Study on "The Relationship Between Energy Consumption and GDP: Evidence From a Panel Of 13 Asian Countries"

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

By

Biddut Chandra Sarker

(ID #: 123-33-1115)

Supervised by

Tasmia Baten Dina

Sr. Lecturer

Department of EEE

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FACULTY OF ENGINEERING

DAFFODIL INTERNATIONAL UNIVERSITY

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Certification

This is to certify that this project and thesis entitled **Study Of "The Relationship Between Energy Consumption And GDP: Evidence From A Panel Of 13 Asian Countries**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

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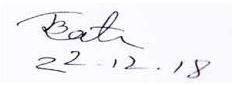
Name: Biddut Chandra Sarker
ID #: 123-33-1115
Batch :10Th
Department of Electrical & Electronic Engraining
Faculty of Engraining
Daffodil International University

Certified By:



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Tasmia Baten Dina
Sr. Lecturer
Department of Electrical & Electronic Engineering
Faculty of Engineering
Daffodil International University

The project and thesis entitled **Study Of "The Relation Between Energy Consumption And GDP: Evidence From A Panel Of 13 Asian Countries,"** submitted by **Biddut Chandra Sarker**, ID No: 123-33-1115, Session: Fall 2012 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering**.

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Dedication

This thesis is dedicated to my parents.

CONTENTS

LIST OF TABLES

List of Abbreviations

GDP	Gross Domestic Product.
HDI	The Human Development Index
GNP	Gross National Product
VAR	Vector Auto Regression
TPE	Total Primary Energy Consumption
BAU	Business As Usual
MGS	Medium Growth Scenario
HGS	High Growth Scenario
VECM	Vector Error Correction Model
PCEC	Per Capital Energy Consumption
IRF	Impulse Response Function

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First of all, I give thanks to Allah or God. Then I would like to take this opportunity to express my appreciation and gratitude to my thesis supervisor **Tasmia Baten Dina, Sr. Lecturer** of **Department of EEE** for being dedicated in supporting, motivating and guiding me through this project. This project can't be done without his useful advice and helps. Also thank you very much for giving me opportunity to choose this project. I also want to convey my thankfulness to **Dr. Engr. Name, Professor and Chairperson** of the **Department of EEE** for his help, support and constant encouragement. Apart from that, I would like to thank my entire friends for sharing knowledge; information and helping us in making this project a success. Also thanks for lending us some tools and equipment. To our beloved family, we want to give them our deepest love and gratitude for being very supportive and also for their inspiration and encouragement during our studies in this University.

ABSTRACT

This study reexamines the relationship between energy consumption per capita and real GDP per capita for Bangladesh, India, Pakistan, Sri-lanka, Maldives, Nepal, Afghanistan, Bhutan, China, Vietnam, Malaysia, Philippines and Thailand using both panel data causality which is taking into account cross-sectional dependence and heterogeneity among the countries and time series causality tests for the period 1971–2009. The findings indicate that taking into account cross-sectional dependence has a substantial effect on the achieved results. The conservation hypothesis is supported for Indonesia, Malaysia and the Philippines. Although a bidirectional relation is found in the case of Thailand, since there is no positive effect of energy consumption on GDP. In the pattern of Singapore, the neutrality hypothesis is supported. In addition, the increase in investment and labor force lead to more energy consumption in Indonesia, Malaysia and Thailand. The relationship and causality direction between energy consumption and GDP is an important issue in the fields of energy economics and policies towards energy use. Extensive literatures have discussed the issue, but the array of findings provides anything but consensus on either the existence of relations or direction of causality between the variables. This study extends research in this area by studying the long-run and causal relations between GDP and energy consumption, labour and capital based on the neo-classical one sector aggregate production technology mode using data of energy consumption and real GDP for ASEAN from the year 2014 to 2017. The analysis is conducted using advanced panel estimation approaches and found no causality in the short run while in the long-run, the results indicate that there are bidirectional relationships among variables. This study provides supplementary evidences of relationship between energy consumption and GDP in ASEAN.

Chapter 1

Introduction

1.1 Introduction: Energy consumption is part of energy homeostasis. Energy consumption refers to all the energy used to perform an action, manufacture something or simply inhabit a building.

- In a **factory**, total energy consumption can be measured by looking at how much energy a production process consumes, for example, by making car parts. This will include water, electricity; gas… any energy source needed for the stuffed animals to be made.

- In a **household**, energy consumption will include the electricity, gas, water, and any other energy used to live in it.

- The energy consumption of a **bus** includes how much diesel or gasoline it uses to run.

All this to clear up the following that stands for energy consumption does not necessarily come from a single energy source. It is a common misconception to think that to save energy you have to save electricity. It could very well be a totally different energy source that has the greatest impact on a certain process.

Looking closely at the definition of energy consumption and going back to our first example, the car parts factory means we have to consider how an entire production process is evaluated. If we are part of a value-added process such as industrial metallurgy for the process does not end when the car parts are manufactured. If the delivery fleet takes them to the customer, the gasoline from that fleet also forms part of our energy consumption.

According to the Bangladesh Power Development Board in July 2018, 90 percent of the population had access to electricity. However per capita energy consumption in Bangladesh is considered low. Electricity is the major source of power for most of the country's economic activities.

The **Gross Domestic Product** (**GDP**) is one of the primary indicators used to gauge the health of a country's economy. It represents the total dollar value of all goods and services produced over a specific time period, often referred to as the size of the economy.

The GDP impacts personal finance, investments, and job growth. Investors look at the growth rate to decide if they should adjust their asset allocation. They also compare country growth rates to decide where the best opportunities are. Most investors like to purchase shares of companies that are in rapidly growing countries.

1.2 Research Motivation:

Electricity, the most usable form of energy, is one of the most important issues for the economic development of a country. The projection of demand for electricity is an integral part of the planning process as it enables the decisions -makers on the regarding matter.

Electricity is a vital ingredient to upgrade the socio-economic condition and to alleviate poverty. The supply of electricity has a great impact on the national economy. Proper and enough reliable energy supply have a great positive impact on our GDP and GDP is one of the key measures to understand the economy of a country. Electricity is a typical form of energy. It is recognized that the pace of power development (especially electricity) has to be accelerated in order to achieve overall economic development of the country because a country's socio-economic development largely depends on it.

1.3 Literature Review:

The existence of a causal link between energy consumption and economic growth nowadays is mainly an accepted thesis, and at the same time, an interesting topic of many empirical studies worldwide. The causal link between energy consumption and economic growth can be synthesized into four possible hypothesis: 1) the growth hypothesis that asserts unidirectional causality from energy consumption to economic growth; 2) the conservation hypothesis which postulates unidirectional causality from economic growth to energy consumption; 3) the neutrality hypothesis that suggests the absence of a causal relationship between energy consumption and economic growth; 4) the feedback hypothesis that emphasizes the interdependent relationship between energy consumption and economic growth in which causation runs in both directions. Kraft and Kraft (1978)

wrote the pioneering and one of the most frequently quoted papers on causality between energy consumption and economic growth. In this paper, the authors investigated the direction of the causal link between gross national product (GNP) and energy consumption in the United States for the period 1947-1974. Using Sims causality test they found that there was a unidirectional causality running from GNP to energy consumption. Akarca and Long (1979) reinvestigated the energy consumption-growth nexus in the United States. Using monthly data (from January 1973 to March 1978) and Granger's causality test, they found a negative causality running from energy consumption to employment. In another study, also on the example of the North American economy but this time for the period 1950-1970, Akarca and Long (1980) used Sims causality test and did not find any statistically significant interdependence. The absence of a causal link between energy consumption and economic growth/employment in the United States has also been confirmed by the research carried out by Yu and Hwang (1984), Yu and Choi (1985), Erol and Yu (1987a), and Yu et al. (1988). Besides USA, Erol and Yu (1987b) have conducted an empirical analysis on the example of six developed industrialized countries for the period 1950-1982 using Sims and Granger causality test. Depending on the analyzed country, Erol and Yu (1987b) proved the existence of all four possible hypotheses: Italy and Germany (GDP→EC), Canada (GDP←EC), Japan (GDP↔EC), France and United Kingdom (no causality). Masih and Masih (1996) also proved the existence of all four possible hypotheses (using Johansen-Juselius procedure and vector error correction model) but on the example of six developing countries: Indonesia (1960-1990; GDP→EC), India (1955-1990; GDP←EC), Pakistan (1955-1990; GDP↔EC), Philippine.

1.4 Objectives:

The objectives of this research are to describe below:

- To Determine the Relation between Energy Consumption and GDP
- To Describe an Overview by the Evidence of 13 Asian Countries
- To Determine the Relation between Energy Consumption and GDP for Bangladesh Perspectives.

Chapter 2

Relation between Energy Consumption & GDP

2.1. Energy Consumption & GDP: Ozturk (2010), Squalli (2007) and Magazzino (2011) provide four hypotheses about the direction of causality between energy consumption and GDP. The first is the **hypothesis of neutrality**, which holds that there is no causality (in either direction) between these two variables. The second Is the energy **conservation hypothesis**, which holds that there is evidence of unidirectional causality from GDP growth to energy consumption. Under the third hypothesis, which is known as the **growth hypothesis**, energy consumption drives GDP growth. The fourth hypothesis is the **feedback hypothesis**, which suggests a bidirectional causal relationship between energy consumption and GDP growth. Narayan *et al*. (2010) examine the long-run elasticities of the impacts of energy consumption on GDP in addition to the impacts of GDP growth on energy consumption for 93 countries during the time period from 1980 to 2006. They apply unit root tests and the cointegration test of Pedroni (1999, 2004) to calculate long-run elasticities between energy consumption and GDP and GDP and energy consumption. Lee (2005) estimates elasticities based on a capital-driven production function, finding a significant coef ficient in the direction of energy consumption to GDP.

2.2. What is GDP: The **Gross Domestic Product** (**GDP**) is one of the primary indicators used to gauge the health of a country's economy. It represents the total dollar value of all goods and services produced over a specific time period, often referred to as the size of the economy. The GDP impacts personal finance, investments, and job growth. Investors look at the growth rate to decide if they should adjust their asset allocation. They also compare country growth rates to decide where

the best opportunities are. Most investors like to purchase shares of companies that are in rapidly growing countries.

GDP is equal to the total monetary value of all final goods and services that have been exchanged within a specific border over a set period of time. For the United States, GDP usually means the dollar-amount value of all purchased goods and services over the course of one year. This includes purchases from private for-profit, non-profit and government sectors. If you buy a roast chicken for $10, GDP increases by $10.

There is a direct and logical sense in which wealth can measure well-being. All economic value is subjective—free market prices are determined by how much better off individuals believe a good or service can make them. Greater access to wealth literally means greater access to things that can improve your life. On the other hand, those who produce wealth in an honest way have literally created the most value for others, at least in an economic sense.

So, in some sense, a higher GDP should equate to greater human progress, because it means more valuable goods and services have been created. Scratch a little deeper, however, and GDP does not even capture this traditional economic value very well.

2.3 Types of GDP:

There are three basic ways to determine a nation's GDP.

- The Expenditure Approach.
- The Production Approach.
- The Income Approach.

2.3.1 The Expenditure Approach:

This method of determining GDP adds up the market value of all domestic expenditures made on final goods and services in a single year, including consumption expenditures, investment expenditures, government expenditures, and net exports. Add all of the expenditures together and you determine GDP.

2.3.2 The Production Approach:

This method also called the Net Product or Value added method requires three stages of analysis. First gross value of output from all sectors is estimated. Then, intermediate consumption such as cost of materials, supplies and services used in production final output is derived. Then gross output is reduced by intermediate consumption to develop net production.

2.3.3 The Income Approach: This method of determining GDP is to add up all the income earned by households and firms in the year. The total expenditures on all of the final goods and services are also income received as wages, profits, rents, and interest income. By adding together all of the wages, profits, rents, and interest income, we can determine GDP.

The three methods of measuring GDP should result in the same number, with some possible difference caused by statistical and rounding differences. The credibility of data is always a significant concern in any form of research. An advantage of using the Expenditure Method is data integrity. The U.S. Bureau of Economic Analysis considers the source data for expenditure components to be more reliable than for either income or production components.

2.4 How GDP is calculated:

As such we will concentrate on the Expenditure Approach which is the most commonly discussed method of representing GNP particularly in non-academic examinations of economic activity.

GDP as examined using the Expenditure Approach is reported as the sum of four components. The formula for determining GDP is: C + I + G + (X - M) = GDP

C = Personal Consumption Expenditures

I = Gross Private Fixed Investment

G = Government Expenditures and Investment

X = Net Exports

M = Net Imports

Before moving forward in our discussion, it should be noted, the income approach is gathering a growing following. This is true particularly among economic blogs, investment publications and cable news business programs due to its concentration on the importance of wages. An alternative method of calculating GNP using the Income Approach is "RIPSAW."

The mnemonic "RIPSAW" breaks down as follows: GDP = R + I + P + S + A + W

R = rents

I = interests

P = profits

SA = statistical adjustments (corporate income taxes, dividends, undistributed corporate profits

W = wages

At this point, we could spend the next thousand words describing alternate means of computing GNP. While that might be beneficial in its attempt to be exhaustive, for our purposes what you need to remember is, in economics, there is rarely only one way to develop and analyze data

Additionally, GDP is impacted by variables beyond economists' control such as the economic health of our trade partners, monetary factors such as the value of the dollar, restrictions in state and local governments spending to the subjective views by consumers to business which influence their consumption/investment choices.

If all you remember from this essay is, jobs are created and lost based on the relative strength of the various components of GDP. Those components can and do fluctuate from internal and external factors beyond the control of any our economic sages. Then you realize why economists are not Einstein and economics isn't physics.

Please consider joining us if you the readers of PolicyMic wish to see this series continue as we next explore C = personal consumption expenditures, perhaps the most factor necessary to stimulate our economic recovery.

2.5 How GDP Affects Economy: Gross domestic product measures the total output of an entire economy by adding up total consumption, investment, government expenditure and net exports. GDP is therefore considered a quality approximation of income for an entire economy in a given period. Per capita GDP is calculated by dividing total GDP by a country's population, and this figure is frequently cited when assessing standard of living. There are a number of adjustments to GDP used by economists to improve the explanatory power of the statistic, and economists have also developed a number of alternative metrics to measure standard of living.

While standard of living is a complex topic with no universally objective measurement, rising global income since the Industrial Revolution has undeniably been accompanied by global poverty reduction, improved life expectancy, increased investment in technology development and a high material standard of living in general.

GDP is divided by population to determine personal income, adjusted for inflation with real GDP and adjusted for purchasing power parity to control for the impacts of regional price disparities. Real per capita GDP adjusted for purchasing power parity is a heavily refined statistic used to measure true income, which is an important element of well-being.

Many economists and academics have observed that income is not the only determinant of well-being, so other metrics have been proposed to measure standard of living. The Human Development Index (HDI) was developed by economists in association with the United Nations Development Programmer, and this metric includes measurements of life expectancy and education in addition to per capita income. Prior to 2010, GDP was a direct input in the official calculation of HDI, but it has since changed to gross national product (GNP). There are also adjustments to HDI that account for such variables as income inequality.

2.6 How GDP Misses the Mark: GDP can increase after a car accident or a major flood. GDP can grow rapidly during a war or after a terrorist attack. If all of Chicago caught fire once again and burnt to the ground, the rebuilding effort just might boost GDP. This is because GDP is very susceptible to the broken window fallacy — false signals of rising prosperity when obvious destruction has taken place.

However, from the perspective of a citizen living with the day-to-day realities of life, GDP can be rather misleading. This is why the genuine progress indicator (GPI) was created in 1995 by a socially responsible think tank called Redefining Progress. It was developed as an alternative to the traditional GDP measure of a nation's economic and social health. Read on to find out what GDP fails to reveal about a country's economic prosperity and how the genuine progress indicator works to make up this gap.

2.7 A Higher GDP means a Better Economy: Economists traditionally use gross domestic product to measure economic progress. If GDP is rising, the economy is in good shape, and the nation is moving forward. If GDP is falling, the economy is in trouble, and the nation is losing ground.

2.8 What is Energy Consumption: Energy consumption is the amount of energy or power used. Energy is also an arena where we can see the importance of technology. New forms of 'clean' energy are being developed, and fossil fuel consumption is becoming more and more efficient. In much of the developing world, photovoltaic cells or 'gobar gas' plants produce energy that is more friendly both to the environment and to people. Per capita energy consumption varies greatly among countries. Rich countries consume 10 to 20 times as much energy per capita as do poor countries.

On the other hand, per capita consumption is increasing rapidly in the less developed regions and is actually declining in some of the more developed areas.

There are also great differences among the wealthy countries. Japan consumes just over half the amount of energy per capita that the United States consumes, for roughly the same standard of living and level of human productivity. Energy consumption at Japanese levels would do far less damage to the environment than consumption at United States levels. Equally, a world of 7.5 billion people will have less energy impact on the environment than would a world of 10 billion. In many countries in the developing world, wood from the forests provides the energy needed for warmth and cooking. It is often the tasks of women to find, cut, and carry the fuel wood. For these women, population growth means there are more people searching farther and spending more time to gather meager supplies. In these areas, fertility reduction means promotion the well being of both the women and the natural environment they use for fuel wood.

2.9 Why is Energy Consumption Important: Energy management is the means to controlling and reducing your organization's energy consumption. And controlling and reducing your organization's energy consumption is important because it enables us to reduce costs, this is becoming increasingly important as energy costs rise.

2.10 Energy is Consumed in the World: According to an IEA estimate, we humans produced and used 5.67×10^{20} joules of energy in 2013, equivalent to about 18.0 terawatt-hours (TWh). One TWh is equivalent to 5 billion

barrels of oil per year or 1 billion tons of coal per year; it also used to be the globe's entire energy consumption in 1890.

2.11 Relation between Energy Consumption & GDP: Using panel co-integration approach over the period 2014-2017 for Asian economies, this study investigates the dynamic linkages between energy consumption and GDP. The results show that, in the short run, feedback relationship holds between energy consumption and GDP and between energy consumption and exports. In the long run, the feedback relation holds between energy and GDP while unidirectional causality holds from export to energy. Thus, feedback hypothesis between energy and GDP holds in the short as well as in the long run. The feedback relationship between trade and energy consumption suggests that any shortage of energy supply will lessen the trade and this reductions in trade will lessen the benefits of trade in the region since results have also shown that reduction in export can impede GDP growth.

The relationship between energy consumption and output is a vastly studied area in energy economics (e.g. Lee, 2005; Khan and Qayyum, 2006; Noor and Siddiqi, 2010) and the relationship between trade and output is a broadly studied area in international economics (e.g. Kemal et al, 2002; Din, 2004). However, the long run relationship among energy consumption, trade and GDP is relatively less studied area of economics particularly for South Asian countries. The understanding of the dynamics among these variables has important implications for new energy and trade policies. For example, if unidirectional Granger causality or no Granger causality is observed between trade and energy consumption then energy conservation policies which could create energy shortages, will have no effect on trade policies which are designed to promote economic growth and welfare of the nation. On the other hand, if there exists bidirectional causality between energy consumption and trade then energy conservation policies to reduce energy wastage can offset the positive effects and benefits of trade promotion and thus economic growth of the country will impede. This study is different from previous studies in following ways: First, most of previous studies focus either on energy-GDP relationship or export-GDP relationship for South Asian economies. This study explores the simultaneous relationship between trade, GDP and energy consumption. In this study panel co-integration approach is used to estimate the long run relationship between the variables and this

approach is considered more advantageous over a single equation technique and thus provides better estimates for the dynamic relationship between the variables. The roadmap for the remainder of this study is as follows.

In the literature, a number of studies have explored the relationship between GDP and energy consumption. The neo-classical growth theories consider labor and capital as important factors of production while ignore the importance of energy. However, following the energy crisis of 1970's, the importance of energy for GDP growth received a considerable importance. Initially, Kraft and Kraft (1978) studied the casual relationship between energy and GNP. Since then there is a plethora of studies in this regard and there are mixed results for the relationship of these two variables. There are four basic hypotheses for the causality relationship between energy consumption and economic growth: First, neutrality hypothesis which suggests that there is no significant causal relationship between energy consumption and GDP. Second, conservation hypothesis which suggests that there is a one-way causality relationship running from GDP to energy consumption. Third, feedback hypothesis which suggests that there is a two-way causality relationship between energy consumption and GDP. Fourth, growth hypothesis suggests there is a one-way causality relationship running from energy consumption to GDP.

Noor and Siddiqi (2010), find out a negative long run relationship between energy and GDP in South Asian countries (Pakistan, Bangladesh, Nepal, Sri-lanka and India). Using panel co integration and fully modified OLS. In the short run, they found unidirectional causality running from energy to GDP.

Using a sample of 18 developing countries, Lee (2005) suggests that energy conservation policies are harmful in selected countries and his findings are in support of growth hypothesis. He used panel co-integration technique and panel VECM to check the relationship between energy and GDP over the period 1975-2001. The results supported long run relationship between these two variables after allowing for individual county effects and energy is impetus for GDP growth in these countries. Lee and Chang (2008) confirm a long run relationship between energy consumption, GDP, capital stock and labor using panel co-integration technique for 16 Asian countries over the period of 1971-2002. Their results are in support of growth hypothesis as there is found one way causality running from energy consumption to GDP. Narayan and Popp (2012) argue that there are some countries where energy conservation policies have minimal effects on GDP growth. They found mixed results

for the long-run Granger causality relationship between energy and GDP for 93 countries using annual data from 1980 to 2006. They found a long-run relationship between energy and GDP for Asia, Chen et al. (2006) suggest that electricity used and GDP have a feedback relationship for ten newly industrialized Asian countries selected in the long run but one way causality running from GDP to electricity is found for short run. The panel co-integration technique is used to investigate the relationship by using panel data from the period 1971-2001. They favor conservative policies to avoid wastage of energy and for a sufficient supply in the long run to enhance economic growth.

There are few studies that investigated the ties between energy consumption, trade and GDP. In particular, Narayan and Smyth (2009) noted statistically significant feedback relationship between GDP, electricity used and exports for a panel of Middle Eastern countries. Further a short run granger causality running from electricity used to real GDP and from income to export while in long run Granger causality running from exports and electricity used to GDP and from export and real GDP to electricity used. 7 Lean and Smyth (2010a) found evidence of unidirectional causality relationship running from electricity consumption to exports in Malaysia by using capital, labor, GDP, export and electricity used in a production function framework. Further export-led growth hypothesis was supported for the country. The annual data from 1970 to 2008 was used to estimate the relationship for above mentioned variables. While in a similar kind of investigation, Lean and Smyth (2010b) noted unidirectional causality relationship from GDP growth to electricity generation while no causal relationship was found between exports and electricity generation. Further export-led growth or growth led export hypothesis were not supported in Malaysia by employing the data from 1970 to 2008. Sadorsky (2011a) noted unidirectional short run granger causality running from export to energy consumption while a feedback relationship between energy consumption and import for a panel of 8 Middle Eastern countries. Further bidirectional causal relationship between energy consumption and GDP was found and long run elasticity estimated by FMOLS showed that both export and import increments will increase energy demand in the countries selected. Sadrosky (2011b) noted for seven South American countries, a long run relationship between GDP, labor, capital and trade (imports or exports) by using an aggregate production function and short run dynamics show a feedback relationship for export and energy consumption and unidirectional causality

running from energy to imports. In the long run a causal relationship was found for trade (exports or imports) and energy consumption. By considering these studies it is clear that energy consumption and trade are inter-correlated and most of the studies described, favor a feedback relationship between energy consumption and trade in short run as well as in the long run. The present study contributes to the literature by investigating the dynamic linkages between trade and energy in the production framework for the South Asian economies as there is little or no empirical literature on this topic for this region.

Chapter 3

Overview

3.1 Overview of Asian Economies: Using panel co-integration approach over the period 2014-2017 for South Asian economies, this study investigates the dynamic linkages between energy consumption and GDP. The results show that, in the short run, feedback relationship holds between energy consumption and GDP and between energy consumption and exports. In the long run the feedback relation holds between energy and GDP while unidirectional causality holds from export to energy. Thus, feedback hypothesis between energy and GDP holds in the short as well as in the long run. The feedback relationship between trade and energy consumption suggests that any shortage of energy supply will lessen the trade and this reductions in trade will lessen the benefits of trade in the region since results have also shown that reduction in export can impede Gross domestic product (GDP) growth. According to the report of the World Bank in 2017, the Asian countries will register a growth rate of 7.1% this year, which remains almost the same as in 2015. As a result, this region remains the most dynamic in the world, despite a slowdown compared to the average growth rate of 8% for 2014–2017. Growth will settle slightly in China from 7.7% in 2014 to 7.6% this year. Apart from China, the region's developing countries will also experience a slight decline in growth, which will amount to 5% against 5.2% last year. The major economies of Southeast Asia, such as Indonesia and Thailand, will face tightening of global financial conditions and an increase in household debt. In Malaysia, growth will accelerate slightly to 4.9% in 2014. Exports will increase, but the increase in the debt service and the fiscal consolidation underway will weigh on domestic demand. In the Philippines, where growth could decline to 6.6%, accelerating reconstruction spending would offset the decline in consumption following the natural disasters in 2017. The economies of smaller size should experience sustained growth, and face risks of overheating that may require further tightening of monetary policy.

Structural reforms are essential to reduce vulnerabilities and ensure long-term sustainable growth. China has undertaken a series of reforms in finance, market access, mobility of labor, and taxation in order to increase the efficiency of growth and boost demand interior. Over time, these measures will sustain the economy on a more stable basis, inclusive and sustainable. Some initiatives already announced by the government, such as tax reform and reducing barriers to private investment, could also boost short-term growth. If they are successful, reforms in China could have tremendous positive effects on trading partners that supply agricultural products, consumer goods, and modern services. However, a disorderly adjustment of the Chinese economy would have a negative impact on regional and global growth, particularly in countries dependent on natural resource exports. In this section, we present the Asian economies under study in terms of CO_2 emissions, GDP per capita, energy consumption, and financial development.

3.2 Overview of Bangladesh: Average annual growth rate of the energy consumption in the countries ranges from a high value of 4.47 per year for Bangladesh. For all of these countries growth rate of energy consumption is more than 2.5 % per year. For Bangladesh average annual growth rate of 9 energy consumption are almost equal to their average annual growth rate of real GDP, the growth rate of the two variables are also closely related which means that for all of these country energy consumption and real GDP are growing almost at the same rate. His shows that energy conservation policies may not affect the economic growth adversely. But in case of Energy consumption, there is unidirectional causality from energy consumption to GDP. This means that the energy consumption will accelerate the GDP growth in the country and shortage of energy may cause the poor economic performance and it will result in fall in GDP. Thus, energy conservation policies in electricity sector affect the economic growth negatively. The results also indicate that there is one way causality running from capital formation to GDP. This implies that capital formation and electricity consumption accelerate the economic growth in Bangladesh while the energy prices are independent of all types of energy consumption (gas consumption, oil consumption, coal consumption, and electricity consumption), GDP, and capital formation. Means in case of Bangladesh the energy

price does not affect the energy consumption and GDP directly so in case of energy prices the neutrality Hypothesis implied

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	49.65	2,50,000.00	7.3	Feedback Hypothesis
02.	2016	48.26	2,35,623.00	7.2	
03.	2015	45.84	2,08,322.00	6.5	
04.	2014	43.84	1,84,013.00	6.0	

Table 3.2: Energy Consumption and GDP for Bangladesh [26], [12]

In Bangladesh it is found positive relationship between energy consumption and economic growth for Bangladesh using data spanning from 2014 – 2017 and reported that higher level of energy use led to higher level of growth. By the investigated the possible existence of dynamic causality among electricity consumption, energy consumption, carbon emissions and economic growth in Bangladesh. The results indicate **Feedback hypothesis** that uni-directional causality exists from energy consumption to economic growth both in short and long run, while bi-directional long run causality exists between electricity consumption and GDP but no causal relationship exists in short run.

3.3 Overview Of India: After carrying out the Granger Causality test, the study trying to estimate the dynamic causality relationship between growth of energy consumption demand and growth rate of GDP through variance decomposition analysis of vector auto regression (VAR) technique. The variance decomposition of growth rate of electricity consumption is presented in that the variation in the electricity growth rate is initially being explained by in its own shock, but from the second period on words, the growth rate of GDP to a certain significant degree explains the variation in growth rate of electricity consumption demand. This states

that the growth rate of GDP leads to increasing the demand for electricity consumption in India. we find the decomposition result for the growth rate of GDP shows that growth rate besides being explained by its own shock, it is also significantly being explained by the shocks in electricity consumption and this almost throughout the periods. At the first period 7 percent of the variance in growth rate is being explained by the shocks in electricity consumption and the second period it is 15 percent and in the third period until the 10th period around 18 percent of variation in growth rate of GDP is being explained by the variation in growth rate of electricity consumption. This implies that there is a bidirectional causal relationship between growth of electricity consumption and economic growth in the context of India. This result is divergent to the Granger causality test reported above as Granger causality shows there is no causal relationship between electricity consumption and GDP growth. The variance decomposition of growth rate of Lignite consumption is explained in that the variation in the lignite growth rate is initially being explained by its own shock, but from first period on words, the growth rate of GDP to a certain significant degree explains the variations in the growth rate of lignite consumption demand. This implies that with the rise in GDP growth, there is an increasing demand for lignite consumption in the economy. we have seen the variance decomposition result for growth of GDP besides being explained by its own shock, it is also significantly being explained by the shock in lignite consumption and this almost through out the periods. This also indicates that there is a bidirectional causal relationship between the growth of lignite consumption and economic growth in India. This result is also contrary to the result obtained from the Granger causality test reported above as Granger causality shows there is unidirectional causality runs from GDP to lignite. The variance decomposition analysis of natural gas consumption explained in that 1 percent variation in the second period, a 13 percent variation in the 3 and 4 periods and 14 percent variation in the growth rate of natural growth is being explained by the growth rate of GDP respectively to the 10 period. That means it is growth of income which causes more demand for natural gas consumption in the economy. This result conformed from the above Granger causality test. However, when one considers the variance decomposition of growth rate of GDP presented, it shows that the variation in growth rate of GDP is not being explained by the consumption of natural gas. Relatively, it is nearly unconditionally being explicated by its own shocks. This implies that the growth rate of consumption of natural gas is

driven by growth of GDP in the economy. The presents the variance decomposition results growth rate of petroleum in relation n to the growth rate of GDP. It shows that the petroleum energy consumption is marginally is being explained by its own variation and shocks. This result is relatively similar to Granger causality, wherever, the study found the growth rate of GDP has no influence on the petroleum consumption. However, the variance decomposition of the growth rate of GDP produced in the same table shows that the growth rate of GDP is not significantly being explained by the shocks in the petroleum consumption. Which suggest that petroleum consumption is not a key to the growth rate of GDP in the economy or it is insignificant to the economic growth for India. This result is reliable with the Granger causality obtained previously.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	1066.268	2237527.00	6.7	Growth Hypothesis
02.	2016	1011.191	2273567.00	7.1	
03.	2015	983.823	2102392.00	8.2	
04.	2014	881.562	2039127.00	7.4	

Table 3.3: Energy Consumption and GDP for India [25], [13].

In the Indian context, there are conflicting results of causality direction between electricity and GDP and it indicates **Growth Hypothesis**. Whereas, some concluded this relationship in both the direction and some more found that there is no causality relationship between EC to GDP.

3.4 Overview of Maldives: Maldives face important challenges that are common to small island states. Real GDP grew by 7.1 percent in 2017, on the back of strong performance of the tourism sector, an acceleration of construction, transport and communication, and fisheries. These sectors contributed about 5 percentage points to headline growth (or over 70 percent). Preliminary estimates for 2018 indicate that

GDP growth accelerated to 12 percent y/y in the first quarter of 2018 compared to 6 percent in the first quarter of 2017. Headline inflation averaged 2.8 percent in 2017, driven by the increases in prices of food and housing and utilities, reflecting the partial removal of food subsidies and the pass-through of rising electricity prices. Over the first half of 2018, major components of the CPI basket receded, with the overall consumer price index falling by 0.4 percent. This decline in prices was more pronounced in the atolls, given the relatively higher weight of food items compared to Male'. Limited uptake of the cash transfer to compensate for the partial removal of food subsidies may have impacted on the poor households' purchasing power.

The current account deficit is estimated to have narrowed to 18.8 percent of GDP in 2017 (from 24.4 percent in 2016). The financing of the current account was mainly through direct investment and, to a lesser extent, portfolio flows. Gross official reserves recovered from US$467million at end-2016 to US$586 million at end-2017 (US$206 million after netting out short-term foreign currency liabilities to domestic banks).

The government made progress in rebalancing fiscal expenditure to accommodate increased capital expenditure. The fiscal deficit narrowed from a 10.6 percent of GDP in 2016 to a 2.5 percent in 2017, driven mainly by a reduction in public investment from 10.9 percent of GDP in 2016 to 8.2 percent in 2017, and a reduction in spending on food subsidies and on the Aasandha unlimited health care system. Excluding the Public-Sector Investment Program, the underlying current fiscal balance went from a deficit of 2.0 percent of GDP in 2015 to an estimated surplus of 5.7 percent of GDP in 2017, reflecting revenue increases and current expenditure reforms. Public debt is estimated to have reached 61.2 percent of GDP in 2017, an increase from 59.7 percent of GDP in 2016, driven by external projected-related borrowing and the US$ 200 million Eurobond issuance.

Sl.No.	Years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	0.35	4600	8.8	Neutrality Hypothesis
02.	2016	0.29	4213	4.5	
03.	2015	0.21	3995	2.2	
04.	2014	0.20	3690	7.6	

Table 3.4: Energy Consumption and GDP for Maldives [25], [14].

This study investigates the dynamic relationship between energy consumption and GDP. This study applies a panel vector auto regression model to provide impulse response functions (IRFs), which enable the impact of shocks to be examined between real gross domestic product, energy use, real gross fixed capital formation, and total labor force. In addition, panel Granger causality tests are employed to examine the direction of causality between energy consumption and GDP. The IRFs show that the shocks of all the variables require a long period to reach the long-run equilibrium level and the greatest response of each variable is attributed to its own shock. The panel Granger causality results evidence bidirectional causality effects between energy consumption and GDP, which supports **Neutrality hypothesis**, meaning that these variables have strong interdependency between each other.

3.5 Overview of Nepal: In energy dependent economies, energy consumption is often linked with the growth in Gross Domestic Product (GDP). Energy intensity, defined herewith, as the ratio of the total primary energy consumption (TPE) to the GDP, is a useful concept for understanding the relation between energy demand and economic development. The scope of this article is to assess the future primary energy consumption of Nepal, and the projection is carried out along with the formulation of simple linear logarithmic energy consumption models. This initiates with a hypothesis that energy consumption is dependent with the national macro-economic parameters. To test the hypothesis, nexus between energy consumption and possible determinant

variables are examined. Status of energy consumption between the period of 1996 and 2009, and for the same period, growth of economic parameters is assessed. Three scenarios are developed differing from each other on the basis of growth rates of economic indicators: total GDP, GDP-agriculture, GDP-trade, GDP-industry, and other variables including growth in private consumptions, population, transport vehicles numbers, prices of fossil fuels etc. Scenarios are: Business as Usual (BAU), Medium Growth Scenario (MGS) and High Growth Scenario (HGS). Energy consumption in all the sectors and for all fuel types are not statistically correlated with every economic parameter tested in the assessment. Hence, the statistically correlated models are included in the prognosis of energy consumption. For example, the TPE consumption and electricity consumption, both are significantly dependent with the total GDP and population growth. Likewise, fuel wood consumption is significantly dependent with the growth in rural population and private consumptions. In BAU the estimated electricity consumption in 2030 would be 7.97 TWh, which is 3.47 times higher than that of 2009. In MGS, the total electricity consumption in 2030 is estimated to increase by a factor of 5.71 compared to 2009. Likewise, in HGS, electricity consumption would increase by 10-fold until 2030 compared to 2009, demanding installed capacity of power plant at 6600 MW, which is only from hydro power and other centralized system.

Sl.No.	Years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	6.25	24000.00	7.5	Neutrality Hypothesis
02.	2016	5.26	21132.00	0.4	
03.	2015	5.00	21421.00	3.3	
04.	2014	4.27	19995.00	6.0	

Table 3.5: Energy Consumption and GDP for Nepal [25], [15].

In this research, an attempt is made to examine the causal relationship between the per capita consumption of coal, electricity, oil and total commercial energy and the per capita real gross domestic product (GDP), using a co-integration and vector error correction model. The increase in real GDP, among other things, indicates a higher demand for a large quantity of commercial energy such as coal, oil and electricity. This implies that low infrastructure development limits the usage of commercial energy, which may also hold back economic growth. Empirical findings reveal that there is a unidirectional causality running from coal, oil and commercial energy consumption to per capita real GDP, whereas a unidirectional causality running from per capita real GDP to per capita energy consumption is found. It refers the **Neutrality hypothesis** .It is suggested that the input of per capita energy consumption stimulates enhanced economic growth in Nepal.

3.6 Overview of Pakistan: Energy is one of the major contributors to the production process of the economy. It is a component which has ever increasing importance and demand in any economy. The use of energy manifolds the production process, thereby increasing the economic growth rate. That is why its relationship with economic growth is studied and analyzed on a large scale. Its need is increasing day by day in all spheres of life. An increase in the growth rate of the GDP is a sign of prosperity for a country. On the other hand a drop off in the growth rate retards the affluence of the country. The economic growth rate of a country is an important phenomenon which has brought under consideration in the literature. It can be said that economic growth is the backbone of a country. Pakistan is a country which does not have a stable and sustainable growth rate. A stable and sustainable growth rate is important for any state to develop. Various sectors of the economy contribute to the GDP of the country. According to the economic survey of Pakistan June 2013 servicing sector contributes 46%, industrial sector contributes 23% and agricultural sector contributes 21% to the GDP of Pakistan. All the sectors demand of energy and various other inputs to produce efficient output. Generally the growth rate of Pakistan is held to be unstable for past few decades and is observed to be at 6% on average, whereas in the last few years the growth rate is observed to be at 3%. There are many reasons of this low and unstable growth rate of Pakistan e.g. lack of efficient policy making and implementation, energy crisis, shortage of technical expertise,

security problems and low foreign direct investment. Since the economic growth rate of a country is considered to be the strength of character of a state. Therefore, it is important to study and analyze the various inputs which affect the economic growth rate, one such input is energy. Energy is as important factor used in the production process. The relation of energy to economic growth can be positive or negative depending upon the country under consideration. Explored a stable relationship between economic growth and energy consumption both in long and short run .Likewise Gas, oil and electricity except coal are positively and significantly elastic to output. Inferred that increased energy consumption has a positive impact on the growth.

The relationship of economic growth can be studied with a number of inputs but this study takes into account the sources of energy to be analyzed in relation to economic growth, since energy is an indispensable component of production and it contributes to the economic growth in one way or the other. The demand for energy is increasing thereby exceeding its supply, for instance; the production of gas in Pakistan can fulfill only 23% of its need. Similarly, total oil production in Pakistan is 22,000 barrel/day, according to economic survey of Pakistan June 2013; however, its demand is more than 100,000 barrel/day. The high demand for energy, its critical supply, and its contribution towards economic growth makes it to be a burning topic to be analyzed.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	107.29	300000.00	5.7	Neutrality Hypothesis
02.	2016	100.36	278913.00	4.5	
03.	2015	90.36	270556.00	4.1	
04.	2014	65.28	244361.00	4.1	

Table 3.6: Energy Consumption and GDP for Pakistan [25], [16].

In this study, we attempted to find the direction of the causal relationship between energy consumption and economic growth in Pakistan. We first found the strength of relationship between energy consumption and GDP then we investigated the causal relationship between growth in energy consumption and GDP. It refers the **Neutrality hypothesis**. The main purpose of this study is to analyze the impact of energy consumption on economic growth and to examine the causality between variables.

3.7 Overview of Sri Lanka: The present study examines the energy demand, supply and investment trends in the process of economic development in Sri Lanka. The relationship between economic development and energy consumption and the major determinants in the energy consumption of the household sector and the issue as to whether there could be an imbalance between the future demand and supply of energy in Sri Lanka and if so, how this gap could be bridged. The author has endeavored to analyze the energy trends with special reference to the decades of the 1970's and 80's and to obtain a vivid picture of these trends in the process of economic development. Energy-GDP relationship has been viewed from the perspectives of both consumption and production. The relationship between energy consumption and GDP has been examined through simple, multiple and simultaneous regression techniques and GDP-Energy technical relationship by using the Cobb-Douglas Production Function. Energy-Economy interactions have been explained in terms of Energy-GDP elasticity's. The energy imbalance issue has been viewed through the overall energy supply-demand balance based upon energy supply-demand balances of the sources of energy under different scenarios making use of macro simulation as a tool. The efficient energy pricing and conservation has assumed increasing importance in meeting energy demand and supply. The efficient prices for electricity and petroleum products have been computed in terms of marginal costs and for fuel wood in terms of incremental annuitized fuel wood cost. Concerning energy conservation in the household sector, the largest consumer of energy, the improved closed wood stoves have been proved to be the most efficient at both market and shadow prices. The analysis of energy consumption trends over the period 2014-1017 in the country has revealed the existence of a consumption-oriented pattern of energy use, the decline in the energy intensity of the economy attributable to the decline in the sect oral energy intensities rather than to the structural changes in the economic

sectors and the changes in the growth rates of the GDP in the same directions as those in the energy consumption. The energy supply trends have depicted the non-existence of structural changes between commercial and traditional energy in the composition of the energy supply over the period, 2014-2017. However, the sources of commercial energy supply have undergone changes in its composition with the rising share of electricity accompanied by a declining share of the petroleum products over the same period. Concerning investment trends, the history of energy sector development ii has been largely a case of hydro-power development with the result of installed capacity of electricity leading to an excess over the optimum electricity capacity over the period, 2014-2017

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	14.671	87000.00	3.1	Neutrality Hypothesis
02.	2016	14.149	80978.00	4.5	
03.	2015	13.089	80412.00	5.0	
04.	2014	12.357	79312.00	5.0	

Table 3.7: Energy Consumption and GDP for Sri Lanka [25], [17].

This study attempts to shed light into the empirical relationship between energy consumption and GDP in Sri Lanka (201`4-2017) and found the **Neutrality hypothesis** employing the vector error-correction model estimation (VECM). The vector specification includes energy consumption, real GDP and price developments, and the latter was taken to represent a measure of economic efficiency. The empirical evidence suggests that there is a long-run relationship among the three variables, supporting the endogeneity of energy consumption and real output. These findings suggest important policy implications, since the adoption of suitable structural policies aiming at improving economic efficiency can induce energy consumption without impeding economic growth.

3.8 Overview of Afghanistan: Currently, the private sector is one of the key drivers of the country's economy and growth. In this sector SMEs make up about 80 percent of Afghan businesses, half the country's Gross Domestic Product (GDP), and employs more than 1/3 of the labor force49. According to the World Bank, the main sectors that contributing to the GDP in 2015 were: agriculture, incl. cereals and fruits with 21.7 percentage; industry, incl. manufacturing, mining and construction, with 23,3 percentage; and services, incl. wholesale and retail trade, transport, communications, financial services and government services, with 55 percentage50. e local currency, the Afghani, has depreciated steadily against the US$ since 2012. The decline of foreign direct investment is increased tendency for households to hold their savings in US$, and capital outflow due to increased migration and security issues Afghanistan trade and industrial pools are mainly located in Kabul, Kandahar, Herat, Jalalabad and Mazar-e Sharif. Kabul, hosts almost all the main branches of major businesses. Kandahar, Herat, Jalalabad and Mazar-e Sharif are the 4 major provinces which represent the 4 zones of the country (North, South, East and West). Excluding Kabul, all of these major cities are located in border areas and their main economic activity is agriculture.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	4.74	21000.00	2.6	Neutrality Hypothesis
02.	2016	4.25	19454.00	2.4	
03.	2015	3.65	20057.00	1.0	
04.	2014	3.10	20616.00	2.7	

Table 3.8: Energy Consumption and GDP for Afghanistan [25], [18].

This study extends research in this area by studying the long-run and causal relations between GDP and energy consumption also found the **Neutrality hypothesis**, labour and capital based on the neo-classical one sector aggregate production technology

mode using data of energy consumption and real GDP for ASEAN from the year 2014 to 2017. The analysis is conducted using advanced panel estimation approaches and found no causality in the short run while in the long-run, the results indicate that there are bidirectional relationship among variables.

3.9 Overview of Bhutan: There are three competing hypotheses concerning the relationship between energy consumption, international trade and GDP. The first set of hypotheses concerns the relationship between electricity consumption and GDP. The competing hypotheses are that there is unidirectional Granger causality running from energy consumption to GDP; unidirectional Granger causality running from GDP to electricity consumption; bidirectional Granger causality between these variables or no Granger causality in either direction (Mehrara, 2007). If there is unidirectional Granger causality running from GDP to electricity consumption or no Granger causality in either direction, reducing electricity consumption will have little or no adverse effect on aggregate output. On the other hand, if unidirectional Granger causality runs from electricity consumption to GDP, reducing electricity consumption in the market could lead to a fall in income, while increases in electricity consumption Contribute to aggregate output. If there is bidirectional Granger causality between the variables, this is suggestive of an energy-dependent economy in which there are feedback effects between electricity consumption and aggregate output.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	3.56×10ˆ-6	2500.00	6.8	Neutrality Hypothesis
02.	2016	3.21×10ˆ-6	2127.00	6.4	
03.	2015	2.56×10ˆ-6	2028.00	6.2	
04.	2014	2.19×10ˆ-6	1830.00	4.0	

Table 3.9: Energy Consumption and GDP for Bhutan [25], [19].

This article examines the two-way linkages between energy consumption and GDP using data from Bhutan over the period 2014-2017.Our empirical results show that there exists bidirectional causal relationship between energy consumption and GDP also found the **Neutrality hypothesis** in the long-run. The study suggests that energy policies should recognize the differences in the nexus between energy consumption and GDP in order to maintain sustainable economic growth in Bhutan.

3.10 Overview of China: There are several reasons why this research question is interesting. Firstly, if the current growth trends in population, industrialization, pollution, and resource depletion continued unchanged, the most probable result will be an uncontrolled decline in both population and industrial capacity in several decades. Therefore, analyzing the causality between energy consumption and economic growth can help economists make better energy policies upon the 3 current situations. Secondly, the rapid growth of Chinese industrialization and urbanization has considerably contributed to the incremental expenditure of energy resources. In an era in which every country pursues a greener economy and energy conservation, an economy that depends on energy – especially nonrenewable and environmentally hazardous resources – may be negatively affected by the energy conservation policy if the causation runs from energy consumption to GDP. But if the reverse direction of the causality is demonstrated, it implies that the energy conservation policy would not harm China's economic growth. Hence, there is a need to understand the interaction between energy use and output growth. The unidirectional causality from energy consumption to economic growth is investigated in this paper, and this result indicates that the energy conservation policy would harm China's economic growth. Soytas and Sari (2003) conducted a study on the causality between energy consumption and GDP in G-7 countries (excluding China). They found a causal relationship between GDP and energy consumption using the time series properties. They used the co-integration and the Vector Error Correction Model (VECM) to overcome the stationary problem in the Granger causality test. From the aforementioned studies, empirical results show little consensus on the direction of the relationship between energy consumption and GDP so far. One possible reason for the inconsistency with the results for individual countries is that they are often impaired with an 8 short data span that lowers the power of the unit root and co-integration tests. As for both the country-specific and

multi-countries studies, the conflicting results may arise due to the differences in data sets, econometric methodologies, extra variables, and countries characteristics.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	6230.00	12000000.00	6.9	Neutrality Hypothesis
02.	2016	5920.00	11221836.00	6.7	
03.	2015	5666.00	11226186.00	6.9	
04.	2014	5583.00	10534526.00	7.3	

Table 3.10: Energy Consumption and GDP for China [25], [20].

This study posits that a better understanding of the relationship between GDP and energy consumption, and CO2 emissions is necessary, in order for the Chinese government to develop the energy saving and emission reduction strategies for addressing the impacts of climate change. This paper investigates the co integrating, temporally dynamic, and casual relationships that exist between energy consumption and GDP in China, using data for the period 2014-2017 and refers the **Neutrality hypothesis**. The study develops a comprehensive conceptual framework in order to perform this analysis.

3.11 Overview of Vietnam: This article investigates the causal relationship between per capita energy consumption and per capita GDP for Vietnam during the 2014-2017periods. In doing so, various co integration testing approaches are employed before estimating the vector error correction models. The empirical findings suggest the existence of a uni-directional causality running from per capita GDP to per capita energy consumption. In addition, it is also found that economic growth has a significant positive long-run impact on energy consumption after the point break, 1992. The research results strongly support the neoclassical view that energy consumption is not a limiting factor for the Vietnam's economic growth. This

in turn implies that the rise in energy prices can be a good opportunity for the economy to promote substitution and technological innovation. This paper uses the time series data of per capita GDP and per capita energy consumption (PCEC) for the 1976-2010 periods in Vietnam. The World Development Indicators (2011). International Financial Statistics (2011); and the Vietnam's General Statistics Office. In this study, per capita energy consumption is expressed in terms of kg oil equivalent and per capita GDP is expressed in constant 2000 US$. The choice of the starting period was constrained by the availability of data and the historical milestone as well. The Vietnam War ended in 1975, and the country was united in 1976. The trends of PCGDP and PCEC for Vietnam are graphically depicted. It's noted that all variables are transformed into natural logarithms in order to reduce heteroskedasticity and obtain the growth rate of the relevant variables by their differenced logarithms (Orturk and Acaravci, 2010). It seems that there might be a structural break in these series around the year 1991. By using the Quandt-Andrews breakpoint test, we recognize that the PCGDP is broken at the year 1992, while the PCEC at the year 1993. This fact might, to which extent, imply that PCGDP causes PCEC. The final answer will, however, be clear after performing Granger causality tests presented in the empirical results. These figures also indicate that both series have increasingly grown since these breakpoints.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	1.611×10ˆ-6	220000.00	6.8	Feedback Hypothesis
02.	2016	1.596×10ˆ-6	201309.00	6.2	
03.	2015	1.520×10ˆ-6	191288.00	6.7	
04.	2014	1.410×10ˆ-6	185759.00	6.0	

Table 3.11: Energy Consumption and GDP for Vietnam [25], [21].

Using co integration and causality analysis, this paper investigates the causal relationship between electricity consumption and GDP in Vietnam during the period

of 2014-2017 also found the **Feedback hypothesis**. Empirical results show that there is no causality effect of per capita electricity consumption on per capita Gross domestic products (GDP) in both short-run and long-run, but a causality relationship running from per capita GDP to per capita electricity consumption in the long-run. This result is helpful to understand the roles of economic growth on making energy policies in Vietnam to deal with the current electricity shortage accompanied with economic growth and to ensure the national energy security.

3.12 Overview of Malaysia: The energy consumption and gross domestic product (GDP) of Malaysia from 2014 to 2017. . The annual report published in 2009 by the Ministry of Energy, Green Technology, and Water stated that the energy pattern in Malaysia is closely related to economic growth. As for the rate of imported energy, Malaysia recorded a negative value, thus indicating its capability to be an energy exporter. The consumption of energy sources exists in various forms, and the methods of consumption vary according to the types of fuels. The most commonly used type of fuel is petroleum, followed by electricity, natural gases, and coal. The consumption trend for petroleum, natural gases, and coal indicates fluctuations, whereas electricity consumption continues to increase annually. The consumption of petroleum, electricity, natural gases, and coal in Malaysia was widely distributed among various sectors in accordance to their respective requirements. the total energy consumption by sector in Malaysia. From the trend of consumption by the various sectors, the industrial sector recorded the highest consumption, followed by the transportation sector, the housing and commercial sector, and then the agriculture sector. The agriculture, transportation, and industrial sectors experienced a fluctuating trend in energy consumption, whereas the housing and commercial sector exhibited
An annual steady increase.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	6.103×10ˆ-6	310000.00	5.9	Neutrality Hypothesis
02.	2016	5.630×10ˆ-6	296536.00	4.2	
03.	2015	5.130×10ˆ-6	301793.00	5.1	
04.	2014	4.596×10ˆ-6	340060.00	6.0	

Table 3.12: Energy Consumption and GDP for Malaysia [25], [22].

This paper aims to examine the relationship between energy consumptions and GDP and to address policy problems on energy consumption in Malaysia by using data from 2014-2017 and found the **Neutrality hypothesis**. Johansen co-integration is employed to analyze the data. Findings show that energy consumptions are related to economic growth. The Granger causality model is used to measure the causal effect of energy consumption and gross domestic product. The results indicate that oil and coal consumption does not Granger cause economic growth and vice versa. Causality runs from economic growth to electricity consumption. A unidirectional relationship exists between gas and economic growth, with causality running from electricity use to economic growth. Therefore, a policy to reduce gas utilization will harm economic growth in Malaysia.

3.13 Overview of Philippine: The electricity sector in the Philippines provides electricity through power generation, transmission, and distribution to many parts of the Philippines. The Philippines is divided into three electrical grids, one each for Luzon, the Visayas and Mindanao. As of June 2016, the total installed capacity in the Philippines was 20,055 megawatts (MW), of which 14,348 MW was on the Luzon grid. As of June, 2016, the all-time peak demand on Luzon was 9,726 MW at 2:00 P.M. on May 2, 2016; on Visayas was 1,878 MW at 2:00 P.M. on May 11, 2016; and on Mindanao was 1,593 MW at 1:35 P.M. on June 8, 2016. However, only 12% of Filipinos have no access to electricity. Power generation in the Philippines is not

considered as a public utility operation, which means interested parties do not need to secure a congressional franchise to operate a power generation company. However, power generation is regulated by the Energy Regulatory Commission (ERC) who must issue a certificate of compliance to interested parties to ensure that the standards set forth in the Electric Power Industry Reform Act of 2001 (EPIRA) are followed. The ERC is also responsible for determining any power abuse or anti-competitive behavior. Power generation is a value added tax zero-rated (i.e. not subject to 12% VAT) to ensure lower rates for end-users.

Electricity in the Philippines is produced from various sources such as coal, oil, natural gas, biomass, hydroelectric, solar, wind, and geothermal sources. The prevailing narrative of the Philippines' energy sector in recent years has centered around energy security concerns and the challenge of meeting growing demand. Efforts to realign the energy sector were ramped up during 2017 with the launch of reforms targeting investment and the promotion of efficiency. The Philippines is an emerging economy and its economy has greatly shifted from agriculture to industry. In terms of energy use, conventional fossil fuels (oil and gas) are the main source for its primary energy demands. According to the 2011 primary energy consumption of the Philippines, 31% of the consumption was met by oil, 20% by coal, 22% by geothermal, 12% by biomass, 6% by hydro and 1% by other renewable energy like wind, solar and bio fuel.

Sl.No.	years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	8.011×10ˆ-7	310000.00	6.7	Conservation Hypothesis
02.	2016	7.603×10ˆ-7	304906.00	6.9	
03.	2015	7.102×10ˆ-7	292774.00	6.1	
04.	2014	6.992×10ˆ-7	284585.00	6.1	

Table 3.13: Energy Consumption and GDP for Philippine [25], [23].

This study extends research in this area by studying the long-run and causal relations between GDP and energy consumption, labour and capital based on the neo-classical one sector aggregate production technology mode using data of energy consumption and real GDP for ASEAN from the year 2014 to 2017 and found the **Conservation hypothesis**. The analysis is conducted using advanced panel estimation approaches and found no causality in the short run while in the long-run, the results indicate that there are bi-directional relationship among variables.

3.14 Overview of Thailand: Although Thailand is 99% electrified, the primary source of energy is domestic and imported natural gas, creating the issue of energy security. Thus, energy diversification should be the prime goal to Thailand to ensure sustainable supply of energy in the country. As of 2014, 45% of primary energy comes from natural gas, 36% comes from oil, 16% comes from coal and 3% comes from hydro. Bioenergy is the dominant renewable energy source in Thailand's end use sectors with 15 TWh generated in 2015 (equal to about 75% of all renewable generation in Thailand. In 2016, 60% of Thailand's energy came from imports. Therefore energy security with low energy price and environmental sustainability are the key priorities for Thailand and is document in the Thailand Integrated Energy Blueprint 2015-2036. The Blueprint was drafted in 2015 by merging five major energy plans into one documented. Thailand has also committed to reduce greenhouse gas emissions by 20-25% also set a renewable energy target of 30% of total final energy consumption. Alternative Energy Development Plan. Both the policy promotes highly efficient green alternatives in Thailand.

The average demand for electricity increased by 3.6% per year during 20014–2017. Total electricity consumption in 2016 was 182,846 gigawatt-hours (GWh), a 4.6% increase from the 2015 level of 174,834 GWh. Peak demand reached a record 29,619 MW in 2016, an 8.3% increase from 27,346 MW in 2015. The overall growth in electricity consumption resulted from the economic recovery (mainly increased manufacturing activities due to the government stimulus program), while the rise in peak demand was largely caused by hot summer weather. The Ministry of Energy expects electricity demand in 2017 to exceed the 2016 total by 2.9%. The trend in electricity consumption in the PEA area closely tracks but consistently exceeds the rate of growth of total electricity consumption.

Sl.No.	Years	Energy Consumption (TWh)	GDP		The Relation Between Energy Consumption and GDP
			Annual GDP ($)	GDP Growth (%)	
01.	2017	3.403×10ˆ-6	460000.00	3.9	Feedback Hypothesis
02.	2016	3.002×10ˆ-6	411847.00	3.3	
03.	2015	2.820×10ˆ-6	401370.00	3.0	
04.	2014	2.539×10ˆ-6	407339.00	1.0	

Table 3.14: Energy Consumption and GDP for Thailand [25], [24].

This paper tries to investigate the relationship between energy consumption and GDP for Thailand over the period from 2014 to 2017 and found the **Feedback hypothesis** Applying NARDL approach. The main finding from the NARDL evidence co integration among economic growth, energy consumption, capital formation and trade openness and found asymmetry is significant for both the long run and short run for economic growth, which implies that taking nonlinearity and asymmetry into account is important when studying the relationship between economic growth and energy consumption.

Chapter 4

Conclusion

Energy consumption is part of energy homeostasis. Energy consumption refers to all the energy used to perform an action, manufacture something or simply inhabit a building. The Gross Domestic Product (GDP) is one of the primary indicators used to gauge the health of a country's economy. It represents the total dollar value of all goods and services produced over a specific time period, often referred to as the size of the economy. It is important to understand the effects of increased energy consumption on GDP so that economic policy makers can predict the impacts of implementing energy policies on a country's GDP. The existence of panel stationary for thirteen Asian countries and bidirectional causality between energy consumption and GDP in all sample countries. In this research, we found the various types of test by which it can be determined the relation between energy consumption and GDP such as

- The standard test of Granger causality test.
- Unit root test
- The co integration test.
- Vector error correction analysis
- Non linear Autoregressive Distributed Lag.

To find long-run and short-run elasticity between energy consumption and GDP we found those types of tests which is used thirteen Asian countries. Using panel co-integration approach over the period 2014-2017 for Asian economies, this study investigates the dynamic linkages between energy consumption and GDP. The results show that, in the short run, feedback relationship holds between energy consumption and GDP and between energy consumption and exports. In the long run, the feedback relation holds between energy and GDP while unidirectional causality holds from export to energy. Thus, feedback hypothesis between energy and GDP holds in the short as well as in the long run. First, we applied a panel unit root test to determine the integration order of each variable. Second, we apply the panel co integration test to determine whether there is a long-run relationship between the model's variables.

Finally, we found the panel co integration test which has used to determine the existence of a long-run relationship between variables, taking into account the cross-sectional dependence and possible structural breaks in the long-run relationship.We found Feedback hypothesis for three countries such as Bangladesh, Vietnam and Thailand which defines that if Energy consumption increases then GDP will be increased as the same direction. Again we found the Neutrality hypothesis for eight Asian countries such as Maldives, Nepal, Pakistan, Sri-Lanka, Afghanistan, Bhutan, China and Malaysia that defines there are no relationship between energy consumption and GDP. Further we found the Growth hypothesis and Conservation for India and Philippine respectively. The growth hypothesis refers the reverse relationship. And the Conservation hypothesis refers that a unidirectional causality relationship between energy consumption and GDP.

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