CHAPTER 4

EMPIRICAL ANALYSIS

The national environmental policy framework and environmental conservation and threats in Myanmar are discussed in section one by using descriptive analysis. This chapter examines the contribution of GDP per capita effect on CO_2 emissions. So it will be investigated for data analysis. Running and analysing of data will be used by applying the VECM model to find out GDP per capita, and urban population affect on CO_2 Emission of Myanmar are described in the section two.

4.2 Descriptive Analysis

This paper mainly studies on the relationship between CO_2 emissions and economic growth in Myanmar. In this part, National environmental policy framework and environmental threat and conservation, energy consumption is described in Myanmar.

4.1.1 National Environmental policy framework

The following 20 National Environmental Policy principles are adopted to do vision mission and objective for environmental protection and governance, natural resource management and economic and social development. These principles will be guided the preparation of a strategic framework for the implementation of the National Environmental Policy Principles in Myanmar. The actors including in master plans are detailed to establish activities, timeframes and budgets for pursuing the National Environmental Policy objectives. The National Environmental Policy Principles are

- Living every person and citizen in the Union of Myanmar can be accessed as the right concerning with clean and healthy environment.

- The absolute value of Myanmar ‘s environment is recognised and considered both tangible and intangible values, including its important spiritual values, ecological assets and cultural heritage, in addition to its direct benefits for humanity.
- Myanmar’s ecosystems are to be protecting and managing in sustainable ways to ensure their natural functions and resilience, and rich biodiversityis maintained.
- Myanmar’s natural resources are to be protecting and managing in integrated lasting approaches to ensure their availability and quality for future generations is not diminished.
- The rights of indigenous people and ethnic nationalities to their lands, territories, resources and spiritual heritage, and their contributions to the respect for and conservation of the environment and natural resources are recognised.
- The significance of Myanmar’s natural capital and ecosystem services for Myanmar’s society and the economy is recognised as a critical factor in environmental and natural resource management.
- A resource efficient and zero waste approach to environmental service provisioning is a necessary part of infrastructure planning and development for all urban areas. Innovative solutions must be found and implemented for rural and remote areas.
- Environmental sustainability will always be the primary objective of determining Myanmar’s economic and social development strategies, which will prioritise low-carbon and green economy pathways.
- Recognizing the inextricable link between environment and poverty,
- environmental considerations are central to effective people-centered
- development and will guide development strategies so that sustainable, green,and equitable approaches to improve prosperity and living standards are pursued.
- Sustainable and renewable energy for all Myanmar will be achieved through the use of existing technology and innovations in the generation, storage and supply of energy.

- Climate smart approaches to development, including resilience, risk management and climate change mitigation strategies, will be aligned with environmental protection and natural resource management approaches in the pursuit of low-carbon, sustainable development.
- Economic values of environmental services will be recognised and incorporated into development policies so that these values are optimised and captured to the extent possible.
- Pollution and waste are to be avoided and minimised at the source as more cost effective than remediation. Enterprises will be encouraged to adopt clean production principles and industrial best practices that go beyond regulatory requirements.
- Remediating of past environmental damage will be prioritised in development planning and decision-making to promote green outcomes and give effect to the polluter pays principle.
- Gender equality and the escapist and the empowerment of women and girls will be integrated into all aspects of environmental protection and management.
- Environmental education will be promoted concerning with the levels of education to enhance understandings of the country's environmental values, challenges and management.
- Institutional and legal frameworks concerned with implementing environmental policies will be strengthened through a clear definition of rights and responsibilities of, and greater collaboration among, different institutions within the government at all levels, as well as with non-government stakeholders.
- Environmental decision making at all levels will be inclusive, transparent able and accountable to relevant stakeholders, with communities and citizens having the right to access information that could affect their lives and property.
- Financial sustainability of environmental governance will be achieved, including through the application of the polluter pays principle and the use of green financial instruments.

- Giving the national environmental interest through consideration will be getting before signing international treaties– this includes future international investment agreements only being signed with an understanding of Myanmar's evolving environmental governance and honouring ratified international agreements in the most environmentally sustainable manner.

4.1.2 Environmental Policies and Legislation in Myanmar

Myanmar's main environmental policies have embraced wording regarding harmony and balance between the protection of its environment and the goal of achieving economic growth. Based on these policy principles, various laws were promulgated to govern the environment sector. So Myanmar has some environmental sectoral laws and regulations which are summarised in the Table (4.1).

Table 4.1: Major Environmental Related Policies and Laws in Myanmar

Law and Regulation	Year	Purpose
Factory Act	1951	To make effective arrangement in every factory for disposal of waste and effluence, and the matter on health, cleanliness and precaution against danger.
Public Health Law	1972	To promote and safeguard public health and to do necessary measures in respect of environmental health.
Territorial Sea and maritime Zone Law	1972	To define and determine maritime zone contiguous zone and continental shelf and the right of the Union of Myanmar to exercise general and exclusive jurisdiction over these zones and continental shelf in respect of preservation .

Table 4.1: Major Environmental Related Policies and Laws in Myanmar (Continued)

Law and Regulation	Year	Purpose
Fishing Rights of Foreign Vessels Law	1989	To conserve fisheries water and to enable systematic operation in fisheries with participation of foreign investors.
Marine Fisheries Law	1990	To conserve marine fisheries water and to enable systematic operation in marine fisheries.
Forestry Law	1992	To implement the forest policy and the environmental conservation policy, to promote the sector of public cooperation in implementing these policies, to develop the economy of the State, to prevent the dangers of destruction of forest and biodiversity, to carry out simultaneously conservation of natural forests and establishment of forest plantations and to contribute towards the fuel requirement of the country.
Protection of wildlife and Wild Plants and Conservation of Natural Areas Law	1994	To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological gardens and botanical gardens.

Table 4.1: Major Environmental Related Policies and Laws in Myanmar (Continued)

Law and Regulation	Year	Purpose
National Environment Policy	1994	To establish sound environment policies in the utilization of water, land, forest, mineral resources and other natural resources in order to conserve the environment and prevent its degradation.
Myanmar Mines Law	1996	To implement concerning with mineral resources policy
Fertilizer Law	2002	To boost development of the agricultural sector, control fertilizer business, and to facilitate conservation of soil and the environment
Environmental Conservation Law	2012	To enable implementation of the Myanmar National Environmental Policy.

Sources: Country Profile Myanmar, UNEP and "A Perspective on Burma", Tun Myint

In 1951, the Parliamentary Government had developed factory law for economic growth. In1972 the Socialist Government had developed public health law to get environmental health. In 1989 to 2002, the State Law and Order Restoration Council had developed such as Forestry Law Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, Marine Fisheries Law, Fishing Rights of Foreign Vessels Law, National Environment Policy, Myanmar Mines Law, Fertilizer Law for many purposes. U Thein Sein government had developed Environmental Conservation law in 2012.

4.1.3 Environmental Threat in Myanmar

The principal environmental threat in Myanmar comes from cyclones and flooding during the monsoon season and regular earthquakes. Due to rain floods regularly

occur during the mi-monsoon period in areas traversed by rivers or large streams. Cyclones, landslides, earthquakes, tsunami, fire and drought are also genuine threats to Myanmar's environment. Nargis, a category three cyclone, struck Myanmar on 2 and 3 May 2008, devastating lives and livelihoods in the Ayeyarwady Division. Consequently, the following environmental concerns have been addressed by the Environmental Thematic Working Group that comprised multiple NGOs, UN agencies and several government ministries and was facilitated by UNDP since May 2009.

(1) Unsustainable agriculture land use practices and the increasing rate of deforestation.

Population growth has limited income opportunities; landlessness and high employment have resulted in intense population pressure on forests, which in turn leads to poverty and land degradation.

(2) Scarcity and degradation of forest resources.

To meet the needs for firewood, charcoal, poles, post, roofing materials like Nipa and conversion to other land use, forests have been exploited beyond the limits

Deforestation causes an environmental threat in Myanmar. The massive deforestation is causing serious problems of erosion, floods, and landslides. Deforestation is a contributing factor to the dwindling biodiversity in tidal forests and elsewhere. The illegal poaching of wild elephants for their tusks and the use of primitive methods for hunting birds also have adverse effects. Also, deforestation for farming or illegal economic gain is the most persistent ecological effect of human encroachment. The main reasons for deforestation are excessive cutting to make way for agriculture and the increasing demand for fuel timber and non-wood forest products. Excessive cutting of trees for fire wood before they are fully grown leads to the loss of growth potential of the forest stand. The rapid deforestation results in increased human pressure on the environment, causing a breakdown in social customs. Despite the relatively low-level of industrialisation, urban problems relating to health, sanitation, and housing already exist in Yangon, Mandalay and other cities. The weather in other regions of Myanmar is also affected by deforestation. It is not known how much people suffer from the effects of both local and global environmental problem. According to Earth rights statement on World Environment Day, it is high time to learn from the devastating impact of Cyclone

Nargis. Globally, gas emission contributes to global warming; storms are increasing intensity while locally deforestation and pollution from mining affects the environment, the statement stated. The massive deforestation is causing serious problems of erosion, floods, and landslides.

Additionally, land degradation poses a widespread environmental threat to Myanmar. An increase in population results in land uses which are not suited to the agro-ecological conditions, and which lead to poor land husbandry practices. It is also due to the accumulation of solid waste which is composed mainly of organic waste. Myanmar is rich in mineral resources comprising tungsten, tin, zinc,silver, copper, lead, coal, and iron.Additionally, limestone,marble deposits and gemstones such as diamonds,rubies, sapphires and jade exist in abundance, along with gold and pearls with its highest quality in the world and, adverse impacts of mining have caused a serious threat to the mountainous regions in the north of Myanmar and fragile coastal areas. Several farmers lost their land to the coal mine and coal power plant in Myanmar Dry Zone is the most problematic area in regard to degradation of land resources due to continued deforestation, in addition to severe climatic changes.

4.1.4 Environmental Conservation in Myanmar

The history of environmental conservation in Myanmar describes from the last dynasty of Myanmar kings, who protected the teak forests and sanctuaries established by King Mindon in 1860. However, there was no central coordinating body for environmental matters before the creation of the National Commission for Environmental Affairs (NCEA) in 1990. The introduction of a market oriented policy made it apparent that there was a need to safeguard environmental interests, and the consequent need for a central institution. The NCEA works under the Ministry of foreign affairs and coordinates the work of various other ministries and departments. Included inthe fourcommittees of the NCEA are the conservation of natural resources, the control of pollution, research education and information and international cooperation. The NCEA has been working to raise public awareness of environmental issues by organising workshops, seminars and conferences among government officials and using mass media to carry its message to the people.Myanmar works to control deforestation through various projects in cooperation with the United Nations Development Program (UNDP)

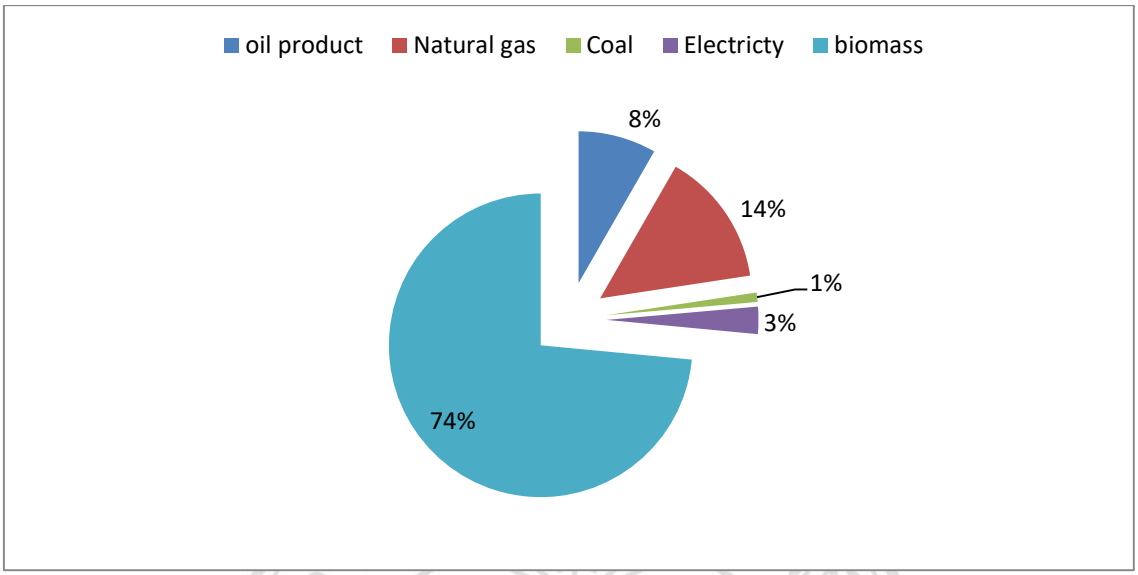
and the Food and Agricultural Organization (FAO). Beyond this, it has entered into some international and regional environmental agreements, including the UNDP's Green House Gas Emission Reduction Plan in Asia and the Project on Regional Cooperation on Global Climate.

Change coordinated by the Economic and Social Commission for Asia and the Pacific (ESCAP).The most recent effort to establish a blueprint for sustainable development is the NCEA's initiation of Myanmar Agenda 21 in 1997.Although Agenda 21 aims specifically at bringing environmental factors to bear on governmental policy making, it has the more general objective of making environmental awareness part of the daily lives of all citizens. To this end, it advocates Environmental education programs in both formal (school) and non-formal settings.

Establishing education courses along with basic literacy programs for all children improved knowledge at the level of basic education and to provide teachers with specific training in environmental education. At the level of higher education where the conservation movement is having its greatest impact, it seeks to establish departments of environmental education to promote research within this area. At the national level, Agenda 21 calls on leaders in business, academia, and other sectors to help raise the level of environmental awareness in all segments of society.

4.1.5 Energy Consumption in Myanmar

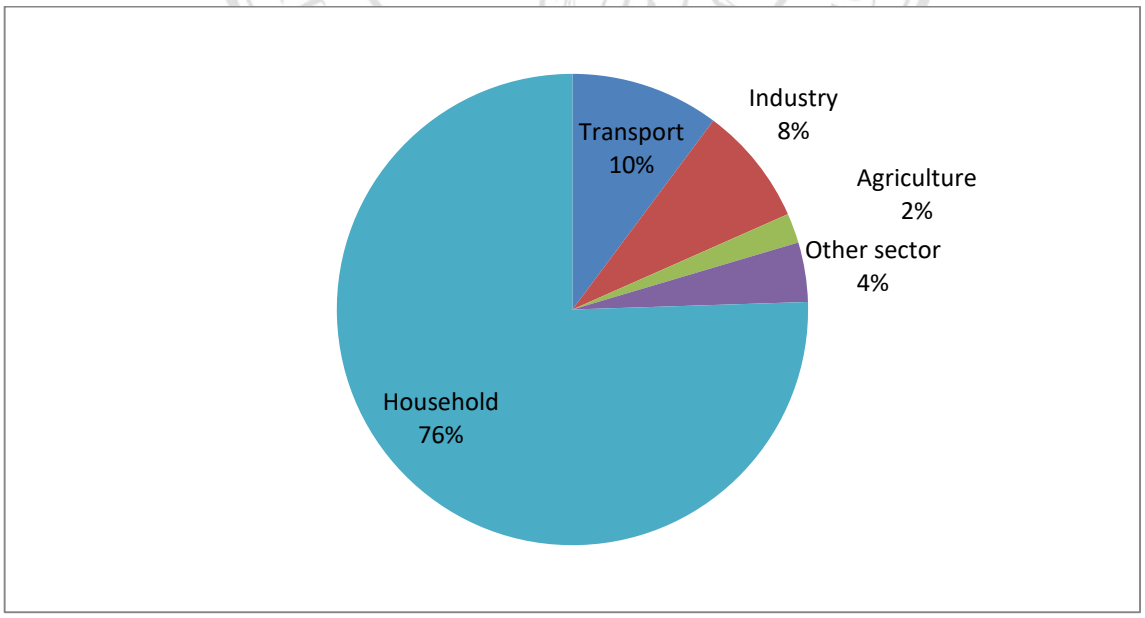
Myanmar primary energy supply consisted of coal, oil, gas, hydro, and biomass. The main sectors of energy consumption in Myanmar include industry consumption and household consumption from the energy sources of biomass, oil product, gas and electricity.



Source; Ministry of energy.

Figure 4.1: Total Final Energy Consumption in Myanmar 2011.

The above figure shows the total final consumption of energy in Myanmar in 2009. Biomass accounted for74 %, natural gas14%, electricity3 %and coal for a mere 1 %. Energy utilisation in Myanmar mainly depends upon traditional energy such as fuel wood, charcoal, and biomass.



Source; Ministry of Energy

Figure 4.1: National Energy Consumption in Myanmar by sector, 2011.

This figure shows the energy consumption by sector. Households used about 76% of total energy consumption followed by the industry sector with 9.69%,while the transport

sector accounted for 4%. The agriculture sector only accounted for 2% of Myanmar's energy use. The low level of energy consumption by industry explains the slow growth in that sector. As industrial development expands, the energy supply needs to expand dramatically to meet the greatly increased demand.

4.2 Exploratory data analysis

There are five steps related to conducting the exploratory data analysis. The ADF test is being used at the first step in favourof to check the stable condition of the data. Tocheck the VECM model, the data have to be stationary at the same level such as at level or the first different. The second step is Johansen cointegration test to know whether the variables are cointegration or not. If the variables are co-integrated, there must be exist VECM mechanism. This implies that VECM model is associated with the cointegration test. The third step is running VECM model to test long term equilibrium. Wald test is conducted in step three to examine the long term and short run causality between CO_2, GDP per capita and URB. Finally, residual diagnostics tests such as normality test, serial correlation and heteroskedasticity test for the VECM model are also conducted.

4.2.1 Augmented Dickey – Fuller Unit Root Test

To use the VECM model three variables (CO_2 emission, GDP per capita and urban population) are needed to check whether they are stationary at the same level or not. To test the stable condition of the time series variables, Augmented Dickey –Fuller unit root test is used. Time series is not stationary is the null hypothesis for the unit root test. If the test statistics is less than 5%, the null hypothesis can be rejected, which means that the time series stationary, ADF unit root test is recorded in table 4.2. At the beginning levels, the null hypothesis is not rejected because three variables such as Ln CO_2, LnGDP and LnURB are not stationary at a level in testing with constant and trend. To see whether the variables are stationary or not at first difference level, the first difference is needed to take. After taking the first difference, the null hypothesis is rejected, and the results mentioned in the table indicate that all series are stationary.

Table4.2.:Results of Augmented Dickey-Fuller unit root

Variables	ADF test statistics	5% Critical value	10% Critical Value	Deterministic Repressor's	lag	Results
$LnCO_2$	-1.895929	-3.544284	-3.204699	Constant &Trend	9	Non-Stationary
LnGDP	-1.449474	-3.544284	-3.204699	Constant &Trend	9	Non-Stationary
LnURB	-0.287047	-3.552973	-3.209642	Constant &Trend	9	Non-Stationary
$dLnCO_2$	-4.591537	-3.548490	-3.207094	Constant &Trend	9	Stationary
dLnGDP	-4.835315	-3.548490	-3.207094	Constant &Trend	9	Stationary
dLnURB	-5.054741	-3.552973	-3.209642	Constant &Trend	9	Stationary

Source :Author's Calculation

4.1.2 Vector Error Correction Model

It is sure that all the variables are stationary at first difference level I (1). Based on the results, the VECM model can be carried out. For this analysis**,** according to the Likelihood-Ratio Test and Akaike's Information Criterion (AIC), the number of lags is defined as two. The decision of the lag length for the VECM model is shown in Table 4.3. For our model, we use only twolag for three our model suggested by both LR test and AIC test.

Table4.3: Lag Order Selection Criteria

Lag	**Log L**	**LR**	**AIC**	**SC**
0	-1.105356	NA	0.241492	0.376170
1	246.9706	437.7812	-13.82180	-13.82180
2	279.2425	51.25525*	-15.19073*	-14.24798*

Source: Author's Calculation

To see the long run relationship between CO_2, GDP and URB we perform the VEC estimation. Before doing VEC estimation, the cointegration analysis is needed to check whether the variables are cointegrated or not. Johansen cointegration test for time series of $LnCO_2$LnGDP, LnURB is run with two lag. The following table 4. 4 show the results of the Johansen cointegration test.

Table 4.4 : Johansen Co-integration Test Results

No. of Co-integration	Log L	SC	AIC
0	285.7668	-16.04647	-15.09415
1	303.1153	-16.73426*	-15.50985*
2	306.8081	-16.59443	-15.09792
3	307.9933	-16.30262	-14.53402

Source: Author's Calculation

This table showed that there is one long run cointegration relationship between CO_2 and its determinants.

Table 4. 5: Normalized cointegrating coefficient

Variable	Coefficient	Std. Error	t-Statistics	Prob
GDP Per capita	0.134	0.041	-3.261	0.002
URB	-0.428	0.172	2.483	0.018
C	3.614170			

Source: Author's Calculation

Table 4. 5 represent long-run results of VEC estimation. According to the table, the equation is the following:

$$LnCO_2=0.134LnGDP-0.43LnURB+3.614170 \quad (1)$$

Resulting estimation of long run relationship can be state in this paper. This result is significant statistical relationship between Carbon dioxide emission and GDP per capita, urban population so we found existence of cointegration relationships. The GDP per capita and CO_2 are positive significant relationship .If the GDP per capita 1% change

, the CO_2 emission would increase 0.13% in the long run. The CO_2 and URB are negative significant relationship in the long run. If the URB increase 1%, the CO_2 emission would decrease 0.43% in the long run. The short run equations are

$$D(\text{LnCO}_2) = -0.52\epsilon_{t-1} + 0.41DLnCO_{2-1} - 0.11DLnCO_{2-2} + 0.43 \text{DLn}GDP_{-1} + 0.25\text{DLn}GDP_{-2} + 121\ DLnURB_{-1} - 76DLnURB_{-2} - 1.06 \quad (2)$$

$$D(\text{LnGDP}) = 0.45\epsilon_{t-1} + 0.22DLnCO_{2-1} - 0.24DLnCO_{2-2} + 0.06\text{DLn}GDP_{-1} - 0.16\text{DLn}GDP_{-2} + 79\ DLnURB_{-1} + 41DLnURB_{-2} + 0.93 \quad (3)$$

$$D(\text{LnURB}) = 0.001\epsilon_{t-1} - 0.001DLnCO_{2-1} - 7.66DLnCO_{2-2} - 0.001\text{DLn}GDP_{-1} - 0.001\text{DLn}GDP_{-2} + 1.62\ DLnURB_{-1} - 0.87DLnURB_{-2} + 0.005 \quad (4)$$

In this case, in order to see the deviations from cointegration values the error term and cointegration equation. We can see error correction for $LnCO_2$, LnGDP and LnURB. The error correction for $LnCO_2$ is statistically significant at 5% level and it is - 0.52. That is, yearly negative adjustment of $LnCO_{2t}$ will be about - 0.52% of deviation of $LnCO_{2t-1}$ from its cointegration value. We see that error correction for LnGDP is 0.45 and is statistically significant. This means that yearly positive adjustment of LnGDP_t will be about 0.45% of deviation of $LnGDP_{t-1}$ from its cointegrating value. The error correction for LnURB is statistically significantly at 5% level and it is 0.001. That is yearly positive adjustment of $Ln\,URB_t$ will be about 0.001% of deviation of LnURB_{t-1} from its cointegrating value. For as a whole, if we consider the long-run relationship as broken, we would say that while the GDP level and the URB, CO_2 level is against error by adjusting

Table 4.6: Vector Error Correction estimation short run results

		Coef	Std.error	T-statistics	P value
$DLnCO_2$	ε_{t-1}	-0.517	0,212	-2.433	0.02*
	$DLnCO_2$(-1)	0.408	0.200	2.039	0.05*
	DLnGDP(-1)	0.433	0.177	2.446	0.02*
	DLnURB(-1)	121.01	52.96	2.285	0.03*
	$DLnCO_2$(-2)	-0.113	0.209	-0.542	0.59
	DLnGDP(-2)	0.255	0.191	1.337	0.19
	DLnURB(-2)	-76.19	45.66	-1.67	0.10
	Constant	-1.067	0.694	-1.564	0.13
DLnGDP	ε_{t-1}	0.454	0.229	1.984	0.05*
	$DLnCO_2$(-1)	0.227	0.215	1.056	0.29
	DLnGDP(-1)	0.068	0.190	0.362	0.72
	DLnURB(-1)	-79.18	56.98	-1.389	0.17
	$DLnCO_2$(-2)	-0.246	0.225	-1.089	0.28
	DLnGDP(-2)	-0.163	0.205	-0.795	0.43
	DLnURB(-2)	41.736	49.127	0.849	0.40
	Constant	0.935	0.747	1.251	0.22
DLnURB	ε_{t-1}	0.001	0.0003	-3.357	0.002*
	$DLnCO_2$(-1)	-0.0005	0.0003	1.760	0.08*
	DLnGDP(-1)	-0.0002	0.0002	-0.784	0.44
	DLnURB(-1)	1.623	0.086	18.90	2.86
	$DLnCO_2$(-2)	-7.66	0.0003	-0.255	0.82
	DLnGDP(-2)	-0.0001	0.0003	-0.363	0.72
	DLnURB(-2)	-0.874	0.074	2.15	2.15
	Constant	0.006	0.001	5.107	1.35

Source: Author's Calculation

The table showed that the short run results of error correction estimation. In this estimation, the current CO_2 is statistically significant to depend on the CO_2 and GDP Per capita, URB in the previous period. This means that 1% increases in CO_2 in the

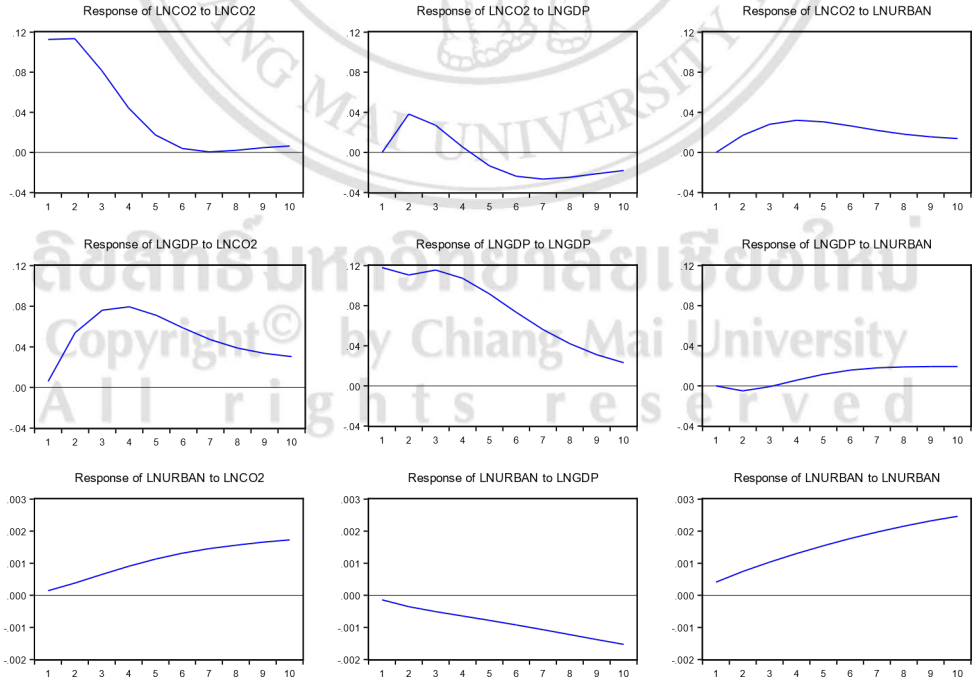
prior period causes 0.41%of current CO_2 to increase, and also 1% increases in GDP Per capita in the previous cycle causes 0.43% of current CO_2 to increase. The URB is 1% increases in the preceding period causes 121% of the current CO_2 to increase. The GDP does not depend on CO_2 and GDP and URB in the priorcycle. The current URB significantly depend on CO_2 and GDP per capita, URB in the previous period. The current URB adverse effect on CO_2 in the prior cycle means that a 1% increase of CO_2 causes 0.0005 % of current URB to decrease.

To summarise the short run VEC estimation result the short term CO_2 depend on CO_2 and GDP Per capita, URB is a positive effect in the previous period.

4.1.3 Impulse Response Function

When the shock is puton the error terms of the VECM model, impulse response function can be used to estimate the response of the three variables. Three impulse response functions can be used to describe the responses between three variables because using in the VECM model are three variables. Figure 4.3 illustrates the responses of the three impulse response function. The result comes out by setting the variables according to Cholesky –dof adjusted method.

Response to Cholesky One S.D. Innovations



Source: Author ‘s Calculation

Figure: 4.3: The impulse responses function of other variables to CO_2, GDP, Urban Population.

Describing in the first column show the time path response of $LnCO_2$ to $LnCO_2$ itself and LnGDP ,LnURB for ten years. $LnCO_2$ was found to have a positive response to shocks LnGDP and LnURB from the first two periods, the positive shock of LnURB was continuously increasing, but LnGDP bottomed out after four periods and remained negative until the end of the tenth period. We could thus infer that both LnGDP and LnURB have a positive effect on the $LnCO_2$ emission of Myanmar.

The figure in the second column, show the responses of LnGDP to $LnCO_2$, LnURB, LnGDP itself for the future ten years. Ln GDP was found to have positive response to shocks $LnCO_2$ and LnURB from the first two periods. Moreover, also the responses of LnGDP are increased, and then these reactions are fell toward reach equilibrium. We could say that LnGDP has a positive impact on $LnCO_2$ and LnURB of Myanmar.

Showing in the third column are the responses of LnURB to $LnCO_2$, LnGDP, LnURB itself for the future 10 years. For the first two periods, the responses $LnCO_2$ and LnURB are positive, and their responses increase year by year. The reaction of $LnCO_2$ is positive, period by period. The response of LnGDP was continuously decreasing and remained negative until the end of the tenth period. We could say that LnURB has both positive impacts of $LnCO_2$ and urban population of Myanmar.