ON THE RELATIONSHIP BETWEEN ENERGY INTENSITY AND URBANIZATION IN SOUTH ASIAN COUNTRIES

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CERTIFICATE

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DEDICATED TO MY BELOVED PARENTS

Acknowledgement

First and Foremost, I would like to thank Almighty Allah for being my strength and guide inwriting of this thesis. Without Him, I would not have had the wisdom or the physical ability todo so.

I express my gratitude to my supervisor, Dr. Attiya Yasmin for her support, valuable comments, and unwavering guidance throughout the course of this work. His special interest andknowledge enabled me the right guidance and provided me much needed motivation.

I am also very thankful for all myclass fellows. When times were tough, they gave me the confidence and strength to keep pressing on to achieve all my goals. God bless them all.

Finally, I thank everyone in my family for always being supportive of my education, especiallymy Father and Mother who have all contributed to and encouraged me during my studies.

ABBREVATION

Variable	Abbreviation
LEI	(log of energy intensity)
LEX	(log of exports)
LIM	(log of imports)
LLF	(log of labor force participation)
LUR	(log of urbanization)
LCO2	(log of carbon emission)
LCPI	(log of consumer price Index)
LEU	(Log of Energy use)
LTP	(log of total population)
GDP	(Log of economic growth)
LLF	(log of labor force participation)

On the Relationship between Energy Intensity and Urbanization in South Asian Countries

ABSTRACT

Population growth and urbanization has been major issues of South Asian Region. Where Urbanization strives economy for excellence, it also negatively impact the quality of environment. The present study examines the impact of urbanization and energy intensity of South Asian economies. Data set from WDI and World Bank has been utilized for the time period of 1980-2017. The model for energy intensity and urbanization is regressed by using co-integration and augmented Dicky fuller techniques. The estimation results depicts positive relationship of energy intensity and urbanization. Further, urbanization has positive relationship with carbon emission. To minimize carbon emission government should switch power plants from fossil fuels to environmental friendly sources.There should be institutional setup to manage urbanization and its associated outcomes like energy efficient building structure, people awareness of climate change etc.

Keywords: Energy intensity, carbon emission, JohannsenCointegration, granger causality test.

CONTENTS

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Movement of people from under developed (rural) areas to developed (urban) cities is called as urbanization (Puga, 1998; Henderson, 2002; Mckinney, 2002; Cohen, 2006; Bloom et al., 2008; Kalarickal, 2009; Liddle and Lung, 2010). There are some reasons that explain themovement of people from underdeveloped to urban areas. Firstly, people moves in search of basic necessities[1] that occur especially in developing economies (Hosken, 1988; City and Assessment, 2010; Adegun, 2011; Setoand Ramankutty, 2016). Secondlyfor economic cause result in the growing trend in the urbanization over the world thathas been studied (Wei-de, 2001; Xiu-juan, 2006). These are some specific benefits with respect to urbanization in developing countries as well as developed countries.

Apart from benefits, Urbanization is among one of those factors which directly affect the environment. There are some important and influential impacts of urbanization on environment, as well as, on resources (Burak and Gazioglu, 2004; Martínez and Maruotti, 2011; Sudha and Mishra, 2012; Srinivasan and Gorelick, 2013). Due to urbanization, there is a decreasing trend[2] in the good environmental condition as, they are the main cause of consumption of food, energy, water and land (Ouyang and Kuang, 2006). Likewise, there is a decreasing trend in the quality of natural resources such as land and in purification of water etc. On the other hand, this increasing trend in urbanization causes a rise in the energy usage. There are several factors that increase the impact of energy intensity and carbon emission along with urbanization. Diseases are spreading more rapidly and quality of life is being disturbed due to polluted environment (Michael, 2000).

With the passage of time, urbanization become important for the economic growth (Henderson, 2003; Hsiao and Shen, 2003; Hossain, 2011). Positive externalities and economies of scale are the main factors which affect the productivity or economic

[1]It may include food, shelter and health.
[2] As people who migrate needs food and shelter to live.

growth. So, urbanization is the main element which enhance the positive externality and economies of scale (Baptista, 2003; Lorenzen and Frederiksen, 2008; Beaudry and Schiffauerova, 2009). Around the world, there are seven continents but, too much urbanization is explained by four continents such as North America, Latin America, Europe and Africa. The estimated ratio of the living people in urban areas was fifty five percent of total world population (Carli and Pellegrino, 2018).

The trend of urbanization in major South Asian Countries Pakistan, India, Bangladesh, Nepal and Sri Lankais increasing urbanization, as stated by the previous studies, (Rasheed, 2017; Raza and Liesenberg, 2018)also found in India (Köhler, 2005; Galligan, et al., 2014). Similarly, in Bangladesh (Chowdhury, 1980; Brooks et al., 2005; Sayeed et al., 2007) Furthermore in Nepal (Tan, 1983; BK and Suwal, 1993; Basyal and Khanal, 2001; Sharma, 2003; Kumar, 2004). With the passage of time there exists an increased trend in urbanization.

According to the World Bank data and graph of urbanization, magnifying or growing trend has been observed with the passage of time.

Furthermore, Sri-lanka is another country in the South Asian countries alsodepictsa growing trend in urban population (Wijesinghe and Dassanayake, 1978; Nugegoda and Balasuriya, 1995; Silva and Smith, 2003; Dassanayake et al., 2011). The World Bank data and graphically representation shows a growing trend.After comparing Pakistan and Srilanka, the graphical representation indicates, too much urbanization (% of total) in Pakistan than Sri-Lanka. So, the combined scenario of urbanization related to selected countries can be explained by a graph, on the bases of World Bank data.

The above discussion shows leads to questions how urbanization effect energy intensity and carbon emission.

Is there any long run relationship between energy intensity and urbanization?

1.2. OBJECTIVES OF STUDY

The aimof the study is

1- To analyses the long run association between energy intensity and urbanization in major South Asian countries.

1.3. RATIONALE OF THE STUDY

According to my knowledge, there is not enough work done in quantitative analytical framework that takes into account the influence of urbanization on energy intensity. The interest is to estimate and proves whether significant relation occurs among the variables or not?

The sample consists of five majr south Asian countries. The analysis is conducted for each country separately to see the difference between five countries about the effect of urbanization on energy intensity and carbon emission along with other independent variables.The issue of urbanization , energy intensity and energy nexus increases the understanding of economist, town planner, energy economist and other policy makers.

1.5. ENERGY AND ITS DETERMINANTS

Energy security[3] is the primary element for the economic development especially in South Asian countries. All the South Asian countries face energy crises from the last few decades. With the passage of time,in growing world, mainly two types of energy security are used such as short and long run energy security. The short run is concerned with the adjustment of supply and demand of energy (Sosa and Desnyder, 2003; Bradley, 2007; Dakpogan and Smit, 2018).Whereas, the long term energy is related with the economic development and improvement in the environmental condition. So, the lack of energy security has an inverse relationship with the economic growth in all over the world. But,in the South Asian countries, there is an increasing trend in the energy usage (kg of oil equivalent per capita). According to the World Bank open data, the consumption of energy has been increasingin Pakistan, Bangladesh, Nepal, India and Sri Lanka such as 484.44,412.72, 222.22, 637.42and 515.68 kg/capita[4].

There are some determinants of energy usage in the growing world such as: per capita real GDP; energy used for industrial growth; price of energy in real terms; population; air temperature; bank and stock variables as financial development variables; capital stock; FDI and efficiency (Samuel and Wereko, 2013).

[3]Continuous availability of energy sources at given reasonable prices is called as energy security (Yergin, 2006; Jacobson, 2009; Kruyt and Groenenberg, 2009; Winzer, 2012).

[4]kg/capita is used for kg of oil equivalent per capita.

The rise in energy usage is due to increase in the population. There are many types of energy which is used by the population at a larger scale such as electricity,natural gas in compressed form, crude oil, gasoline, petrol and also liquid petroleum gas. There are two sources of energy production such as renewable energy[5] and non-renewable energy[6]. The productions of energy from the renewable sources are not sufficient for the excess demand of energy across countries (Rodriguez, Becker, Andresen, Heide, & Greiner, 2014).Furthermore, there occur significant relation among population growth and energy usage. The consumption of energy is going to increase more than that of the supply of energy. So, due to the excess of demand in all South Asian countries; it faces the shortage of energy, which will be filled up by imports of energy. Similarly, the imports of energy use, in the South Asian countries like Pakistan has a net use of 24.13 (% of energy use), India (34.30 net use), Bangladesh (16.67 net use), Nepal (16.84 net use) and Srilankahas around 50.26 net use (% of energy use) respectively (World Bank, 2014).

Economic growth and standard of living are going to improve and is based on the availability of energy present in different forms (Dewen, et al., 2005; Mensah and Adu, 2015; Wu and Guo, 2018).Sustainable development[7] is basically dependent on the availability of energy (Li, 2005; Lund, 2007; Atkinson, 2007; Fragaszy et al., 2011; Vosylius and Tvaronavičienė, 2013). Across the globe, no country is certain about the consumption and production of energy. Various studies have investigated that developed nations are much careful about the energy production and usage as compared to the developing nations, as they are far too much concerned about the energy use. There is a positive associationamong energy usage and economic growth, as well as, with the standard of living in the developed states. Likewise, all countries in the growing world are going to save their energy sources for the future consumption (Alcantara and Duro, 2004; Frondel and Rennings, 2007; Adeyemi and Hunt, 2007; Hu & Kao, 2007; Ramesh and Shukla, 2010).

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[5] Renewable energy are those that cannot be depleted or consumed completely like (biomass, hydropower, geothermal, wind, and sun).

[6] On the other hand, non-renewable energy can be consumed completely e.g. (petroleum, natural gas, coal and uranium).

[7] It explains how to improve living standards without depleting the natural environment.

Zheng et al., (2011)highlighted the deteriorating impact of higher exports on energy intensity and suggested that in general greater exports abrade energy intensity of the industrial sector thus, great divergence exists across sub-sectors.

1.6. ORGANIZATION OF THE STUDY

The upcoming chapters are arranged in the following order. The First chapter is based on Introduction; of Urbanization and also on the energy intensity. Second chapter on Literature review and graphical representation on urbanization in south Asian countries. Third chapter on Data and Methodology. Fourth chapter is based on Result discussion andLastly, fifth chapter will cover the conclusion of the thesis and policy implication.

CHAPTER 2
LITERATURE

2.1. REVIEW OF LITERATURE

The effect of urbanization for different aspects of life have been explained by number of studiessuch as, economic growth,employment level,carbon emission, energy consumption, industrialization, and agricultural land and so on.

2.1.1. Urbanization and Economic growth

Eaton and Frydenberg (2000) investigated that urban birth rate has been affected by the urbanization by applying logistic regression. While, Otsu and Voorhees (2004)[8] elaborated through multiple linear regression models,and found inverse relationship between the male suicide rate with urbanization and economic growth. Ma and Fan (2012) showed significant relation among night lights and urbanizationwhich showed some variations in the cross cities of china through OLS and the rest variables[9]were insignificant.Ghosh and Kanjilal (2014) explainedthe relationship between urbanization, economic growth and energy usage, two models were used (i.e. by Autoregressive Distributive Lag model and Threshold co-integration tests) and found structural break down in among the concerned variables in long run.

Salim and Shafiei (2014) investigated OECD countries to check the effect of urbanization on renewable and non-renewable energy consumption through STIRPAT model. While, the variable like population, population density and urbanization. Positive association between non-renewable energy, population and urbanization have been found. While, the population density has negative link with renewable energy. On the other hand, only population and renewable energy has significant relation.

[8] While, no evidence was found with was related to female suicides.

[9] Other variables were like population, gross domestic product (GDP), night lights built-up area and electric power consumption has been used.

2.1.2. Urbanization and Carbon Emission

Liu (2009) used Factor Decomposition model as well as Autoregressive Distributive Lag models and estimated a long term association among the concerned variables[10]and found only uni-directional causality among total energy consumption and urbanization. Poumanyvong and Kaneko (2010) explained the impact of urbanization on the carbon emission and energy usage through STRIPAT model, and elaborates the changes that occur due to different stages of development across countries. Similarly, low income countries show more negative effect of urbanization on carbon emission as compared to working and elite groups. Li and Lin (2015) applied STRIPAT model and concluded that low income group countries state an inverse association while, middle income countries and high income countries has significant relationship between energy consumption and carbon emission. Finally, the main factor of carbon emissionin low and also in middle income countries was population. While, in the high income countries no such results have been found.

Ren et al., (2011) described the relationship between urbanization and vegetation carbon storage and explained that, vegetation carbon emission was increased due to increasing trend in the urbanization. Martinez and Maruotti (2011) revealed that there is a greater unit effect of population on carbon emission but the effect was found different across the lower, middle, and upper-income countries. While in the upper-middle income countries and highly developed states, there had an inverse relationship between urbanization and carbon emission. Yanmei and Zhao (2015) showed that the carbon emission was greater in developed areas as compared to the rural areas and also found uni-directional causality from urbanization to both direct and indirect carbon emission through Johnson co-integration test and Granger causality. Yu and Zhang (2017) explained an inverse relationship between the urbanization and energy usage through STRIPAT model.

Bekhet and Othman (2017) applied ARDL econometric technique and revealed a unidirectional causality in the short time span at one percent significance level. While, in the longertime span bi-directional causality from urbanization to carbon emission has been found. Franco and Rao (2017) predicted a significant impact of urbanization on

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[10] Concerned variables include like energy consumption, population, economic growth and urbanization growth.

energy usage and also on carbon emission (as a main factor). Another study shows urbanization as the main cause in order to increase the energy intensity, as well as, coal intensity (Yan, 2015). While, Ma (2015) found a positive and significant impact of urbanization on the energy intensity and electricity intensity in the long run elasticity's. On the other hand, the urbanization had no significant effect on the coal intensity. Zhang and Wei (2016) used fixed effect model and observed a significant relationship among concerned variables, while the coal consumption was third, as a source of energy in china.

Pata (2018) used The ARDL econometric technique as well as Fully Modified Ordinary Least square and explained that economic growth was the main cause of carbon emission, urbanization and also for the financial development and had a same behavior with respect to carbon emission. Liu and Bae (2018) investigated a positive correlation and causality between the carbon emission with economic growth and industrialization by using Autoregressive Distributive Lag model and Vector Error Correction model. Kurniawan and Managi (2018) examined co-integration between coal consumption with all the concerned variables[11]in the long run through ARDL, and also elaborated positive association between consumption of coal, trade openness and urbanization.

2.1.3. Urbanization and Energy Demand

Madlener and Sunak (2011) showed the correlationamong energy demand and urbanization and concluded that urbanization was the main factor; which positively influence the economic growth. Solarin and Shahbaz (2013) explained the causality andlong run relation between the economic growth, electricity consumption and urbanization, through ARDL and VECM methods. They also found the bidirectional causality between the economic growth and electricity consumption. The study of MENA countries revealeda bi-directional causality between all concerned variables[12] for long run.Similarly, due to change in income levelvariation across the countries were also found (Al-mulaliand Sab, 2013). He and Chen (2017) explained a positive relationship between the carbon emission and income level by using STRIPAT model.Lin and Zhu

[11] Concerned variables include (i.e. economic growth, urbanization, industry, and trade openness)
[12]Solarin and Shahbaz (2013) variables such as carbon emission, energy consumption and urbanization.

(2017) investigated that with the passage of time, development of industrial structure was the main cause of decline in energy and carbon emission intensity in the long run through panel Vector Auto regression.

Shahbaz and Ozturk (2017) explained the main factors that enhanced the energy demand by using ARDL methodology, these factors areeconomic growth, transport sector and technological change has a positive effect on the energy consumption. Howarth et al., (1991) estimated that Structural change led to modest reductions in energy use andalso reduction in energy intensities (across 8 OECD countries). The estimation was done on the basis of Divisa and layspare approach. Range was from 20% (Norway) to 36% (Japan) over the period of the analysis.

Ang (1994) highlighted the decomposition of industrial energy consumption through energy intensity approach. Two general parametric divisia methods (by variables like structural intensities, estimated intensities effect and actual aggregate energy intensity), and five specific decomposition methods were used, and observed that the production effect[13]has been notably larger estimates than the structural and intensity effects.Sinton and Levine (1994) used laspyers index method and divisia index to check the change with respect to variables (like structural factors, physical energy intensity, manufacturing activities and gross energy used). The results suggested that rise in real intensity causes to change the overall share, and on the other hand sector shifts would probably reduce the magnitude of the real intensity. Sun (1998) considered decomposition model through lespeyer and pasche index[14], and estimated the intensity effect which saved half of the energy demandback in 1973,in corresponding to the economic structure and intensity level.Gales et al., (2007) observed that technical advancementcauses to limit the energy consumption[15], As the importance of energy consumption had been grown in Europe, in the last few decades (Sweden, Holland, Italy and Spain)with the help ofquadratic logarithmic model. The empirical results of 22 urbanized emerging economiesthrough second generation heterogonous linear panel model, showed that population density and accumulation of wealth increasesboth carbon emissions and energy intensity

[13]Production effect has been obtained by using the energy consumption approach.
[14] Estimated the change by variables i.e. structure effect in sector, intensity effect in sector, activity effect and percentage of total energy change in GDP.
[15] Consumption of energy in food, firewood, wind, water, fossil fuels yearly growth in population, GDP and primary electricity were estimated.

while,renewable energy seemed to be dying or vanishing in these emerging economies, but non-renewable energy increases them both (Rafiq et al., 2016).

2.1.4. Urbanization and Agriculture

Bruckner (2012) explained the cross country analysis and concludedan inverse relationship between urbanization with the share of agricultural value added, While, the urbanization had significant effect on the economic growth. But, has an insignificant relation among economic growth (per capita due to agricultural value addition)and urbanization. Deng and Li (2015) predicted that rapid urbanization was the main cause of loss in agricultural land. Masters et al., (2013) depicts the impact of urbanization on the food security (i.e. Africa and Asia). The concerned variables were urbanization, rural population growth, economic growth and land area, and concluded that in the Asia, the average farm size has been increasing as compared to the Africa.

2.1.5. Urbanization and Industrialization

Shahbaz and Lean (2012) revealed abidirectional causality between(financial development and industrialization), (industrialization and energy consumption) and (development and energy consumption) for a long run by ARDL and Granger causality econometric techniques. Sadorsky (2013) explained cross country (seventy-six countries) analysis anddepicted that there occursmixed effect of urbanization on energy intensity across countries. By selecting the industrial sectors, and estimated the energy intensity values (i.e. for production of iron and steel, aluminum, cement, pulp and paper, ammonia, and ethylene). The indication or representation for energy consumption should be the "best practice" as, they are highly dependent on material inputs (Worrell et al., 2007).

The share of different sectors (coal, electricity, petroleum, gaseous products and physical energy intensity) were estimated through structural changes and decomposition analysis. The results showed that the combined effect[16] on both iron and steel, as well as on paper and pulp industries were negative. While, it showed a positive impact for aluminum and textiles (Reddy and Ray, 2011).Mendiluce et al., (2010)explained the difference in energy intensity of Spain and EU15, and their comparison in evolution. The method

[16] Considers both structural and intensity effects together at the same time.

Logarithmic Mean Divisia Index (LMDI) showed that the Spanish economic structure was driving the divergence in energy intensity ratios with the EU15[17], mainly due to strong transport growth, And also, because of the increased activities in construction boom.

2.2. RESEARCH GAP

As per my knowledge, there has been no case study based on the estimation of "Impact of urbanization on energy intensity in South Asian countries and to further forecast the future trend of urbanization with energy, coal and electricity intensity. So, this is why this study has been conducted for additional contribution to literature.

- There is a very scarce work on urbanization and its impact on energy intensity. As Asian countries comes as a part of cross sectional analysis, but it is not addressed as a separate region.
- To further forecast the future trend of urbanization with energy, coal and electricity intensity.
- So, this is why this study has been conducted for additional contribution to literature.

2.3. Conclusion

The existing literature for urbanization shows contradictory views about carbon emission and energy intensity. In developing countries, urbanization and accumulation of wealth has negative effects on carbon emission and energy intensity. While, renewable energy seems to be dying in these economies. Whereas, in developed countries, there exist inverse relationship between carbon emission and urbanization. Several studies examined co-integration between coal consumption with variables i.e. economic growth, urbanization, industry and trade openness in the long run through ARDL and found direct association between consumption and urbanization.

[17] It contains European Union countries like France, Greece, Italy, Ireland, Austria and UK etc. and collected data for 16 sectors (agriculture, wood, metallic, industry, equipment, transport, construction, textile etc.)

CHAPTER 3
METHODOLOGY AND DATA

3.1. METHODOLGY

An appropriate methodology can give us the accurate results about research on the basis of theory prediction. In this section, methodology of study is developed according to our objectives. The data, data sources, estimating model and data estimation technique has also been mentioned. The relationship between Energy Intensity, Carbon Emission, Exports, and Imports, Trade openness, Population growth, urbanization, labor force participation, Energy use, Economic growth, inflation and proposed variables were explained on the base of Johannsen Co-integration econometric test. We used this econometric technique because all concerned variables of the study are integrated at order 1^{st} (i.e. I (1)). Now, the study will be focused on general energy intensity rather than coal and electricity due to study title and time limitation.

3.1.1. THEORATICAL FRAMEWORK

Now a days, energy intensity and urbanization is one of the sound topics of Pakistan. The law of supply and demand is the theory that explains the interaction between the producer of consumer good and the consumer of that product. People moves in search of basic necessities that occur especially in developing economies (Hosken, 1988; City and Assessment, 2010; Adegun, 2011; Seto and Ramankutty, 2016). Apart from benefit of urbanization has negative effect on environment (Burak and Gazioglu, 2004; Martínez and Maruotti, 2011; Sudha and Mishra, 2012; Srinivasan and Gorelick, 2013), such as diseases low quality of life, polluted environment (Michael, 2000) and increase in energy use (Ouyang and Kuang, 2006).

3.1.2. EMPIRICAL MODEL

The main idea is adopted from Dong et al., (2018). For energy intensity oil per capita to GDP is used because it is the major source of energy. It is used directly as fuel and indirectly as raw material. Separate model is estimated for carbon emission. The construction of energy intensity is based on the empirical literature. Those variables are selected that have impact on energy.

3.2. DATA SOURCES AND DESCRIPTION OF VARIABLES

Time series data set has been used for Cross-country analysis for five South Asian Countries. The dependent variables were energy intensity[Energy use (kg of oil equivalent per capita)/ GDP (US $)] and carbon emission (% of total fuel combustion), while independent variable used such as urbanization (% of total), GDP (US$), trade openness (X in US $ plus M in US $ divided by GDP US $), Inflation, Exports, and Imports, Population growth, urbanization, labor force participation, Energy use.Data has been taken from the World Bank and World Development Index.

3.3. ECONOMETRIC MODELS

Two models have been applied to estimate the association among concerned variables. According to first model, energy intensity is used as dependent variable. While, export, import, labor force participation and urbanization has been used as independent variable. While, in the second model carbon emission has been used as dependent variable, while inflation, energy use, trade openness, total population, economic growth and labor force participation as independent variables across all the concerned countries (like Pakistan, Nepal, Bangladesh, Sri-Lanka and India). Furthermore, these variable like Exports was supported by (Zhenget al., 2011; Suri and Chapman, 1998), import by (Liu et al., 2010; Vera and Langlois, 2007), labor force participation by (Wu et al., 2005; Wang et al., 2014), Urbanization by (Madlener and Sunak, 2011; Sadorsky , 2013), CPI by (Chiu and chnag. 2009; Bin and Dowlatabadi, 2005), Energy usage by (Al-mulali et al., 2013; Arouri et al., 2012), trade openness by (Shahbaz et al., 2013; Akin, 2014), total population by (Martínez-Zarzoso and Maruotti, 2011; Begum et al., 2015) and economic growth used by (Al-Mulali and Sab, 2012; Saidi and Hammami, 2015). In order estimate the Long run association between emission and energy intensity.

There are unlimited papers which tries to estimate the energy intensity on behalf of following models, but current study selects the case study of China which has utilized the same methodology (Dong et al, 2018).

MODEL ONE

The First estimation equation is for Energy intensity

$LEI = \beta 0 + \beta 1\, LEX + \beta 2\, LIM + \beta 3\, LLF + \beta 4\, LUR + \mu i$ ... **Eq (1)**

LEI is taken as(log of energy intensity), LEX (log of exports), LIM (log of imports), LLF (log of labor force participation), LUR (log of urbanization) all are in percentage form.

MODEL TWO

The Second estimation equation is for Carbon emission

$LCO2 = \beta 0 + \beta 1\, LCPI + \beta 2\, LEU + \beta 3\, LTO + \beta 4\, LTP + \beta 5\, LGDP +$

$\beta 6\, LLF + \mu i$ ... **Eq (2)**

The following variables are as LCO2 (log of carbon emission), LCPI (log of consumer price Index), LEU (Log of Energy use), LTP (log of total population), LGDP (Log of economic growth), LLF (log of labor force participation) are in percentage form.

3.4. VARIABLES DEFINITION

Energy Intensity (EI)

Energy intensity can be taken as Energy use. It is taken as kg of oil equivalent per capita)/ GDP US $. It shows how much energy is being consumed to produce one unit. The data for energy intensity will be taken from World Bank.

Energy use (EU)

It indicates the use of primary energy. The energy that is used before transformation. Data will be taken from WDI.

Urbanization

The word urbanization has been defined by national statistical offices and they refer to those people who migrated to urban areas and live there. The data for urbanization will be taken from WDI.

GDP growth

It adds up all the gross production by home produces plus taxes and excludes any subsidies. They depend on constant currency at market prices and is in annual percentage form. Data will be taken from WDI.

GDP per capita

GDP per capita is the GDP which can be attained by division by the mid-year population. Data will be taken from WDI and is available in current U.S $.

Imports

It is also based on constant US $ and is in annual % growth. It refers to all the goods and services which are received from other countries. Data would be taken from WDI.

Exports

Export is also based on constant US $ and represented in annual % growth.It refers to all the goods and services which are sent to other countries. Data would be taken from WDI.

Population growth (annual %)

It refers to the continuous rise of mid-year growth of population, it is expressed in percentage and includes all home residents i.e. regardless of legal status or citizenship.

CO2 emissions

It includes all toxic gases that emits from burning of fossil fuels and due to making of cements. Data will be taken from World development indicator.

CO2 emissions from electricity and heat production, total (% of total fuel combustion)

CO2 emissions from electricity and heat production includes three categories. Firstly, the Main Activity Producer Electricity and Heat. Secondly, Unallocated Auto producers and Lastly, Other Energy Industries. Data will be taken from WDI.

3.5. ESTIMATION TECHNIQUE

The study analyses relationship between urbanization, energy intensity and carbon emission for the major south Asian countries. For tie series data the first step is to test the stationarity of the data. The results of stationaarity test indicate that all-time series are integrated of order one. The Johnson co-integration technique is more suitable. This allows t estimate long run, short run relationship and error of adjustment. The vector error correction model is also applied to separate analysis is done for each country.

The above models explain different relationships on the basis of co-integration technique. According to the first model, in which energy intensity is a dependent variable. The positive association among all concerned variables has been found. In other words, one percent rise in independent variable shows an increase in the dependent variable.

Likewise, in the second model, carbon emission has been used as dependent variable. While, the determinants show different relationship with dependent variable over the time by using Johnson co-integration technique.

3.5.1. TESTS FOR STATIONARITY

Firstly, we have tested the stationarity property[18] to see hypothesis of unit root against stationarity property. To see the magnitude of the unit root problem both(i.e. we will check in the level, and alsoat their first difference in order to determine the order of the integration i.e. whether I(1), I(0) or I(2).

3.5.1.1. ADF test

Augmented Dickey Fuller (ADF) has been used when error or disturbance terms (Ut) are correlated to the lagged values of the dependent variables. Most of the time series data in level are non-stationary. Whichgive "Spurious Regression" when estimated without dealing it. SoADF test is used to demonstrate the presence of non-stationarity. To proceed further the ADF test will be estimated as:

$$\Delta Xt = \alpha + \beta\ Xt\text{-}1 + \Sigma\ \delta k\ \Delta X\ t\text{-}k + Ut \ldots \qquad \textbf{Eq(3)}$$

Where "Δ" (delta) shows the difference operator, X is for the series that are being tested, K is used when the number of lagged terms in differenceand "U" is a disturbanceterm. When the calculated critical value is greater than that of ADF Statistics, we jump to the conclusion i.e. to reject null hypothesis or vice versa. (Or else, If t-statistics is smaller from the critical value, in that casewe accept null hypothesis of nonstationary ($\beta = 0$) or vice versa.

3.5.1.2. Johansen Co-Integration Technique

This technique was introduced by Soren Johnson (2009) in order to estimate different impacts of variables with one another in time series data. The co-integration test is used to check long run relationship between the variables. The test explains the presence of stable long run relationship. The selection of methodology is based on integrated data. If, all variable is integrated at 1st difference then we use the Johnson Co-integration

[18] A variable is said to be stationary, if its mean, variance and auto covariance remain the same

econometric technique. Two forms of Johnson Co-integration tests are known as Trace and Eigenvalue test.

Similarly**,** there are two hypotheses for trace value.

Null Hypothesis: Number of co integration vectors $r = r* < K$

Alternatives: Number of co integration vectors $r = K$

Hypothesis for the eigenvalue

Null Hypothesis: Number of co integration vectors $\mathrm{r} = \mathrm{r}* + 1 < K$

Alternatives: Number of co integration vectors $\mathrm{r} = \mathrm{K}$

Two possible specifications for error correction term i.e. the long run VECM and the transitory of VECM.

CHAPTER 4
EMPIRICAL ANALYSIS

4.1. INTRODUCTION

Thesection has been based on the empirical analysis of our data and the best possible results for the Asian countries. Firstly, we have checked for stationarity test and after that, we have estimated our models through Johanson co-integration test. Afterwards, the final results have been be incorporated according to their significance level.

4.3.2. EMPIRICAL RESULT FOR PAKISTAN

The first step is to conduct the unit root test. All-time series are integrated of order 1 for Pakistan. So,Johnsonjollies co-integration test is applied. The trace statistics is used to test the co-integration.

Result of stationarity for Pakistan

UNIT ROOT TEST

Tableexplains the stationarity of data for all Asian countries on the basis of ADF test. As the independent side has the same variables for both models except energy intensity and carbon emission.

Table No. 4.7. Augmented Dickey Fuller Test

Variable	Level		1st Difference	
	Intercept	Without Intercept	Intercept	Without Intercept
LCO2	-0.6170	-2.0260	-5.0822***	-5.5698
LEI	0.4396	-1.0709	-2.8586**	-2.8389
LEU	0.7155	-2.2992	-5.6389***	-5.8802
LEX	0.7398	-2.1416	-4.9863***	-5.3073
LGDP	0.6216	-1.5456	-2.5775*	-2.5822
LIM	0.5950	-2.3502	-1.1530	-1.8130*
LPCCO2	0.2817	-2.5977	-3.8390***	-4.4959
LPCGDP	0.6359	-1.5013	-2.5288**	-2.5544
LTO	-0.6514	-1.5026	-3.5147***	-3.8207

LTP	2.2321	3.7219	-0.8821	-1.2370*
LUR	-2.1703	-1.1226	-0.9521	-2.2230*

MODEL 1 ENERGY INTENSITY

Table No. 4.1. Johansen Co-integration test results for Pakistan

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alternative	Statistic	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	116.225*	69.819*	51.286*	33.880*
r = 1	r ≤ 2	64.843*	47.856*	35.898*	27.584*
r = 2	r ≤ 3	28.955*	29.797*	19.114*	21.132*
r = 3	r ≤ 4	9.831*	15.495*	9.299*	14.265*
r = 4	r ≤ 5	4.986	3.841	0.532	3.842

Note: The same size ranges from 1980 to 2017. Critical values are given at p = 0.05 levels for co-integration. "r" shows the number of co-integration vector. "*" indicates significance level at 5% level (reject the null hypothesis of no co-integration).

The Johansen co-integration shows where r approaches to 0, against the hypothesis of r = 1,then we will conclude there is no co-integrating vector. We can also reject our null hypothesis on the basis of Trace statistics as it is greater than the critical value (at 5% level of significance; (116.2247 > 69.81889 respectively). Now, the null hypothesis of r = 1, means that there is a possibility of two co-integrating vectors. With respect to trace, the null hypothesis can also be rejected as at 5% level of significance, as the trace value is greater than critical value (i.e. 64.84309 > 47.85613). And for r = 4 against 5, there might be three co-integrating vectors. So, we cannot reject the null hypothesis using either the trace statistics. The reason behind is that; the trace statistics value shows lower value than that of the critical value (i.e. at 5%) (0.531860 < 3.841466). Hence, trace stat. shows the possibility of four co-integrating equations.

Table No. 4.2. Estimates of Long run Co-integrating

Variable	Coefficient	Std. Error	T-stat	P-value

LEX	0.112	0.101	1.105	0.028
LIM	0.424	0.065	6.503	0.000
LLF	0.692	0.389	1.777	0.000
LUR	0.798	0.540	1.478	0.000
C	5.878	0.592	9.920	0.000
		R^2 = 94		

The long run resultsshows that the estimated results were significant in model-3, also these results were explained that long run relationship exists betweenenergy intensity, export,import, labor force and urbanization. According to the resultsexport,import and labor force had positive relationship and urbanization has also positive effect. In other words, 1percent increases inexport cause to increase 11 percent inenergy intensity (EI). And 1percent increases inImport cause to increase 42 percent in energy intensity (EI),also 1percent increases inlabor force cause 69 percent increase in energy intensity (EI) and 1percent increases inurbanization cause 79 percent increase inenergy intensity (EI).

Table No. 4.3. The Vector Error-Correction Model Estimates for Pakistan

Variables	Coefficients	Standard Error	T-Statistics
Constant	-0.033	0.080	-0.418
ΔLEIt-1	-0.110	0.272	-0.405
ΔLEt-2	-0.092	0.214	-0.427
ΔLEXt-1	-0.057	0.149	-0.385
ΔLEXt-2	-0.018	0.133	-0.132
ΔLIMt-1	0.147	0.116	1.265
ΔLIMt-2	0.175	0.110	1.581
ΔLLLFt-1	2.031	1.366	1.487
ΔLLLFt-2.	2.374	1.386	1.712
ΔLURt-1	3.548	31.507	0.113
ΔLURt-2	-21.540	21.155	-1.018
ECM	-0.945	0.291	-3.245

Note: "*" Indicates Significant at 5% level of significance. The term"Δ" is used for difference of the variable.

The ECM indicate that coefficient predicts significant but negative0.94, means that it has a tendency to attain equilibrium in the long run immediately (i.e. in the next year). While, t-values determines the short run causality of the coefficients of the lagged (t-k) terms of independent variables.

MODEL 2 CARBON EMISSION

Table No. 4.4. Johansen Co-integration test result for Pakistan

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alternative	Statistic	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	307.259*	125.615	125.426*	46.231
r = 1	r ≤ 2	181.833*	95.754	74.888*	40.077
r = 2	r ≤ 3	106.945*	69.819	44.398*	33.877
r = 3	r ≤ 4	62.546*	47.856	29.447*	27.584
r = 4	r ≤ 5	33.100*	29.797	23.682*	21.132
r = 5	r ≤ 6	9.414*	15.495	9.391*	14.265
r = 6	r ≤ 7	0.027	3.841	0.027	3.841

Note: The same size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis of no co-integration).

The Johansen co-integration test has five co-integration equations. Hence, according to the above analysis, the trace statistics test shows the possibility of five co-integrating equations at 5% level of significance.

Table No. 4.5. Estimates of Long run co-integrating vectors for Pakistan

Variable	Coefficient	Std. Error	T- Stat	P-value
LCPI	-0.146	0.024	-5.958	0.556
LEU	0.971	0.272	3.572	0.001

LTO	0.300	0.134	2.245	0.032
LTP	0.494	0.051	9.604	0.007
LGDP	0.295	0.096	3.077	0.000
LLF	0.648	0.449	1.424	0.018
C	2.296	0.969	2.369	0.025
		R^2 = 0.67		

The long-run result shows the significant and long-run association among variables likeenergy intensity, energy use,consumer price index, openness, population, labor force and GDP in model-4. According to the results,energy use, tradopenness, total population, labor force and Gross Domestic Product has positive relationship while,consumer price index has negative and insignificant effect. In other words, 1percent increases inconsumer price index cause to decrease -0.14 percent inenergy intensity (EI). And 1percent increases inenergy use cause to increase 97 percent in energy intensity (EI),also 1percent increases intrade openness cause 30 percent increase in energy intensity (EI) and 1percent increases intotal populationcause 49 percent increase inenergy intensity (EI).1percent increases inGDP causes 29 percent increase inenergy intensity (EI).1percent increases inlabor force causes 49 percent increase inenergy intensity (EI).

The literature regardingconsumer price index (CPI) has negative and insignificant impact as (Chiu and Chang, 2009;Bin and Dowlatabadi, 2005), energy usage(Al mulali et al., 2013; Arouri et al., 2012),trade openness (Shahbaz et al., 2013; Akin, 2014), Total population (Martínez-Zarzoso and Maruotti, 2011; Begum et al., 2015), GDP (Al mulali and Sab, 2012; Saidi and Hammami, 2015) and labor force has also positive and significant impact, supported by (Al Mulali, 2014).

Table No. 4.6. The Vector Error-Correction Model Estimates for Pakistan

Variables	Coefficients	Stand. Error	T-Statistics
Constant	0.138	0.055	2.487
ΔLCo2t-1	0.196	0.223	0.879
ΔLCO2t-2	0.301	0.187	1.607
ΔLCPIt-1	-0.020	0.024	-0.491
ΔLCPIt-2	-0.007	0.022	-0.337
ΔLEUt-1	0.982	0.626	1.569
ΔLEUt-2	0.076	0.556	0.136
ΔLTOt-1	0.376	0.181	2.073
ΔLTOt-2	0.279	0.133	2.091
ΔLTPt-1	-33.840	30.678	-1.234
ΔLTPt-2	-14.990	15.181	-0.988
ΔLGDPt-1	-0.300	0.989	-1.588
ΔLGDPt-2	-0.162	0.138	-1.178
ΔLLLFt-1	0.950	1.707	0.557
ΔLLLFt-2	1.813	1.524	1.190
ECM	-0.787	0.304	-2.589

Note: "*" Indicates Significant at 5% level of significance. The term"Δ" is used for difference of the variable. T-values depicts short run causality of the lagged terms coefficients of independent variables.

According to the value of ECM -0.78 which is also significant indicates the convergence to a long termequilibrium of variable (i.e. in the next coming year) which has an effect on the economic growth.

4.3. RESULTS AND DISCUSSION

The Johnson Co-integration test shows two statistical values (i.e. the trace and Eigen value). Trace tests indicateslevel of significance at 0.05 for four co-integrating equations.While, Maximum Eigen-value test shows level of significance at 0.05 (5% significance level) for two co-integrating equations.

4.3.1. CASE INDIA

MODEL 1 ***ENERGY INTENSITY ESTIMATIONS***

Table No. 4.8. Johansen Co-Integration Test results for India

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alternative	Statistic	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	165.194*	69.819*	90.443*	33.877*
r = 1	r ≤ 2	74.750*	47.856*	34.732*	27.584*
r = 2	r ≤ 3	40.018*	29.797*	22.777*	21.132*
r = 3	r ≤ 4	17.241*	15.495*	17.204*	14.265*
r = 4	r ≤ 5	0.037	3.841	0.037	3.841

Note: The same size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis of no co-integration).

The Johansen co-integration testshowswhere r approaches to 0, against the hypothesis of r = 1, then we will conclude there is no co-integrating vector. We can also reject our null hypothesis on Trace statistics basis, as it is greater than the critical value (at 5% level of significance; 165.2 > 69.82 respectively)[19]. Now, to test the r = 1 against r = 2 means that there may occur two co-integrating vectors. The null hypothesis can be rejected according to the trace value at 0.05 level of significance; trace value is greater than critical value (i.e. 74.7504 > 47.8561). After that,in order to test r = 4 against r = 5, there might be three co-integrating vectors. The reason behind is that; the trace statistics value shows lower value than that of the critical value (i.e. at 0.05 level of significance) (0.0366 < 3.8414 respectively). Hence, according to the above analysis, trace statistics test shows the possibility of four co-integrating equations at 0.05 level of significance.

[19]In case of Eigen-value, the critical value is lower than the Eigen value statistics i.e. at 5% level of significance so, the null hypothesis is rejected.

When the value of the Error-Correction Model Estimates(ECM)shows non positive sign, it concludes to speed of adjustment, the speedfrom which the variable will come from fluctuation state tolong run stability state. The value of -0.87 which is not significant indicates that there is no convergence of variables disequilibrium from short run to long run time period, further depicts that there is no-significant impact on the economic growth. While, t-values shows the short run causality of the coefficients of the lagged terms of independent variables.

Table No. 4.9. Estimates of Long Run Co-integrating Vectors for India

Variable	Coefficient	Std. Error	T-Stat	P-value
LEX	0.606	0.270	2.243	0.032
LIM	0.861	0.212	4.051	0.000
LLF	0.732	0.324	2.256	0.031
LUR	0.829	0.037	22.470	0.001
C	-7.042	2.203	-3.200	0.003
		R^2 = 0.99		

The long run result shows significant estimated results of model-1, which depicts that long run relationship exists between energy intensity, export, import, labor force and urbanization. According to the results export, import, labor force and urbanization has a positive effect. In other words, 1percent increases in export cause to increase 60 percent in energy intensity (EI) and 1percent increases in Import causes an increase 86 percent in energy intensity (EI), when 1percent labor force rises it causes to rise energy intensity (EI) by 73 percent and 1percent increase in urbanization cause 83 percent increase in energy intensity (EI).

In review of literature, it also shows positive and significant impact for export (Zheng et al., 2011; Suri and Chapman, 1998), for import (Liu et al., 2010; Vera and Langlois, 2007), for labor force (Wu et al., 2005; Wang et al., 2014) and also for urbanization (Sadorsky, 2013; Madlener and Sunak, 2011).

Table No. 4.10. The Vector Error-correction Model Estimates for India

Variables	Coefficients	Standard Error	T-Statistics
Constant	0.160	0.068	2.357
ΔLEIt-1	0.234	0.349	0.672
ΔLEt-2	-0.130	0.278	-0.467
ΔLEXt-1	-0.827	0.458	-1.806
ΔLEXt-2	0.092	0.392	0.235
ΔLIMt-1	0.550	0.431	1.275
ΔLIMt-2	-0.277	0.300	-0.921
ΔLLLFt-1	6.078	3.442	1.766
ΔLLLFt-2	-2.501	3.178	-0.787
ΔLURt-1	-39.12	18.074	-2.165
ΔLURt-2	-4.174	15.308	-0.273
ECM	-0.878	0.450	-1.955

Note: "*"Indicates Significant at 5% level of significance and "Δ" Indicates difference of the variable used.

MODEL 2 *CARBON EMISSION ESTIMATION*

Table No. 4.11. Johansen Co-Integration Test Results for India

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alternative	Statistic	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	248.429*	125.615	101.614*	46.231
r = 1	r ≤ 2	146.815*	95.754	46.829*	40.077
r = 2	r ≤ 3	99.986*	69.819	40.512*	33.877
r = 3	r ≤ 4	59.474*	47.856	27.102*	27.584
r = 4	r ≤ 5	32.372*	29.797	17.272*	21.132
r = 5	r ≤ 6	15.101*	15.495	13.303*	14.245
r = 6	r ≤ 7	1.798*	3.841	1.798*	3.841

Note: The same size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis of no co-integration).

The Johansen co-integration test shows where r approaches to 0, against the hypothesis of r = 1,then we will conclude there is no co-integrating vector. We can also accept our alternative hypothesis,as Trace statisticsis greater than the critical value (at 5% level of significance(248.4288>125.6154). There may occur two co-integrating vectors if we test the null hypothesis of r = 1 against r = 2 means. According to trace stat., the null hypothesis can also be rejected at a given value (i.e. 146.8151 > 95.7536). If we take r = 4 against r = 5, there has been co-integration. The reason behind this is that the trace statistics value shows lower value than that of the critical value (17.2717<21.1316 respectively). Hence, trace statistics test depicts the possibility of four co-integrating equations at 5% level of significance.

Table No. 4.12. Estimates of Long Run Co-Integrating Vectors for India

Variable	Coefficient	Std. Error	T-Stat	P-value
LCPI	-0.431	0.021	-2.009	0.054
LEU	0.924	0.478	1.935	0.062
LTO	0.377	0.060	6.311	0.000
LTP	0.842	2.084	0.404	0.075
LGDP	0.216	0.073	2.965	0.006
LLF	0.349	0.039	8.925	0.001
C	13.472	2.205	6.110	0.000
		R^2 = 0.83		

The long run resultshows significant long run relationship exists betweenCO2, energy use,consumer price index, and trade openness, the population % of the total, labor force and GDP in model-2. The variables like energy use, trade openness, total population, and labor force, growth has a positive relationship, and consumer price index has negative and insignificant effect. In other words, 1percent increases inconsumer price index causes to reduce -0.43 percent in CO2, 1percent increases inenergy use causesto increase 92 percent in CO2, when trade openness increases by 1percentit causes to raise 37 percent in CO2. And 1percent increase intotal populationcauses to 84 percent increase inCO2.1percent increase inGDP causes an increase inCO2 by 21 percent. 1percent increase inlabor force cause 34 percent increase inCO2.

In the literature,consumer price index (CPI) shows negative and insignificant impact such as (Chiu and Chang, 2009; Bin and Dowlatabadi, 2005), consumption of energy depicts significantand positive impact (Al-mulali et al., 2013; Arouri et al., 2012),also positive and significant effect also seen by trade openness and supported by (Shahbaz et al., 2013; Akin, 2014). The total population also has positive and significant effect(Martínez-Zarzoso and Maruotti, 2011; Begum et al., 2015). GDP positive and significant effect(Al-Mulali and Sab, 2012; Saidi and Hammami, 2015) and labor force has also positive and significant impact supported by (Al Mulali, 2014).

Table No. 4.13. The Vector Error-Correction Results for India

Variables	Coefficients	Stand. Error	T-Statistics
Constant	-0.119	0.041	-2.890
ΔLCo2t-1	0.061	0.195	0.315
ΔLCO2t-2	0.105	0.103	1.023
ΔLCPIt-1	-0.037	0.020	-1.836
ΔLCPIt-2	-0.015	0.016	-0.929
ΔLEUt-1	-0.773	0.370	-2.089
ΔLEUt-2	-0.903	0.355	-2.545
ΔLTOt-1	-0.146	0.083	-1.761
ΔLTOt-2	-0.108	0.069	-1.573
ΔLURt-1	27.610	8.405	3.284
ΔLURt-2	9.603	9.013	1.065
ECM	-1.246	0.310	-4.025

Note: “*”Indicates Significant at 5% level of significance. “Δ” Indicates difference of the variable used.

The ECMdepicts -1.24 with a significant value, it indicates that 1.24% of the disequilibrium in variables will be improved immediately (i.e. in the next coming year) which has a crash on the economic growth. While t-values determine the short-run causality of the coefficients of the insulated terms of independent variables. This practice is gorgeous over the standard VAR as it allows transitory causality to come out from.

4.3.3. CASE BANGLADESH

MODEL 1 ENERGY INTENSITY

Table No. 4.14. Johansen Co-integration results for Bangladesh

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alter.	Stat.	Criti. Value	Statistic	Critical Value
r = 0	r ≤ 1	97.635*	69.820	46.615*	33.877
r = 1	r ≤ 2	51.020*	47.856	21.703*	27.584
r = 2	r ≤ 3	29.318*	29.797	19.038*	21.132
r = 3	r ≤ 4	10.280*	15.495	9.536*	14.265
r = 4	r ≤ 5	0.743*	3.841	0.744*	3.841

Note: The sample size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis of no co-integration).

The value of Trace statistics, and Eigen-value there has been five co-integration equations showed in the above table, at 5 percent level of significance.

Table No. 4.15. Estimates of Long run co-integrating for Bangladesh

Variable	Co-efficient	St. Error	T-statistic	P-value
LEX	0.183	0.097	1.889	0.068
LIM	0.444	0.085	5.242	0.000
LLF	0.716	0.389	1.777	0.000
LUR	0.318	0.373	0.852	0.006
C	-2.236	0.529	-4.226	0.000
		R^2 = 0.73		

The results show significant variables and also long run relation among variables like energy intensity, export,import, labor force and urbanization in model-5.According to the resultsexport,import, labor force and urbanization also has positive effect. In other words, 1percent increase inexports causes a rise inenergy intensity (EI) of 18 percent. And 1percent increase inImport causes44 increase percent in energy intensity (EI),also 1percent increases inlabor force cause 71 percent increase in energy intensity (EI) and 1percent increases inurbanization cause 31 percent increase inenergy intensity (EI).

In our review of literature,export shows positive and significant effectsupported by(Zheng et al., 2011; Suri and Chapman, 1998), import (Liu et al., 2010; Vera and Langlois, 2007), Labor force supported by (Wu et al., 2005; Wang et al., 2014) and also urbanization also has a positive and significant effect and this result was supported by (Sadorsky, 2013; Madlener and Sunak, 2011).

Table No. 4.16. The Vector Error-Correction Model Estimates for Bangladesh

Variables	Coefficients	Standard Error	T-Statistics
Constant	0.024	0.067	0.354
∆LEIt-1	0.000	0.210	0.002
∆LEt-2	-0.084	0.198	-0.426
∆LEXt-1	0.154	0.162	0.954
∆LEXt-2	-14.084	0.110	-1.274
∆LIMt-1	-0.155	0.166	-0.935
∆LIMt-2	0.808	0.145	0.557
∆LLLFt-1	-1.226	1.586	-0.773
∆LLLFt-2.	1.001	2.216	0.451
∆LURt-1	-7.880	6.796	-1.159
∆LURt-2	3.527	2.498	1.412
ECM	-0.012	0.049	-0.006

Note: "*" Indicates Significant at 5% level of significance. The term"Δ" is used for difference of the variable.

According to given value of ECM_t-1 shows the negative sign and significant. It indicates that 0.01 percent of the speed of correction from the short run disequilibrium to the long runequilibrium state (i.e. in the next period).

Model 2 CARBON EMISSION

Table No. 4.17. Johansen Co-Integration Test for Bangladesh

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alternative	Statistic	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	267.741*	125.615	83.726*	46.231
r = 1	r ≤ 2	184.014*	95.754	77.688*	40.078
r = 2	r ≤ 3	106.346*	69.819	50.612*	33.877
r = 3	r ≤ 4	55.734*	47.856	24.452*	27.584
r = 4	r ≤ 5	31.282*	29.797	17.191	21.132
r = 5	r ≤ 6	14.091*	15.495	13.371	14.265
r = 6	r ≤ 7	0.720	3.841	0.027	3.841

Note: The same size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis of no co-integration).

Four co-integration equations has been formed. Hence, trace statistics test illustrates the possibility of four co-integrating equations at 5% level of significance (i.e. 0.05 level).

Table No. 4.18. Estimates of Long run co-integrating vectors for Bangladesh

Variable	Coefficient	St. Error	T- Statistics	P-value
LCPI	-0.106	0.004	-28.872	0.556
LEU	0.913	0.074	12.357	0.000
LTO	0.464	0.015	12.365	0.011
LTP	0.795	0.106	7.4806	0.000
LGDP	0.070	0.020	3.450	0.001
LLF	0.167	0.054	3.086	0.004
C	2.633	0.380	6.928	0.000

R^2 = 0.65

The long run estimates showthat long run and significant relationship of model 6 between CO2, energy use,consumer price index, trade openness, total population, labor force and GDP. According to the results,tradopenness, energy use, GDP, total population, and labor force has positive relationship andconsumer price index has negative effect. In other words, 1percent increases inconsumer price index cause to reduce -0.10 percent inCO2and 1percent increases inenergy use causesto increase 91 percent in CO2, also 1percent increase intrade openness causes 46 percent increase in CO2 and 1percentrise intotal populationcauses 79 percent increase inCO2.1percent increases inGDP causes 0.06 percent increase inCO2.1percent increase inlabor force causes 16 percent increase inCO2.

In literature review ofconsumer price index (CPI), It has a negative and insignificant impact (Chiu and Chang, 2009; Bin and Dowlatabadi, 2005). energyusage (Al Mulali et al., 2013; Arouri et al., 2012),trade openness (Shahbaz et al., 2013; Akin, 2014), Total population supported by (Martínez-Zarzoso and Maruotti, 2011; Begum et al., 2015), GDP (Al Mulali and Sab, 2012; Saidi and Hammami, 2015) and labor force hasalso positive and significant impact and this results supported by (Al Mulali, 2014).

Table No. 4.19. The Vector Error-Correction Model Estimates for Bangladesh

Variables	Coefficients	Stand. Error	T-Statistics
Constant	0.468	0.128	3.656
ΔLCo2t-1	0.361	0.159	2.277
ΔLCO2t-2	0.047	0.155	0.303
ΔLCPIt-1	0.064	0.025	2.573
ΔLCPIt-2	-0.020	0.021	-0.947
ΔLEUt-1	-2.999	0.856	-3.503
ΔLEUt-2	-1.450	0.517	-2.803
ΔLTOt-1	-0.037	0.124	-0.295
ΔLTOt-2	0.1225	0.154	0.793
ΔLTPt-1	-25.136	6.208	-4.481
ΔLTPt-2	4.870	2.025	2.406
ΔLGDPt-1	0.724	0.230	3.149
ΔLGDPt-2	0.266	0.189	1.412
ΔLLLFt-1	0.537	1.400	0.384
ΔLLLFt-2	-22.239	5.535	-4.018
ECM	-0.745		-4.049

Note: "*" depicts Significant at 5% level of significance. "Δ" shows difference of the variable used. Short term causality is shown by t-values.

The coefficient of the error correlation term (ECM) provides significant, negative and less than 1 value,which indicates that it has a tendency from short term variations to attainstability in the longer term. The estimated coefficient (ECM) reveals that the disequilibrium will be corrected by 0.74 percent in coming year. It is widely usedas it permits us temporary causality to emerge from, the coefficient of ECM term and the lagged coefficients of the independent differenced variables.

4.3.4. CASE NEPAL

MODEL 1 ENERGY INTENSITY

Table No. 4.20. Johansen Co-Integrating Test results for Nepal

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alter.	Stat.	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	123.377*	69.820	61.821*	33.877
r = 1	r ≤ 2	61.556*	47.856	28.786*	27.584
r = 2	r ≤ 3	32.771*	29.797	21.194*	21.132
r = 3	r ≤ 4	11.577	15.495	10.931*	14.265
r = 4	r ≤ 5	0.646	3.841	0.646	3.841

Note: The sample size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis of no co-integration).

There have been three co-integration equations. Hence, according to the above analysis, trace stat.depicts the possibility of four co-integrating equations at 5% level of significance.

Table No. 4.21.Estimates of Long run co-integrating results for Nepal

Variable	Coefficient	Std. Error	T-statistic	P-value
LEX	0.422	0.057	7.372	0.000
LIM	0.245	0.029	8.584	0.000
LLF	0.272	0.044	6.149	0.007
LUR	0.855	0.042	20.122	0.000
C	-10.751	2.628	-4.091	0.000

R^2 = 0.79

The long run resultdepicts significant and also long run relationship betweenenergy intensity, export,import, labor force and urbanization in model-7. According to the resultsexport,import, labor force and urbanization has a positive relationship. In other words, 1percent increase in level ofexport causes to increase 42 percent inenergy intensity (EI). And 1percent increase inImport causesan increase of 24 percent in energy intensity (EI),also 1percent increase inlabor force causes 27 percent increase in energy intensity (EI) and 1percent increases inurbanization causes 85 percent increase inenergy intensity (EI).

In our review of literature,export levelshowssignificant and positive impact supported by(Zheng et al., 2011; Suri and Chapman, 1998), import (Liu et al., 2010; Vera and Langlois, 2007), Labor force supported by (Wu et al., 2005; Wang et al., 2014) and also urbanization has positive and significant impact and this result was supported by (Sadorsky, 2013; Madlener and Sunak, 2011).

Table No. 4.22. The Vector Error-Correction Model Estimates for Nepal

Variables	Coefficients	Stand. Error	T-Statistics
Constant	-0.134	0.101	-1.325
ΔLEIt-1	-0.161	0.341	-0.474
ΔLEt-2	-0.199	0.318	-0.625
ΔLEXt-1	-0.319	0.179	1.785
ΔLEXt-2	-0.010	0.153	-0.068
ΔLIMt-1	-0.268	0.236	-1.138
ΔLIMt-2	-0.048	0.210	-0.230
ΔLLLFt-1	-5.169	6.880	-0.751
ΔLLLFt-2.	12.135	8.436	1.438
ΔLURt-1	-2.228	4.489	-0.496
ΔLURt-2	4.401	4.677	0.491
ECM	-0.172	0.179	0.962

Note: "*" shows Significant values at 5% level of significance. The term"Δ" is used for difference of the variable.

The error correlation term (ECM) coefficient depicts a -0.17 value, which is also significant and has negative sign. Which lies between 0 - 1 range, means that given variables will be adjusted by 17 percent from short term variation to long term stability in the coming year.

Model 2 CARBON EMISSION

Table No. 4.23. Johansen Co-Integration Test results for Nepal

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alter.	Stat.	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	302.220*	125.615	97.842*	46.231
r = 1	r ≤ 2	204.378*	95.754	73.503*	40.077
r = 2	r ≤ 3	130.875*	69.819	47.106*	33.877
r = 3	r ≤ 4	83.769*	47.856	40.472*	27.584
r = 4	r ≤ 5	43.297*	29.797	22.922*	21.132
r = 5	r ≤ 6	20.374*	15.495	18.772	14.265
r = 6	r ≤ 7	1.160	3.841	1.160	3.841

Note: The sample size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis, which is there is no co-integration).

According tosecond given model related to emission and its determinants, and shows the five co-integration equations in the light of Trace and Eigenvalues.

Table No. 4.24. Estimates of Long run co-integrating vectors for Nepal

Variable	Co-efficient	St. Error	T- Statistics	P-value
LCPI	-0.102	0.027	-3.802	0.001
LEU	0.633	0.430	1.475	0.000

LTO	0.044	0.120	0.399	0.692
LTP	0.612	0.076	8.023	0.043
LGDP	0.758	0.098	7.717	0.000
LLF	0.519	0.706	0.736	0.047
C	8.887	1.917	4.634	0.001
		R^2 = 0.68		

The long run resultdepicts significant and long run link in model-8, between CO2, energy use,consumer price index, trade openness, total population, labor force and GDP. According to the results,tradeopenness, energy use, GDP, total population, and labor force has positive relationship andconsumer price index has negative effect. In other words, 1percent increases inconsumer price index cause to decrease -0.10 percent inCO2and 1percent increase inenergy use causesto increase 63 percent in CO2 also 1percent increase intrade openness causes 0.04 percent increase in CO2 and 1percent increase intotal populationcauses 61 percent increase inCO2.1percent increases inGDP causes 75 percent increase inCO2.1percent increase inlabor force causes 51 percent increase inCO2.

In our literature review,consumer price index (CPI) has negative and insignificant impact (Chiu and Chang, 2009; Bin and Dowlatabadi, 2005), energy usage(Al Mulali et al., 2013; Arouri et al., 2012),trade openness (Shahbaz et al., 2013; Akin, 2014), Total population supported by(Martínez-Zarzoso and Maruotti, 2011; Begum et al., 2015), GDP (Al Mulali and Sab, 2012; Saidi and Hammami, 2015) and labor force has also positive and significant impact and this results supported by (Al Mulali, 2014).

Table No. 4.25. The Vector Error-Correction Model Estimates for Nepal

Variables	Coefficients	Standard Error	T-Statistics

Constant	-0.446	0.153	-2.909
ΔLCo2t-1	1.459	0.503	2.898
ΔLCO2t-2	1.033	0.327	3.159
ΔLCPIt-1	-0.218	0.060	-3.612
ΔLCPIt-2	-0.030	0.043	-0.706
ΔLEUt-1	0.113	1.428	0.079
ΔLEUt-2	-0.621	1.299	-0.478
ΔLTOt-1	0.074	0.326	0.227
ΔLTOt-2	-0.231	0.326	-0.709
ΔLTPt-1	-30.734	36.312	-0.846
ΔLTPt-2	166.156	55.162	3.012
ΔLGDPt-1	-0.375	0.418	-0.898
ΔLGDPt-2	-0.134	0.418	-0.320
ΔLLLFt-1	-26.710	14.827	-1.801
ΔLLLFt-2	-32.878	15.440	-2.129
ECM	-2.327	0.569	-4.089

Note: "*" depicts Significant at 5% level of significance. The term"Δ" is used for difference of the variable. t-values shows the lagged terms of independent variables.

The error correlation term (ECM) shows negative coefficient, means that they have a tendency to fluctuate from short term to long term in order to attain equilibrium level.The term error correction shows a significant value of -2.32,depicts that 2.32 percent of the instability occurs in variables will be corrected in the coming year.

This procedure is widely used and more attractive over the standard VAR because it allows temporary causality to emerge from the coefficient of ECM term and the lagged coefficients of the independent differenced variables.

4.3.5. CASE SRI-LANKA

MODEL 1 ENERGY INTENSITY

Table No. 4.26. Johansen Co-Integration Test results for Sri-Lanka

Hypothesis	Trace Test	Maximum Eigen-value Test

Null	Alter.	Stat.	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	120.978*	69.820	46.220*	33.877
r = 1	r ≤ 2	74.759*	47.856	23.303	27.584
r = 2	r ≤ 3	51.455*	29.797	21.511*	21.132
r = 3	r ≤ 4	29.944*	15.495	20.295*	14.265
r = 4	r ≤ 5	9.649*	3.841	9.648*	3.842

Note: The sample size ranges from 1980 to 2017. At p = (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (accept the alternative hypothesis of co-integration).

As shown above there has been five Co-integratedequations for concerned model and its variables.

Table No. 4.27. Estimates of Long run Co-integrating vectors for Sri-Lanka

Variable	Coefficient	Std. Error	T-Statistics	P-value
LEX	0.340	0.089	3.804	0.000
LIM	0.273	0.088	3.114	0.000
LLF	0.474	0.146	3.243	0.002
LUR	0.749	0.097	7.678	0.086
C	4.300	5.482	0.784	0.000
		R^2 = 0.95		

The long run results show that the estimated results has been significant in model-9, also these results illustrates that long run link exists amongenergy intensity (EI), export,import, labor force and urbanization. According to the resultsexport,import, labor force and urbanization has a positive relationship. In other words, 1percent rise inexport causes to increase 34 percent inenergy intensity (EI). And 1percent rise inImport causesto increase 27 percent in energy intensity (EI),Furthermore, 1percent increase inlabor force causes 47 percent increase in energy intensity (EI) and 1percent increase inurbanization cause 74 percent increase inenergy intensity (EI).

Literature of exportspredicts positive and significant effectsupported by(Zheng et al., 2011; Suri and Chapman, 1998), import (Liu et al., 2010; Vera and Langlois, 2007), Labor force supported by (Wu et al., 2005; Wang et al., 2014) and also urbanization has positive and significant impact and this result was supported by (Sadorsky, 2013; Madlener and Sunak, 2011).

Table No. 4.28. The Vector Error-Correction Model Estimates for Sri-Lanka

Variables	Coefficients	Stand. Error	T-Statistics
Constant	-0.045	0.031	-1.436
ΔLEIt-1	0.200	0.252	0.790
ΔLEt-2	0.102	0.241	0.424
ΔLEIt-3	0.375	0.272	1.377
ΔLEXt-1	-0.027	0.276	-0.098
ΔLEXt-2	0.038	0.308	0.124
ΔLEXt-3	0.308	0.244	1.262
ΔLIMt-1	0.177	0.235	0.755
ΔLIMt-2	-0.157	0.207	-0.761
ΔLIMt-3	-0.180	0.227	-0.790
ΔLLLFt-1	-0.725	0.840	-0.369
ΔLLLFt-2	-0.241	0.814	-0.296
ΔLLLFt-3.	0.109	0.905	0.120
ΔLURt-1	64.750	91.277	0.709
ΔLURt-2	-131.628	152.543	-0.863
ΔLURt-3	-27.110	21.952	-1.235
ECM	-0.013	0.007	-1.785

Note: “*” is used for Significant variables at 5% level of significance. The term“Δ” is used for difference of the variable.

The coefficient term (ECM) shows significant and a negative value i.e. the value of -0.01 which indicates that 0.01 percent of the variables will be attain stability immediately (i.e. in the next year).

MODEL 2 CARBON EMISSION

Table No. 4.29. Johansen Co-integrating test results for Sri-Lanka

Hypothesis		Trace Test		Maximum Eigen-value Test	
Null	Alter.	Stat.	Critical Value	Statistic	Critical Value
r = 0	r ≤ 1	286.49*	125.615	94.351*	46.231
r = 1	r ≤ 2	192.14*	95.754	65.835*	40.077
r = 2	r ≤ 3	126.30*	69.819	40.125*	33.880
r = 3	r ≤ 4	86.177*	47.856	36.219*	27.584
r = 4	r ≤ 5	49.958*	29.797	24.269*	21.132
r = 5	r ≤ 6	25.689*	15.495	15.380*	14.265
r = 6	r ≤ 7	10.308*	3.841	10.308*	3.841

Note: The sample size ranges from 1980 to 2017. At p = 0.05 (5% significance) levels critical values are given. "r" shows the number of vector. "*" indicates significance level (reject the null hypothesis of no co-integration).

As above table shows there has been six co-integration equations. So, the trace and Eigen value statistics test depicts the possibility of six co-integrating equations at 5 percent level of significance.

Table No. 4.30. Estimates of Long run Co-integrating vectors for Sri-Lanka

Variable	Co-efficient	Std. Error	T-Statistic	P-value
LCPI	-0.062	0.008	7.964	0.000
LEU	0.255	0.103	2.466	0.000
LTO	0.321	0.042	7.580	0.454

LTP	0.678	0.326	2.083	0.046
LGDP	0.755	0.032	23.498	0.026
LLF	0.401	0.149	2.688	0.012
C	2.085	2.820	0.730	0.000
		R^2 = 0.71		

The long run estimated results are significant in model-10, also these results shows the long run relationship exists between CO2, energy use,consumer price index, tradopenness, total population, labor force and GDP. According to the results,trade openness, energy use, GDP, total population, and labor force has positive relationship andconsumer price index has negative effect. In other words, 1percent increase inconsumer price index causes to decrease -0.06 percent inCO2and 1percent increase inenergy use causesto increase 25 percent in CO2, also 1percent rise intrade openness causes 0.32 percent rise in CO2, and 1percent increase intotal populationcauses 67 percent increase inCO2.1percent increase inGDP causes 75 percent increase inCO2.1percent increase inlabor force causes 40 percent increase inCO2.

Literature review of consumer price index (CPI) has negative and insignificant impact (Chiu and Chang, 2009; Bin and Dowlatabadi, 2005), energy usage (Al Mulali et al., 2013; Arouri et al., 2012),trade openness (Shahbaz et al., 2013; Akin, 2014), Total population supported by (Martínez-Zarzoso and Maruotti, 2011; Begum et al., 2015), GDP (Al Mulali and Sab, 2012; Saidi and Hammami, 2015) and labor force has also positive and significant impact and this results supported by (Al Mulali, 2014).

Table No. 4.31. The Vector Error-correction Model estimates for Sri-Lanka

Variables	Coefficients	Stand. Error	T-Statistics
Constant	-0.062	0.096	-0.064
ΔLCo2t-1	-0.074	0.273	-0.271
ΔLCO2t-2	-0.130	0.348	-0.373
ΔLCPIt-1	-0.034	0.046	-0.748

ΔLCPIt-2	0.026	0.038	0.680
ΔLEUt-1	-0.043	0.800	-0.053
ΔLEUt-2	0.365	0.824	0.444
ΔLTOt-1	-0.400	0.431	-0.927
ΔLTOt-2	0.349	0.485	0.719
ΔLTPt-1	-47.532	56.071	-0.847
ΔLTPt-2	44.370	42.635	1.041
ECM	-0.045	0.1366	-0.327

Note: "*" predicts Significant variables at 5% level of significance. The term"Δ" is used for difference of the variable.

Theerror correlation term (ECM) shows negative and significant coefficient, it concludes to a tendency to attain equilibrium level from short timevariations to the long period stability. The value -0.04 shows the unstable state of variable which will be adjustedquickly (i.e. in the next coming period) which has an effect on the economic growth. While, t-values determines the short run causality of the coefficients of the lagged terms of independent variables.

CHAPTER 5

CONCLUSION

The relationship(long run, short run on energy intensity of five major south Asian countries Pakistan, India, Nepal, Bangladesh and Sri-Lanka for time period 1980 to 2017 have been analyzed. The result suggest that urbanization has positive relationship with energy intensity and negative relationship with carbon emission.

The trace statistics results indicates that co-integration exist between urbanization and energy intensity for Pakistan, India, Bangladesh, Nepal and Sri-lanka.

The result of johanson co-integration for carbon emission indicate that long run and significant relationship of model 6 between CO2, energy use, consumer price index, trade openness, total population, labor force and GDP. Tradopenness, energy use, GDP, total population, and labor force has positive relationship and consumer price index has negative effect.

The Johansen co-integration test for Bangladesh shows that there is co-integration among energy emission and urbanization. Value of ECM_t-1 shows the negative sign and significant. The results show significant variables and long run relation among variables like energy intensity, export, import, labor force and urbanization. According to the results export, import, labor force and urbanization also has positive effect.According to the results export, import, labor force and urbanization has a positive relationship. According to second given model related to emission and its determinants, it is concluded that more urbanization leads to more energy utilization captured by energy intensity. Further, as a result more energy intensity leads to more carbon emission.

The results for Nepal explained that long run relationship exists between energy intensity, export, import, labor force and urbanization. According to the results export, import and labor force had positive relationship and urbanization has also positive effect. The energy intensity model for Sri Lanka (i.e. dependent variable) has positive association with all other concerned variables. Similarly, carbon emission Model (i.e. dependent variable) also shows positive association but causal relation that differs among variables. So, our estimate suggests that Johnson co-integration predicts different linkagesamong all the regressand variables and regressor variables over the time.According to the results, when energy intensity shows maximum four Cointegration equations at 0.05 significance level.

While, the error correction coefficient depicts a negative association, means that there is a tendency for variations in the way of equilibrium form short to long term time span. The causality test predicts the bidirectional causality between all variables when energy intensity has been chosen as dependent in the case of all 5 South Asian countries.

It is concluded that more urbanization leads to more energy utilization captured by energy intensity. Further, as a result more energy intensity leads to more carbon emission.

Policy Implications

The result leads to following implication for each country.

- Results imply that environment friendly sources would be considered for future energy generation.
- The results also recommend that urbanization should be planned in energy efficient manner.

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Appendex (A)

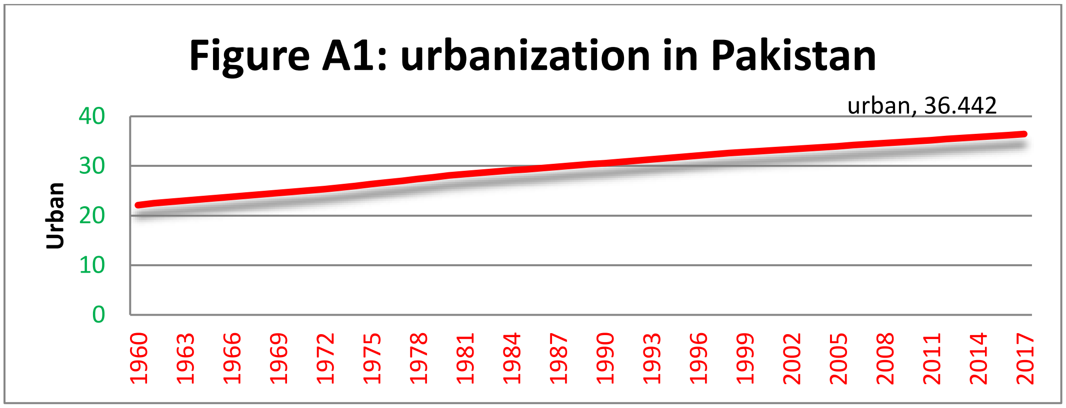
Figure A1: urbanization in Pakistan
urban, 36.442
Urban
40
30
20
10
0
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017

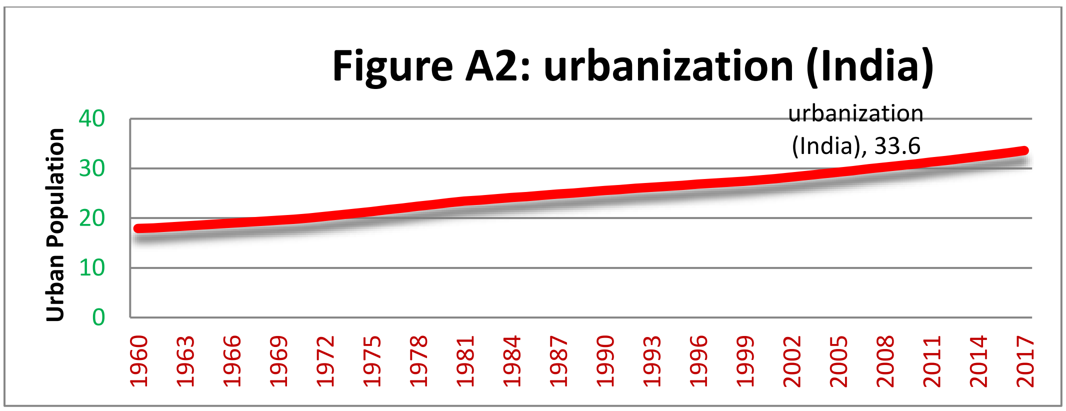
Figure A2: urbanization (India)
urbanization (India), 33.6
Urban Population
40
30
20
10
0
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017

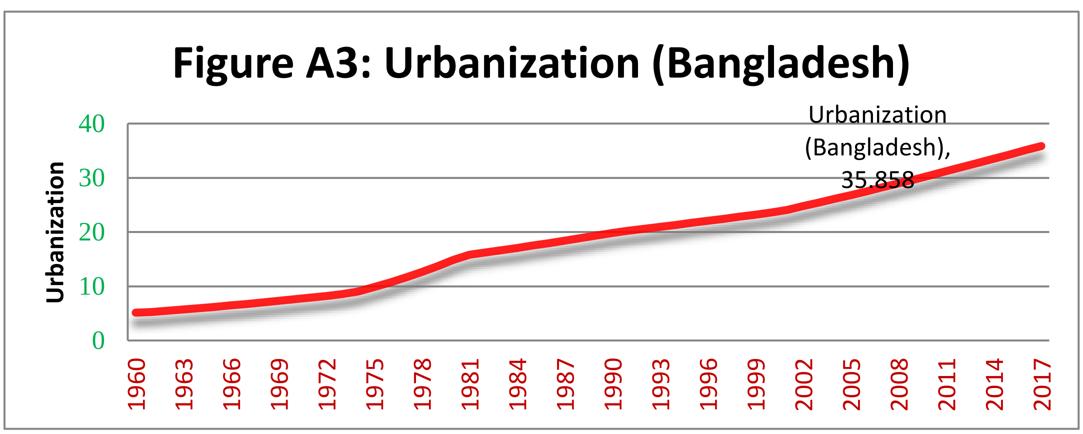
Figure A3: Urbanization (Bangladesh)
Urbanization (Bangladesh), 35.858
Urbanization
40
30
20
10
0
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017

Figure A4: Urbanization (Nepal)

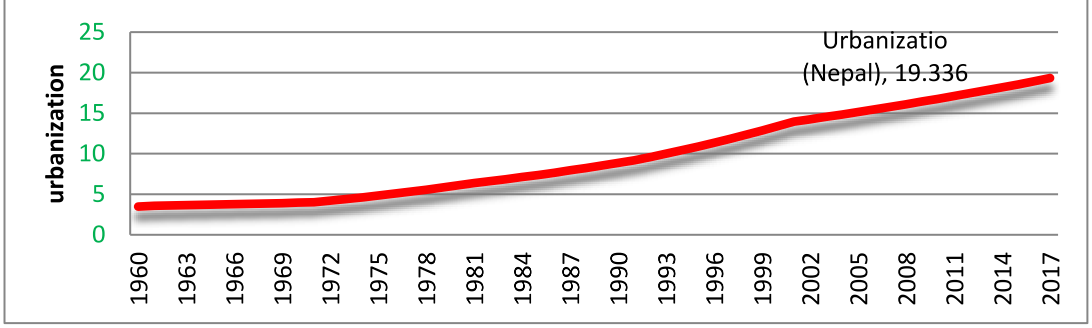

Figure A5: Urbanization (Srilanka)