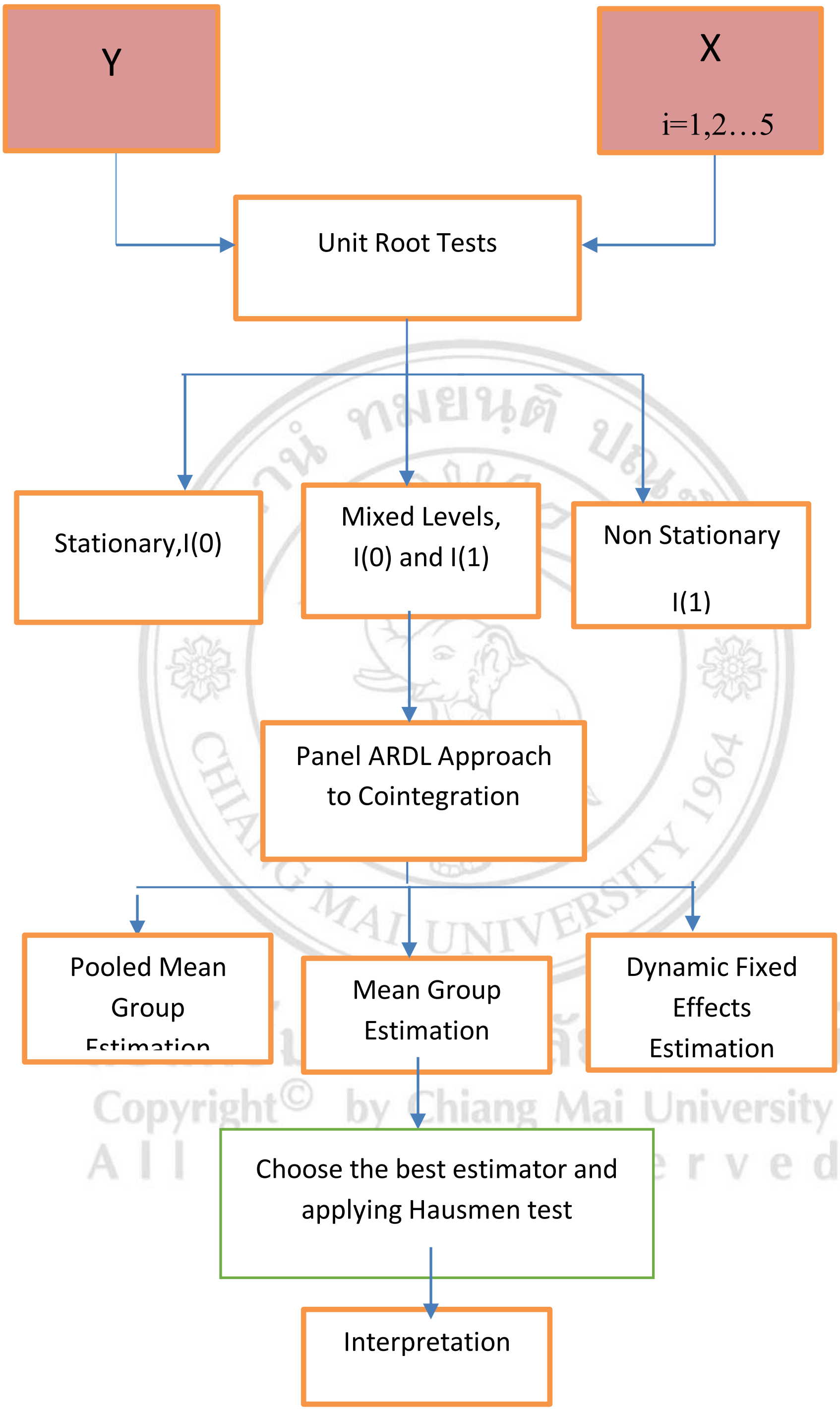
3.1.1 Research Design for the first step



Source: Author's own illustration
Note: Y stands for dependent variable and X stands for the independent variables

Figure 3.1: The research method of estimation for this research (first step)

3.1.2 Research Design for the first step (Developed & Developing Country)

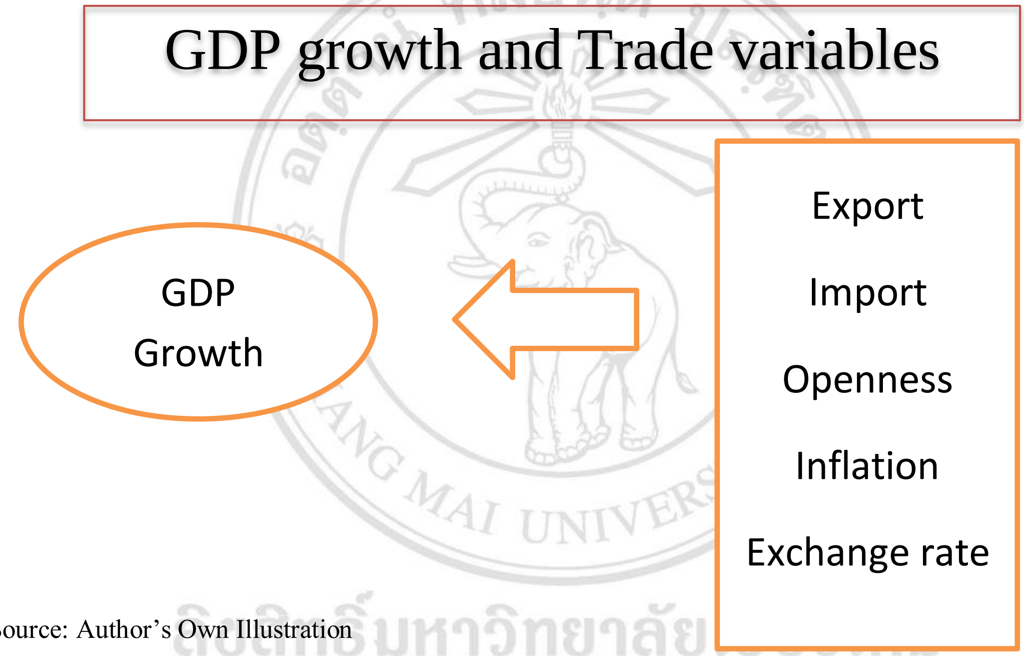


Source: Author's own illustration
Note: Y stands for dependent variable and X stands for the independent variables

Figure 3.2: The research method of estimation for this research (second step)

3.2 Conceptual Framework

In this study, the author examines the relationship between economic growth and trading in ASEAN plus three countries by using GDP growth (GDPGR), export (EXP), import (IMP), openness (OPN), inflation (INF) and exchange rate (EXC). To estimate the relationship and the coefficient of variables and investigates the relationship between economic growth and trading in ASEAN plus China, Korea and Japan for the short run and long run by using Panel ARDL approach. This study relies on the previous researches and empirical studies. The conceptual framework for this research is shown in the following figure (3.2).



Source: Author's Own Illustration

Figure 3.3: Conceptual Framework

3.3 Variables Used in the Model and Sources of Data

In this research, the author tests the data by using PMG, MG and DFE estimators for panel level and individual level. The dependent variable in this paper is economic growth of the observed countries. This variable is measured by an annual percentages of growth rate of GDP. The independent variables are export, import, openness, inflation and exchange rate in each country. All the data are collected from World Bank in the form of spreadsheets of data which are summarized before testing results and drawing conclusions. The observed variables that the author used for this research and their sources are summarized in the following table (3.1).

Table 3.1: Data Definitions and Sources for the variables

Variables Notation		Definitions	Units	Data
GDP	Y	Annual percentage of growth rate of GDP	%	World Bank
EXP	X	The annual growth rate of export of good and services based on constant local currency.	%	World Bank
IMP	X	The annual growth rate of import of good and services based on constant local currency.	%	World Bank
OPN	X	Sum of exports and imports of goods and services measured as share of GDP	%	World Bank
INF	X	Measured by annual growth rate of GDP implicit deflator shows the rate of price changing in the whole economy	%	World Bank
EXC	X	The exchange rate determined by the national authorities. It is calculated by annual average based on monthly average.	USD	World Bank

Sources: Author's design

3.4 Model Specification

Based on the literature reviews of the previous authors, the relationship between economic growth and trading can be analysed by using the following function.

This model can be captured by:

$$(GDP)_{it} = \alpha_0 + \alpha_1(EXP_{it}) + \alpha_2(IMP_{it}) + \alpha_3(OPN_{it}) + \alpha_4(INF_{it}) + \alpha_5(EXC_{it}) + \varepsilon_0$$

For the impact of macroeconomic variables on Economic Growth,

$$\Delta GDP_{it} = \emptyset_i\left[GDP_{it-1} - \propto_1^i EXP_{it} - \propto_2^i IMP_{it} - \propto_3^i OPN_{it} - \propto_4^i INF_{it} - \propto_5^i EXC_{it}\right] + \sum_{i-1}^{p-1} Y_{ij}^* \Delta GDP_{it-1} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta EXP_{it} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta IMP_{it} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta OPN_{it} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta INF_{it} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta EXC_{it} + \mu_i + \epsilon_{it}$$

The above equations is for panel level where i represents cross-section data and t represents time-series data.

α_0 = constant terms, α_1, ……., α_5 = coefficients

$(GDP)_{it}$ =GDP growth rate as % of GDP

(EXP_{it}) = total export as a % of GDP

(IMP_{it}) = total import as a % GDP

(OPN_{it}) = degree of openness; total trade % of GDP

(INF_{it}) = inflation rate as % of annual

(EXC_{it}) = exchange rate as USD

For the individual model, the model is constructed as follows.

$$(GDP)_{it} = \beta_0 + \beta_1(EXP_{it}) + \beta_2(lnIMP_{it}) + \beta_3(OPN_{it}) + \beta_4(FLA_{it}) + \beta_5(lnEXC_{it}) + \mu_{it}$$

Where β_0= constant terms, β_1, ………. , β_5 = coefficients

The variables chosen in in this paper are complied with theories or hypothesis and their expected signs derived from the theories and previous studies. The author used econometric techniques to test the data by using Panel Unit Root Test, Panel ARDL approach to co integration, PMG, MG and DEF estimators to comply with the objectives of the study.

3.5 Research Methodologies

In this research, the author tested the selected data with Panel unit root test to identify the appropriate methodology to apply for the estimation process. The panel unit root test was derived from time series unit root tests, and the estimates are more consistent and efficient for panel unit root test to examines how the export and import of country that influence on the GDP of ASEAN countries plus China, Korea and Japan and investigates the effects of export and import on GDP, so the countries can learn to improve their economic growth.

3.5.1 Panel Unit Root Test

Panel Unit Root Test were derived from time series unit root testing. Time series unit root tests lacked power in testing the difference of the unit root test from stationary alternatives. There are four most widely used panel unit root tests which are developed by Levin, Lin and Chu (2002), Im, Pesearan and Shin (1997-2003), Fisher type of ADF and PP tests (Maddala and Wu (1999)).

3.5.1.1 Levin, Lin and Chu (2002) Test

The nature of panel data has both cross-section and time-series dimensions. Levin et al (2002) considered a stochastic term (yit) for i=1,...,n and t=1,…,t. when t or n is large and t is small & n is large, this test is one of the suitable test to apply to test the panel data. Normally all panel shares a common autoregressive parameter and LLC augment the test with additional lags of the dependent variables. The following equation is to LLC let’s regression model:

$$\Delta Y_{it} = \alpha Y_{it-1} + \sum_{j=1}^{pi} \beta_{it}\ \Delta Y_{it-j} + X^{*}{}_{it}\delta + \varepsilon_{it}$$

In the above equation, ΔY_{it} is the difference term of Y_{it} and Y_{it-j} is panel date where is exogenous variables such as individual time trend or country fixed effects, the assumption of LLC test is that ε_{it}, the error term is distributed independently across panel data and follows a stationary invertible autoregressive moving-average process for each panel. The null and alternative hypotheses are as below;

H_0: $\beta_i = 0$ for all i which means panel data has unit root test

H_A : $\beta_i < 0$ for all i which means panel data has no unit root test

LLC test requires β_i to be homogenous across i for this hypothesis and this homogeneity requirement become a disadvantages of LLC test. This implies that if the autoregressive parameters are same across panel, H_A is restrictive and t-statistics relied on pooled estimation can be described as;

$$t_\alpha^* = \frac{t_\alpha - (NT)S_N\hat{\alpha}^{-2}se(\hat{\alpha})\mu_{mT^*}}{\sigma_{mT^*}}$$

Where $\hat{\alpha}$ has standard normal distribution, t_α^* for standard t-statistics for α = 0.

$se(\hat{\alpha})$ = standard error of $\hat{\alpha}$

$\hat{\alpha}^{-2}$ = error term

S_N = average standard deviation ratio

μ_{mT^*} = adjustment term of the mean

σ_{mT^*} = adjustment term of the mean

3.5.1.2 Im, Pesaran and Shin (2003) Test

Im et al. (2003) suggested that a t-bar statistics to analyse the unit root test hypothesis for panel data which is relied on the average of individual ADF t-statistics. IPS test is more accurate than LLC test. For a sample having n groups and t time periods where i = 1, ….. ,n and t = 1, …. ,t, the regression model of the conventional ADF test for panel unit root is as follow.

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{it} + \sum_{j=1}^{pi} Y_{ij}\ \Delta Y_{it-j} + \varepsilon_{it}$$

The null and alternative hypotheses are as below;

H_0: β_i = 0 for all i which means panel data has unit root test

$H_A : \beta_i < 0$ for at least one cross-section which means panel data has no unit root. Two alternatives are specified and tested a unit root with an intercept and as unit root with trend and intercept. The test statistics can be written as follows;

$$Z_{tbar} = \frac{\sqrt{n}\{ tbar_{NT} - N^{-1} \sum_{t=1}^{N} E(t_{Ti})\}}{\sqrt{N^{-1} \sum_{t=1}^{N} Var\ (t_{Ti})}} \ \ldots \ \mathrm{N}\ (0, 1)$$

Where $tbar_{NT}$ is the average ADF t- statistics;

$E(t_{Ti})$ and $Var(t_{Ti})$ are mean and the variance and computed based on Monte-Carlo simulated moments. They depends on time dimension, lag order and structure of ADF test. IPS test is one –sided lower tail test approached to standard normal distribution. Only balanced panel data is applicable according to the theory but in reality, when unbalanced data is applied, more simulations are required to get critical values.

3.5.1.3 Fisher Type Test (Maddala and Wu 1999)

Test statistic discussed by Maddala and Wu (1999) is based on Fisher (1932) and combining p-values of t statistics for each unit root of each cross` section. Fisher tests do not need to use the same unit root test in each cross section. This test permits different first-order autoregressive coefficients and tests stationary of null hypothesis and is similar to IPS. The Fisher test statistics is written as below:

$$P(\lambda) = -2 \sum_{t=1}^{N} Ln\ (P_i)$$

Where $P(\lambda)$ is Fisher's panel unit root test, N=all N cross section:

P_i is P-value of ADF test for cross-section i and the test follows chi – square distribution with 2N degree of freedom. Fisher test is more flexible, accurate and powerful than LLC test and also having an advantage over IPS. This test allows panel unit root test with no intercept or trend. Maddala and Wu (1999) stated that "Fisher test is simple, straight forward and better test than LL and IPS.

Inverse normal test (Z) equation and logit test is;

$$Z = \frac{1}{\sqrt{N}} \sum_{t=1}^{N} \phi^{-1}\ (P_i)$$

ϕ^{-1} is the inverse of standard normal cumulative distribution function $0 \leq P_i \leq 1$ and $\phi^{-1}(P_i) \sim N\,(0, 1)$, therefore $Z \sim N\,(0, 1)$

The null and alternative hypotheses are as below;

H_0 ; $P_i = 1$, which means panel data has unit root.

H_A : $P_i < 1$, which means panel data not has unit root.

Table 3.2: Panel unit root tests and hypotheses

Panel unit root test	Levin, Lin and Chu, LLC	Im, Pesaran and Shin, IPS	Fisher Type: ADF and PP tests
Null Hypothesis:	Has unit root	Has unit root	Has unit root
Alternative Hypothesis	Has no unit root (stationary)	Has no unit root (stationary)	Has no unit root (stationary)
Statistics Test	t-statistics	w-statistics	Chi-square
Probability < 0.1	0.00-0.10	0.00-0.10	0.00-0.10

Sources; Own illustrations

3.5.2 Panel ARDL Approach

Dynamic panel data with large N and large T are different from data with large N and small T. the small T are tested with fixed effect models and random effect models or combination of them with instrumental variables model. They needed the data for pooling individual groups and only intercepts are allowed to differ across groups. For data has large n and large t, it is not consistent to use the assumption of homogeneity of slope parameters. Therefore, the increase in large N and T dynamic panels, panel ARDL model is useful for the mixed of stationary and non-stationary of data at level I(0) and I(1). The following equation is Autoregressive Distributed Lag Model (ARDL) with unrestricted specification,

$$Y_{it} = \sum_{i=1}^{p} \lambda_{ij} Y_{i,t-j} + \sum_{i=0}^{q} \gamma_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it} \ldots$$

Where X_{it} (k x 1) is a vector of regressors for group i, λ_{ij} represents for the coefficients of lagged dependent variables and μ_i is the fixed effect and they all are scalars and coefficient vectors are γ_{ij} (k x 1). If the data has large T, we can apply ARDL for individual group estimations. We discuss about three estimators developed by Pesaran and Smith (1995) and by Pesaran et al. (1999) which are mean group (MG), pooled mean group (PMG) and dynamic fixed affect (DFE).

3.5.3 Pooled Mean Group Estimator

Pooled mean group (PMG) is an estimation method based on both pooling and averaging and estimate the long-run and short-run correlation with one equation. The estimators allows error variances, intercept and short-run coefficients to differ freely across countries while long-run coefficients remained constant across groups. The PMG estimator is used to apply the homogeneity restrictions on the long run coefficients and averaging across countries to get estimated means for error-correction coefficients and the other short-run parameters. The good point for using this estimator is that when we estimate for the parameters of dynamic models from panel data that include time series observations for each country. The main feature is the responsiveness of co integrated variables can have any deviation from long run equilibrium. This method is mainly relied on maximum likelihood method.

$$\Delta Y_{it} = \phi_i \left(Y_{it-1} - \acute{\theta}_i X_{it}\right) + \sum_{t=1}^{p=1} \lambda_{ij}^{*} \Delta Y_{it-1} + \sum_{j=0}^{q=1} \delta_{ij}^{*} \Delta X_{it-j} + \mu_i + \varepsilon_{it}$$

Where $\phi_i = -\left(1 - \sum_{j=1}^{p} \lambda_{ij}\right)$

$\phi_i =$ error correction speed of adjustment

If ϕ_i is zero, there is no long-run cointrgration

If ϕ_i >o, there has no long run cointegration.

If ϕ_i < o, there has no long run cointegration.

t = 1,2, …., T (time series)

i = cross-section groups

Y_{it} = dependent variables in countries i at time t

δ_{ij}^{*} = coefficient kx1 vector of independent variables

λ_{it} = scalars

μ_i = fixed effects

$$\theta_i = \sum\nolimits_{j=0}^{q} \delta_{ij} \,/ \left(1 - \sum\nolimits_{k} \lambda_{ik}\right)$$

$$\delta_{ij}^{*} = -\textstyle\sum_{m=j+1}^{p} \delta_{im}$$

$$\lambda_{ij}^{*} = -\textstyle\sum_{m=j+1}^{p} \lambda_{\ im}$$

θ_i is the important vector which has long-run relationship between variables. PMG estimations allows for heterogeneous short-run dynamics and common long-run and for examining long-run homogeneity without imposing parameter homogeneity in the short-run.

The advantages of using PMG is the short-run coefficient, speed of the adjustment and error variance are allowed to differ across countries and give the consistent estimates of long-run parameters are stationary, non-stationary or mutually co integrated.

$$\Delta Y_{it} = \phi_i \left(Y_{it-1} - \acute{\beta}_i X_{it}\right) + \sum\nolimits_{t=1}^{p=1} \lambda_{ij}^{*} \Delta Y_{it-1} + \sum\nolimits_{j=0}^{q=1} \delta_{ij}^{*} \Delta X_{it-j} + \mu_i + \varepsilon_{it}$$

By using the independent be EXP, IMP, OPN, INF, and EXC,

$$\Delta GDPGR_{it} = \emptyset_i\left[GDPGR_{it-1} - \alpha_1^i EXP_{it} - \alpha_2^i IMP_{it} - \alpha_3^i OPN_{it} - \alpha_4^i INF_{it} - \alpha_5^i EXC_{it}\right] + \sum_{i=1}^{p=1} \lambda_{ij}^{*} \Delta GDPGR_{it-1} + \sum_{j=1}^{q-1} \gamma_{ij}^{*} \Delta EXP_{it-j} + \sum_{j=1}^{q-1} \gamma_{ij}^{*} \Delta IMP_{it-j} + \sum_{j=1}^{q-1} \gamma_{ij}^{*} \Delta OPN_{it-j} + \sum_{j=1}^{q-1} \gamma_{ij}^{*} \Delta INF_{it-j} + \sum_{j=1}^{q-1} \gamma_{ij}^{*} \Delta EXC_{it-j} + \mu_i + \varepsilon_{it}$$

3.5.4 Mean Group Estimator

There are two common ways to apply for panel data which are estimating separate equations for each country and examining the distributions of estimated coefficients across countries. The estimation gives the averaged estimates of parameters but this does not considered that certain parameters can be in the same group. Mean Group estimator allows that intercepts, error variances and slope of coefficient vary across countries. The MG estimator was derived from the equation for ARDL;

$$Y_{it} = \alpha_i + \gamma'_1 y_{i,t-1} + \beta_i X_{it} + \mu_i$$

Where i=1,2, ……, N and t=1,2, …., T, estimation of long run parameter's coefficient θ_i for country i can be written as;

$$\theta_i = \frac{\beta_i}{1-\gamma_i}$$

Mean Group estimator for the whole panel can be written as below;

$$\widehat{\theta} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_i$$

Mean Group's variance is;

$$v(\hat{b}_{MG}) = \frac{1}{N(N-1)} \sum_{i=1}^{N} (\hat{b}_i - \hat{b}_{MG})(\hat{b}_i - \hat{b}_{MG})$$

3.5.5 Dynamic Fixed Effect Estimator (DFE)

The Dynamic Fixed Effect Model has restricted on the coefficient of co integrating vector to be equal across panels, speed of adjustment coefficient and short run coefficient to be equal. It also restricts on convergence coefficient and common variance. DFE allows for the greater heterogeneity of the parameters and imposes homogeneity on all slope coefficients. With DFE, all coefficients are resulted similar to PMG and MG estimators as it only allows individual intercepts to differ across countries.

3.5.6 Error Correction Term

In the dynamic model, the error correction term (ECT) can be described as the speed of adjustment to reach the equilibrium. Its coefficient confirmed that how the variables converge or diverge to the equilibrium and its sign would be negative or positive. The statistically significant ECT shows that there has a stable long run relationship.

3.5.7 Hausman Test[1]

[1] http://www.statisticshowto.com/hausman-test/

Hausman test is used to determine the best estimation to choose a mong PMG and MG or PMG and DFE. The hypothesis for long run parameters are not able to assume as priori. Hausman test determine the effect of heterogeneity on the coefficients' mean and if the parameters are homogenous, PMG's results are more consistent and efficient than MG's or DFE's. It can be said that if null hypothesis is accepted, PMG is preferred upon choosing efficient estimator and if null is rejected, MG or DFE is preferred. The test is described by Chi-square.

$$H = (\hat{\beta}_b - \hat{\beta}_B)D^{-1}(\hat{\beta}_b - \hat{\beta}_B)$$

$$D^{-1} = (V\hat{\beta}_b - V\hat{\beta}_B)$$

Where, $V\hat{\beta}_b$ is the variance of coefficient

H_0 ; Accept PMG if p value of λ^2> 0.05

H_A; Reject MG or DFE if p value of λ^2> 0.05.