# CHAPTER 3

# Methodology

## 3.1 Conceptual Framework

After studying the literature and theories related to $CO_2$ emissions and economic growth, this paper studies how the effect of economic growth on $CO_2$ emissions and urban population effect on $CO_2$ emissions of Myanmar. Using ADF test in this article examine all variables are stationary at levels or the first difference. If the variables are stationary at the first difference, VEC model will be used to estimate the long run and short run of the variables. The theoretical framework for the functions of Myanmar can be taken as the following.
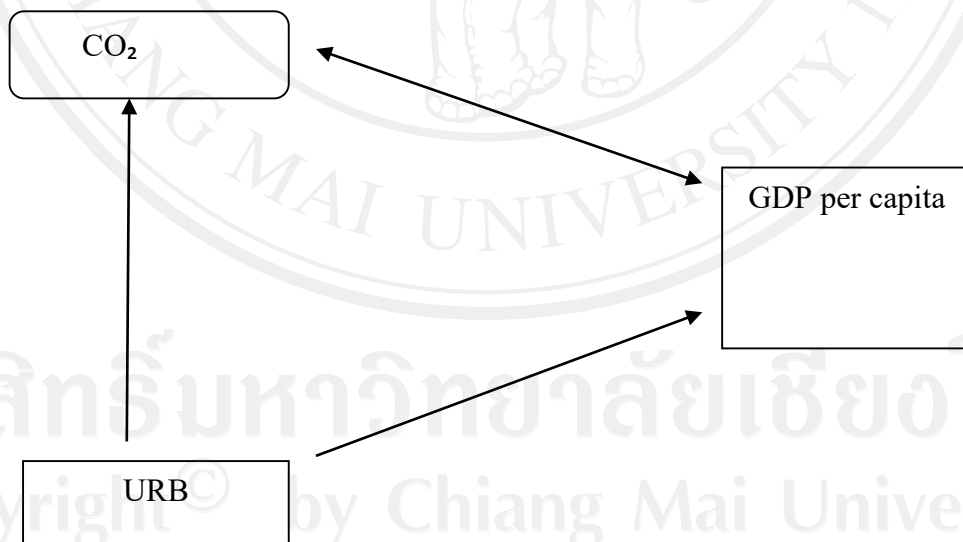


**Figure 3.1:** Interaction between $CO_2$, GDP per capita and URB for Myanmar

$$CO_2 = f(GDP, URB) \tag{3.1}$$

Above these equations mentioned can be explained why these variables contribute and influence to the economic growth of Myanmar. $CO_2$ and GDP are two ways relationship. All variables used in this study are endogenous variables as GDP per capita and $CO_2$ emissions. The exogenous variable is urban population.

### 3.2 Variables Used in the Model

The variables used in this study are endogenous variables such as GDP per capita and $CO_2$ emissions. The exogenous variable is urban population.

**Table 3.1 :** Summary Descriptions of the Variables

| Variables | Descriptions |
|-----------|--------------|
| $CO_2$ | Carbon dioxide emission |
| GDP | Gross Domestic product per capita |
| URB | Urban population |

Source: Statistical Year Books of Myanmar and World Bank database

In this study, all the variables are changed into the   form logarithm as follows:

$LnCO_2$ = The Natural Logarithm of Carbon dioxide Emissions

Ln GDP = The Natural Logarithm of Gross Domestic Product Per Capita

Ln URB = The Natural logarithm of Urban population

### 3.3 Hypothesis of the Study

The main objective of this study is to investigate how GDP growth effects on Carbon Emissions in Myanmar.  In favour of this aim, the hypotheses can be testable are described in the following:

Hypothesis 1: Economic growth affects on $CO_2$ Emission of Myanmar over the
period    of 1980-  2015.

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Hypothesis 2: Urban Population is a factor that leads to $CO_2$ Emissions in
Myanmar.

## 3.4 Research Methodology

### 3.4.1 Test Unit Root Test (ADF Test)

First and Foremost, all the variables are tested whether they are stationary or
not before doing the analysis. It is a necessary condition to examine the relationship
between variables and the stationary of variables in the first difference. Therefore, ADF
unit root test can be used.

$$\Delta GDP_t = \beta_0 + \beta t + \theta GDP_{t-1} + \sum_{i=1}^{m} U_i \Delta GDP_{t-i} + \varepsilon_t \tag{3.2}$$

$$\Delta CO_{2t} = \beta_0 + \beta t + \theta CO_{2t-1} + \sum_{i=1}^{m} U_i \Delta CO_{2t-i} + \varepsilon_t \tag{3.3}$$

$$\Delta URB_t = \beta_0 + \beta t + \theta URB_{t-1} + \sum_{i=1}^{m} U_i \Delta URB_{t-i} + \varepsilon_t \tag{3.4}$$

If test statistics of a variable is less than the critical value in absolute terms,
then the null hypothesis cannot be rejected. Thus, the $1^{st}$ difference of a variable is
needed to test. The null hypothesis can be dismissed which means there is no unit root
and stationary condition of the variable if the test statistics of a variable is greater than
the critical value in absolute terms.

### 3.4.2 Johansen Cointegration Test

The cointegration test is used to check the presence of a long-run relationship
among the selected economic and financial variables. The absence of cointegration
indicates that within the stock market there is no long-run relationship In
maximumlikelihood, two nested models may also be compared, but the comparison
involves different statistics. One major test is the likelihood ratio test (LRT). The
likelihood ratio test is

$$LRT = 2(L(x)f - L(x)r) \tag{3.5}$$

The two statistics are the Akaike information criterion usually abbreviated as AIC  and
the  Schwarz' criterion.

AIC = −2 ln (L(x)) + 2p  (3.6)

SC = −2 ln (L(x)) + ln(N)  (3.7)

When a series of models is fitted to data, the one with the lowest AIC or lowest SC is preferred.

### 3.4.3 VECM model

Testing for Johansen cointegration test can be running and finding cointegrating vector. VEC estimation can be analysed. The long term relationship among variables can be analysed by seeing cointegration equations.

$$\Delta CO_{2t} = \beta_0 + \beta_1 \Delta GDP_{t-1} + \ldots + \Delta GDP_{t-n} + \gamma_1 \Delta CO_{2t-1} + \ldots + \gamma_n \Delta CO_{2t-n} + \delta_1 \Delta URB_{t-1} + \cdots + \delta_n \Delta URB_{t-1} - \lambda_y (GDP_{t-1} - \alpha_0 - \alpha_1 CO_{2t-1} + \alpha_2 URB_{t-1}) + V_t^c$$

(3.8)

$$\Delta GDP_t = \beta_0 + \beta_1 \Delta GDP_{t-1} + \ldots + \Delta GDP_{t-n} + \gamma_1 \Delta CO_{2t-1} + \ldots + \gamma_n \Delta CO_{2t-n} + \delta_1 \Delta URB_{t-1} + \cdots + \delta_n \Delta URB_{t-1} - \lambda_x (GDP_{t-1} - \alpha_0 - \alpha_1 CO_{2t-1} + \alpha_2 URB_{t-1}) + V_t^g$$

(3.9)

$$\Delta URB_t = \beta_0 + \beta_1 \Delta GDP_{t-1} + \ldots + \Delta GDP_{t-n} + \gamma_1 \Delta CO_{2t-1} + \ldots + \gamma_n \Delta CO_{2t-n} + \delta_1 \Delta URB_{t-1} + \cdots + \delta_n \Delta URB_{t-1} - \lambda_z (GDP_{t-1} - \alpha_0 - \alpha_1 CO_{2t-1} + \alpha_2 URB_{t-1}) + V_t^u$$

(3.10)

### 3.4.4 Impulse response function

We use impulse response function to find out the effects over time of economic policy. When all others variables are constant, the impulse response function will illustrate the response over time of each variable in VEC model. According to the lag length of the VECM model and the variable numbers, we can define the number of impulse response function. When we multiply the lag length and the number of variables, the result is equal to the numberof impulse response functions.

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## 3.5 Descriptive Statistics

In this part, National Environmental policy framework and Environmental threat and conservation are discussed as descriptive analysis. Moreover, also, Energy Consumption in Myanmar discussed as descriptive analysis.

## 3.6 Data of the study

### 3.6.1 Data Collection

Using the secondary information in this research is to examine the relationship between $CO_2$ emission and economic growth of Myanmar over the period of 1980-2015. Using variables in the econometric model are $CO_2$ emission and urban population collected from Ministry of Energy and statistical yearbooks of Myanmar and World Bank database. They can provide sufficient level of information and data on accounts of (urban population and $CO_2$ emission) statistics of Myanmar and World Bank database.GDP per capita data is collected from Statistical year books of Myanmar and World Bank database.

In this section, annual data of $CO_2$ emission, GDP per capita and urban population are collected from 1980to 2015 to run Johansen co-integration test and VEC estimation.Logged values are used in the VEC estimation.
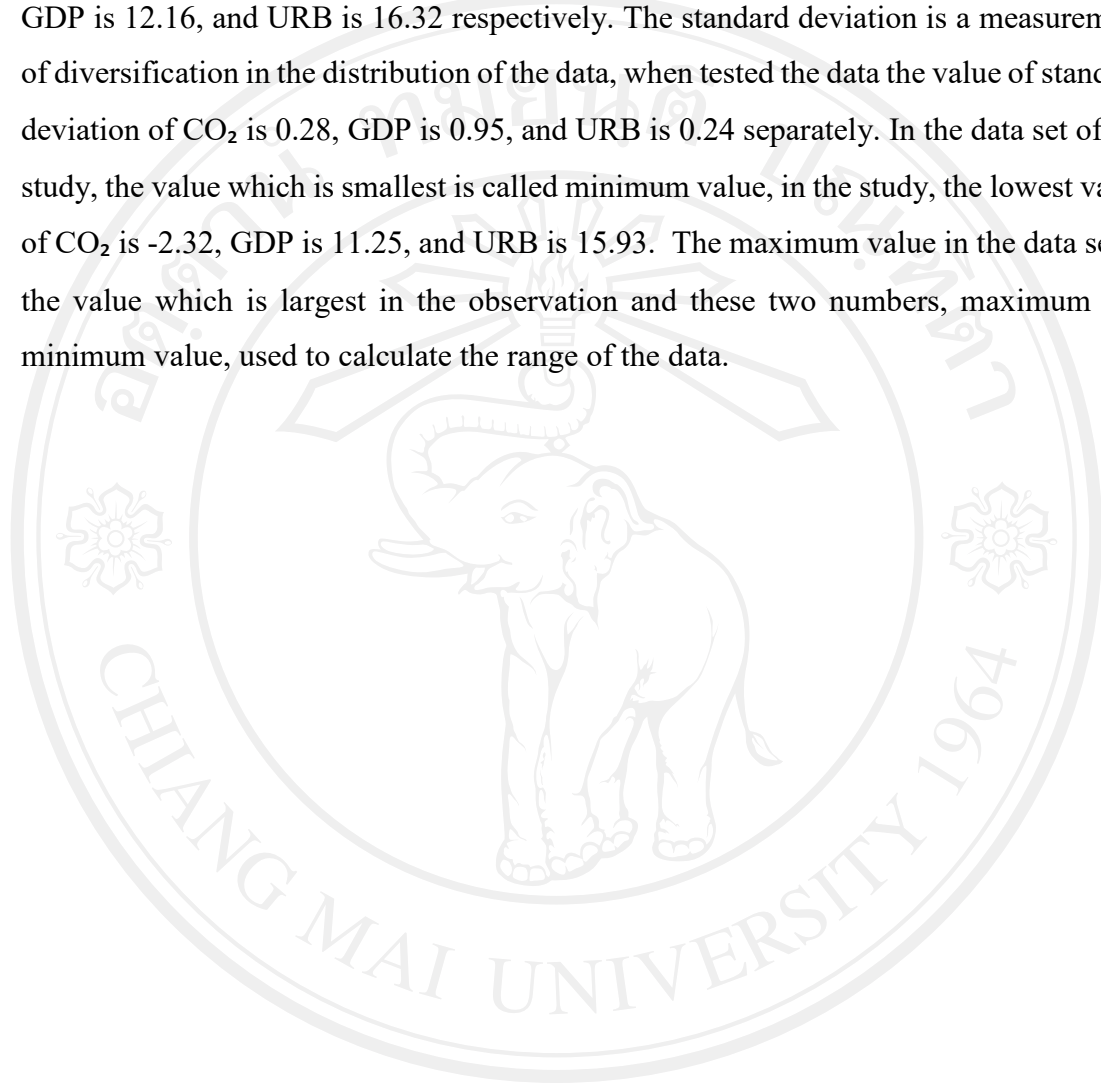
### 3.6.2 Data Description

The descriptive statistics of the data used in this study are depicted in thfollowing table.

**Table 3.2 :**Descriptive Statistics of the variables

| Variables | Observations | Mean | Standard Deviation | Minimum Value | Maximum Value |
|---|---|---|---|---|---|
| $CO_2$ | 36 | -1.75213 | 0.286012 | -2.321171 | -1.293559 |
| GDP | 36 | 12.15918 | 0.949016 | 11.25744 | 13.86999 |
| URB | 36 | 16.31860 | 0.238359 | 15.92738 | 16.72666 |

In Table 3.2 the descriptive statistics of each variable are depicted. In the study, there were 36 observations after adjustment with growth rate. The mean value is the average value of all observation in the data set, in this study the average value of $CO_2$ is -1.75, GDP is 12.16, and URB is 16.32 respectively. The standard deviation is a measurement of diversification in the distribution of the data, when tested the data the value of standard deviation of $CO_2$ is 0.28, GDP is 0.95, and URB is 0.24 separately. In the data set of the study, the value which is smallest is called minimum value, in the study, the lowest value of $CO_2$ is -2.32, GDP is 11.25, and URB is 15.93. The maximum value in the data set is the value which is largest in the observation and these two numbers, maximum and minimum value, used to calculate the range of the data.

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