Impact of Financial Development, Industrialization and Urbanization on Energy Consumption in Pakistan

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Dedicated to My Parents

May ALLAH Almighty bless them with a long life

ABSTRACT

Voluminous work has been produced on energy consumption and economic growth but empirical studies dealing specifically industrialization, financial development, urbanization and energy consumption linkages are scant[1], particularly for Pakistan. The present study is an attempt to find the relation among energy consumption, industrialization, urbanization and financial development of Pakistan by employing Autoregressive Distributed Lag (ARDL) approach for the analysis of co-integration from 1972-2013.The result confirms the presence of short-term and long-term association of energy consumption with industrialization, urbanization and financial development in Pakistan. This study finds significant positive impact of industrialization on energy consumption suggesting that industrialization stimulates economic activities which raise demand for energy. This study shows that energy consumption is significant positively affected by urbanization which is implying that more people living in urban areas stimulate economic and housing activities which trigger many structural changes in the economy. Moreover, finding of financial development exhibit significant positive impact on energy consumption identifying that developed financial markets enables the investors to get high returns from projects that also attracts foreign direct investment by enhancing investors' confidence. Based on the findings, in general, this study recommends formulating policies to invest in these financial institutions that encourage energy sectors to fulfill the escalating demand for the energy. Furthermore, steps should be taken to discover new sources of energy that can fulfill the growing demand of the energy, which in turn stimulate economic activities.

[1] See, for example, Liu, Y. (2009), Komal. *et al.* (2015) and Sadorsky (2010).

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List of Abbreviations

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
CUSUMSQ	Cumulative Sum of Square Residuals
DF	Dickey-Fuller
ENRG	Energy Use
FD	Financial Development
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
IND	Industrialization
UECM	Un-Restricted Error Correction Model
URB	Urbanization
VECM	Vector Error Correction Model
WDI	World Development Indicators

Chapter No.1

INTRODUCTION

1.1) Background:

The traditional production process was carried out with land, labor, capital, and entrepreneur but the industrial revolution in the eighteenth century lead to recognition of major role of energy as a prime factor of production. The technological advancement in a country will lead to increase energy consumption in the country through multiple dimensions. As the technological progress will involve the introduction of new capital goods in the manufacturing sector and industries along with rapid generation of new household durable consumer goods which will again raises the energy consumption. Development is a long-term process that includes social, political, and institutional improvement and sustained economic growth of a nation. Cities play crucial role in the process of development and lead to expand cities through migration from rural to urban centers. The expansion of urban centers will lead the energy consumption to further expand thus in turn increase the overall energy consumption in the country. The objective of this study is to examine the association among urbanization, industrialization, financial development and energy consumption in Pakistan.

The financial development refers to process of liberalization of financial sector by expansion in the financial institutions, improved financial services, reduction in financial risk and investment profitability in an economy. Industrialization process involves the widespread expansion in the industries and installment of new and advanced industries in the country to help in enhancing the economic prosperity of the country in number of ways. The urbanization in the

country leads to help in the economic growth by developing local economies and thus increases energy consumption in the economy. While rapid process of urbanization will enhance the usage of durable consumer goods, which will also increases energy demand in the country.

There is a massive literature, which highlights the role of financial liberalization in altering energy consumption by affecting it either positively or negatively [Fung (2009)]. A well-developed financial system in a country ensure improved financial services in the economy in terms of reduction in transaction costs, high profitability of investment, minimization of financial risk, easy borrowing facility, borrowing lending transparent process and effective financial institutions; but this advancement also boost the energy consumption in the country due to digitalization of financial sector and introduction of electronic system. Moreover, the reforms in financial sector, more specifically in banking sector largely contribute to high energy consumption in the country (Kahsai *et al.* 2012). These reforms allow the consumers to avail the opportunity to easily borrow money from financial institutions to fulfill their needs for the consumption of durable consumer goods. These goods include Car, Television, Air conditioners and automobiles thus lead to increase the energy consumption in the economy. Financial liberalization also helps out the businesses by providing easy access to financial capital which helps the businessmen to expand their business or go for new ventures. In case of developed countries, the financial development might also negatively affect energy consumption as the technological advancement and innovations in the financial sector will lead to reduce the problem of asymmetric information and thus shrinks the energy use in the sector due to increased efficiency [Townsend (1979); King and Levine (1993); Baier, *et al*, (2004)].

In general Asian economies have significant rise in energy consumption due to high population growth and massive industrialization in the region, and Pakistan among the other

economies particularly faces increased energy consumption (Zaman *et al.* 2012). Being the middle income earning country Pakistan is facing the high demand for energy due to escalating population growth and high industrialization. Industrialization refers to expansion in the industrial setup and formation of new industries and factories in a country it may be in terms of new production plants and technological advancement. Financial sector's growth also allows the industrialists to expand their industries and create new factories to fulfill the growing demand for durable consumption goods. This will enlarges the energy consumption in the economy through multiple channels due to sectoral growth which will enhance the economic growth of the country. Apart from this casual impact, the industrialization in an economy will raise the demand for input factors which will lead to provide opportunity for worker to consume various durable goods thus enhancing the energy consumption.

The process of urbanization refers to re-distribution of population from rural areas to urban centers, natural urban population growth, and re-classification of cities. Urbanization is one of major factor of economic activities as the fact that cities are the base camp for agglomerated economies and often known as "engine of growth" in a country. The large share of urbanization in the world took place in the developing regions such as Asia and Africa. Pakistan is also facing rapid process of urbanization which have several impacts on the economy as well as welfare of society. The fact that this process contribute to economic growth of the country also entails high energy consumption in terms of more utilization of crude oil, electricity, natural gas, and coal. Due to massive urbanization the resource utilization took place very inadequately which in turn lead to cause downward trend in energy consumption for future.

1.2) Objectives of the Study:

The broad objective of this study is to analyze the relation among the energy consumption, financial development, urbanization and industrialization of Pakistan. The specific objectives of the study are given below:

- To assess the short-term association among the financial development, energy consumption, urbanization and industrialization of Pakistan.
- To analyze the long-term association among the financial development, urbanization, energy consumption and industrialization of Pakistan.
- To suggest policy recommendations based on the results from objectives (i) and (ii).

1.3) Organization of the Study

The rest of the thesis is organized in five chapters. Chapter two describes literature review. Chapter three provides theoretical framework, data, variables construction, and model specification. Chapter four details estimation, results and discussion. Conclusion, policy implications and future research directions are furnished in chapter five.

Chapter No.2

LITERATURE REVIEW

2.1) Introduction:

This chapter reviews the existing literature relevant to this study. This chapter brings together different strands of empirical literature answering the linkages between energy consumption with financial development, urbanization and industrialization in local and global context with reference to objectives of this study outlined in section 2.2 and finally, contributions of this study to the literature are documented in section 2.3.

2.2) Literature Review:

Yaobin Liu. (2009) creates a relation of energy consumption with urbanization, population growth and economic activities for the time period 1978-2008 by using ARDL and factor decomposition technique and specifies empirical evidence for energy consumption and urbanization for China. The findings of the bound co-integration test concludes the presence of co-integration that drives the stochastic series trend in the data set, and author find a long-run stable association among the urbanization, population growth, gross domestic product and energy consumption along with short-run self-adjustment ability. Unidirectional causality runs towards urbanization to energy consumption both in short-run and long-run. The present study recommends energy policies in accordance with the urbanization process in China.

Shahbaz*et al*. (2011) finds long run and casual association between energy consumption, industrialization, urbanization, economic activities, and financial development from 1971-2008 in Tunisia using ARDL technique. Moreover, the study uses VECM Granger causality test in order to evaluate the causality between energy consumption and other variables. The findings of

this study show the presence of long-run association of energy consumption with urbanization, economic activities, industrialization, and financial development in Tunisia. It also locates the long-run bidirectional causalities between energy consumption and financial development, energy consumption and industrialization, financial development and industrialization. Furthermore, the results suggest that unidirectional causality exists from energy consumption to financial development. Therefore, this study suggests that government should pursue loose monetary policy, which in turn stimulates investment activities, economic growth and energy production capacity. In rank viable economic growth creates more demand for financial services therefore government should concentrate to foresee new sources of energy to fulfill the growing demand for energy.

Sharif *et al*. (2012) show that electricity consumption effect economic growth positively than other energy sources used, while oil consumption effects growth negatively due to higher imports volume in Pakistan for the period 1972- 2012. The findings of this study suggest that the use of other energy sources, such as gas or coal supply, should be increased to reduce import burden. Shahbaz *et al.* (2013) find the energy consumption, financial development, exports, capital, imports and international trade to be positively related with economic growth in China from 1971-2011. Unidirectional causal link from energy consumption to growth exists while bidirectional causal link among the financial development, trade, capital, and energy consumption.

Rabia Komal *at el*. (2014) attempts to capture the impact of financial development on energy consumption through the economic growth channel and includes urbanization and energy prices in the structural model by using time series data from 1972-2012. The study finds positive and significant impact of economic growth and urbanization on energy consumption, while the

impact of energy prices on energy consumption is significantly negative. While financial development is positively related with energy consumption and significantly affects energy consumption through economic growth, the energy prices have significant effect on energy consumption and inversely related with energy usage and these results are in accordance with the economic theory. In addition, urbanization has also a positive and significant impact on energy consumption.

The finding of this work implies that government should take serious measures to ensure the efficient use of the available energy resources as well as the up-gradation of the current energy production capacity at macro level in order to overcome the problem of energy shortage. Government and financial institutions should assist the people to invest in the renewable energy resources which will provide access to cheap energy for the economic growth. Escalating energy prices have adverse effect for the economy due to de-industrialization since production cost is increases and manufacturers loss of competitive advantage in foreign markets. The promotion of cheap renewable energy resources can mitigate this problem as well.

Sadorsky (2009) uses the technique of generalized method of moments (GMM) to tackle the possible problem of endogeneity among the energy demand, income and financial development. The empirical models perform very well, which he examine through various diagnostic tests. It is inferred that the increase in financial development, measured through stock variables, like stock market value traded to GDP value, stock market capitalization to GDP value, and stock market turnover, lead to accelerate the energy demand in emerging economies. These findings reveal that the stock markets continue to develop in the emerging economies and raise the demand for energy more than the demand generated from the income.

Lee and Chang (2008) find long-run relationship between energy consumption and real GDP for 16 Asian countries for the period 1971 to 2002. They find unidirectional Granger causal association running from energy consumption to energy growth in long-run but not in the short-run. Farid-ul-Islam et al (2011) analyzed the long run relationship between energy consumption, aggregate production, population, and financial development and diagnosed Granger causality within the Vector Error correction Model (VECM) for the Malaysia by using approach of auto regressive distributed lag model (ARDL) to co-integration. The findings show that growth of economic and financial sector influenced the energy consumption in short run as well as in long run while energy consumption and population growth are related with each other in the long run. The focused area of investment should be renewable energy resources and adoption of other energy saving techniques in the long-run and mixture of energy usage, while financial development strategy should be executed in such a manner to build a sound energy infrastructure that leads to raise the efficiency of energy usage as a long-run goal.

Wei and Weidoing (2006) find that major share of industrial output in China is largely based on the heavy consumption of fossil fuel energy and their relationship is almost linear. Since the massive national industrialization in China, industry total value addition was fastest and rose more than five times in the period 1991 to 2005. In the same era the industrial energy consumption fluctuated due to high demand.

Mahadeven at el (2006) examine the nexus between energy consumption and GDP growth for 20 net energy exporters and importers, taking annual data from 1971-2002. Each group of ten countries contains seven developing and three developed countries. In this study, causal relationship among economic growth and energy consumption was tested in three stages; in the first step, the unit root was applied to check the order of integration of economic growth,

energy consumption and price series. In the next step, the examination of long-run relation between these series was conducted through panel co-integration tests and in the final stage the evaluation of short-run co-integration was confirmed with the help of dynamic panel causality test. These results were compared with the separately estimated conventional VECM of each country. They suggest some policy implications that plays important role to conserve the energy by keeping efficiently use of energy usage and reduction in the amount of energy that is wasted most of the time.

Many studies in which causality among energy consumption and economic growth was analyzed, suggest policies of energy conservation based on empirical findings without taking into account the environmental and economic elements such as energy efficiency considerations or institutional capacity constraints. Formulation of energy policy, without considering the nation's objectives such as BOP and condition of national fuel industries will be difficult to implement and this will complicate the policy. On the other hand, economic growth of net energy importers will be stimulated with energy consumption and it means that if production process that includes energy saving techniques and methods which raises the energy efficiency does not show energy conservation will negatively affect the economy. Due to given causality that runs from energy consumption, energy conservation to GDP may retard the economic growth in the short-run in case of energy exporting developing economies, while in long-run by the use of other measures, excessive energy demand can be curtailed because it will not negatively affect the GDP growth.

2.3) Conclusion:

Overall literature review documents positive impact of financial development, urbanization and industrialization on energy consumption at international level. There are short-

run and long-run relationship along with bidirectional causality exists among all the mentioned variables. In the context of Pakistan, there is a large empirical work devoted to check the relationship of energy consumption, economic growth, and financial development using time series data. But relationship between urbanization and energy consumption remains scant in case of Pakistan. Present study contributes to the literature by analyzing energy consumption and other three factors namely financial development, industrialization, and urbanization linkages for Pakistan.

Chapter No.3

THEORETICAL FRAMEWORK

3.1) Introduction

Reliability of any work depends upon its theoretical groundings. This chapter develops theoretical ground which is employed for empirical estimations in this study. This study finds short term and long term association among urbanization, industrialization, financial development, and energy consumption of Pakistan.

The rest of the chapter is set up as follows: Section 3.1 provides theoretical framework for energy consumption and financial development. Section 3.2 and 3.3 presents theoretical framework for 'energy consumption and industrialization' and 'energy consumption and urbanization' respectively. Description of the variables is given in section 3.4. Whereas section 3.5 develops econometric specification and lastly, section 3.6 discusses estimation methodology.

3.2) Financial Development:

Financial development in a country leads to increased efficiency in the financial system, and helps to develop a financial system by boosting effectiveness and performance of financial sectors in terms of reduction of information costs, improved transparency among the borrower and lender, ensuring profitable investment, management of complex and risky transactions in an efficient way, and innovation in financial delivery services. These factors play major role for the better business investment environment and high economic activity, thereby stimulating domestic production cause high energy consumption (Shahbaz 2012; Ahmed and Islam 2013). Energy consumption can be reduced by encouraging the use of efficient technology. Shahbaz et

al. (2013) find that innovations and technological progress in the laissez faire system is primarily caused by entrepreneurs, which indicates that energy consumption induced by financial development depends upon the overall performance of the economy that includes business investment environment, technology, quality of labor, capital, institutions, and fiscal policy. Sadorsky (2009) argues that the estimates of energy demand that do not contain the impact of monetary development as an explanatory variable will lead to give under-estimated energy demand.

3.3) Industrialization:

Conceptually, industrialization, energy prices and urbanization influence the energy consumption in an economy directly while financial development affects it indirectly, energy use and financial development are positively related with each other, because mechanism of energy saving is not up to the mark (Barro 1991; King 1993; Levine 1995; Gregorio 2000). Literature suggests that increase in energy consumption in the developing economies is contributed due to the rise in income level (Lean 2013) and same trend is observed in Pakistan.

3.4) Urbanization:

Urban population in Pakistan reached 69.87 million in 2012-13 from 67.5 million in the previous year [Economic Survey of Pakistan (2012-2013)]. Due to urbanization, large population engages in the industrial sector leading to increase energy consumption [Jones (1991) and Solarin (2013)]. The high energy consumption is also caused by the migration factor which happens due to improved economic activities in the cities and thus country face rural to urban migration and raises the level of urbanization in a country [Sadorsky (2010) and Shahbaz (2013)]. Shahbaz and Lean (2013) assert that energy usage increases due to high demand of

household appliances caused by rising urban population, so it is inferred out that energy consumption accelerated in Pakistan due to urbanization and it has direct and significant impact on energy consumption. Urbanization has multiple impacts on the energy consumption as it contains redistribution of population across, as well as within, regions and also accelerates the economic activity in the country because large population shifts from agriculture sector to the industrial sector which is the major consumer of the energy hence altering the energy consumption. The process of modernization of production technology also alter the energy consumption and this can be confirmed with the fact that low density cities use more gasoline in contrast to the high intensity cities because the people have to travel short distances and citizens likely to use the public transport [Lariviere (1999)].

3.5) Model:

In general, three main factors namely industrial growth, urbanization, and rapid population growth significantly affect the energy consumption [Kazim (2007)]. Rapid population growth rate is the key ingredient for escalating the fossil fuel consumption, massive large scale industrial production and discoveries of oil and gas at large scale. A large number of consumers lead to raise consumption per capita and this, in turn, increases the demand for energy obtained from all primary sources, while the process of urbanization and globalization accompanied with high energy consumption life styles worsens the whole scenario [Alam and Fatima (2007)].

Keeping in view the theoretical background discussed above, general form of our model is as follows:-

ENRG= f (FD, IND, URB) ---------- (1)

Where *ENRG* is per capita energy consumption, *FD* is the financial development, *IND* represents to industrialization, and *URB* refers to urbanization. By transforming the variables in linear form energy consumption model in log form is stated as:

LENRG= f (LFD, LIND, LURB) ---------- (2)

3.6) Description of Variables:

Descriptions of the variables are given as follows.

3.6.1) Energy Consumption (ENRG):

ENRG is used for energy consumption in kilogram of oil per capita. Data are taken from the online version of WDI from 1972 to 2013.

3.6.2) Financial Development (FD):

FD is denoted as financial development which is taken as domestic credit to private sector as a percentage of gross domestic product and data are taken from WDI for the period of 1972 to 2013.

3.6.3) Industrialization:

IND is used for industrialization which is constructed as industrial value added as a percentage of gross domestic product for the period of 1972 to 2013 from WDI.

3.6.4) Urbanization:

URB is denoted as urbanization which comprises of urban population as percentage of total population. Data are taken from the online version of WDI from 1972 to 2013.

Description of variables is given in Table 1, given below.

Table 1: Variable Definition and Data Source

Variable	Definition	Source
LENGR	Log of energy use in kilogram of oil per capita.	WDI, 2014
LFD	Log of domestic credit to private sector as percentage of gross domestic product.	WDI, 2014
LIND	Log of industrial value added as a percentage of gross domestic product.	WDI, 2014
LURB	Log of urban population as a percentage of total population.	WDI, 2014

3.7) Econometric Specification:

This study investigates the short term and long term relation among the selected variables. Theoretical reasoning for including the main variables in the model is discussed in theoretical framework chapter. Present study considers the equation 1 to determine the econometric specification which is discussed in theoretical chapter. To analyze the relation among the variables; firstly, we find out co-integration among the variables.

3.7.1) Co-integration:

The purpose of the study is to analyze the long term association of energy consumption with financial development, urbanization and industrialization, so the appropriate method to accomplish this objective is the co-integration analysis. The most notable approaches to co-integration analysis include Engle-Granger (1987), Johansen and Juselius (1990), and Autoregressive distributive lags (ARDL) approaches. The first two mentioned techniques are

based on the strict definition of co-integration which entails that the order of integration of all variables should be the same. The ARDL approach is based on the loose definition of co-integration, which implies that if we have variables of different order of integration, then ARDL approach is viable for co-integration. Co-integration exists among the variables, if concerned variables have same integrated order and their linear combination integrated of an order less than the co-integration order of the variables. To identify what estimating technique is reliable to find out the co-integration, it depends upon the level of stationarity i.e., there may be possible all variables have co-integration order I(0) or and order of integration I(1) or both. To find out the stationarity among the variables therefore, we employ unit root test.

3.7.2) Unit-Root Test:

Philips and Perron (1988), Ng and Perron (1995), and Enders (1995) are recognized as complicated strategies in the literature to find the unit root for three reasons.

1) They do not explain the growth status of the variables to cover all possibilities.
2) Their outcome may not realistic about the trend and simultaneous existence of a unit root.
3) It raises the problem of the low power of unit-root tests due to pretest bias

It is evident that in many cases, macroeconomic data grow over the time such as financial development, urbanization, industrialization and energy consumption with deterministic time trend, or due to annual change in the variables. These annual changes may be equal to constant. Therefore, ADF tests incorporate trend or/and intercept as an automatic correction than DF tests, Philips and Perron (1988), Ng and Perron (1995), and Enders (1995). Thus present study employs ADF test to observe the unit root by incorporating the constant, trend term and lagged values of the variables. At first, if unit root presents in the series, then the series is non-stationery at level, then we go to check whether it has unit root on first difference, if it remains non-

stationery then we check for unit root on second difference and this process continues until we get the desired result of stationery series. However, if we get stationery series at any level we will stop at this point. The ADF test includes lagged difference as a key ingredient in order to counter auto-correlation. The optimum numbers of lags are used by implying Schwartz (SIC) selection criteria. The specification for the ADF test is:

$$\Delta Y_t = \alpha + \beta t + \rho Y_{t-1} + \sum_{i=1}^{p} \Delta Y_{t-1} + \mu_t \text{ ---------- (3)}$$

The test for stationary is conducted in three steps one by one: (i) including both intercept and trend term, (ii) only intercept term, no trend term, and (iii) without trend and intercept term. Our one tailed null hypothesis is:

$$H_o : \rho = 0$$

$$H_A : \rho < 1$$

The rejection of null hypothesis states that there is no unit root then series is stationary, while the non-rejection of null hypothesis implies that if series has a unit root then series is called non- stationary. The first application of test will be in log form at level if we get stationary series then we will stop there and if we found unit root then we apply the test at first difference and so on until we reach to a desirable result. Since the test statistic in unit root test are not supported by the student t-distribution so this study uses the critical values presented in the Pearson's table.

We have applied the ADF test to determine the unit root in the series and results are as follows:

Table 2: Unit Root Tests

ADF Test			
Variable	**At Level**	**At First difference**	**Decision**
LENRG		-4.921***	I(1)
LFD		-5.069***	I(1)
LIND		-7.204***	I(1)
LURB	-3.618**		I(0)

Note: *, ** and *** denotes significance at 10%, 5% and 1% respectively.

Table 2 indicates that LENRG, LFD, and LIND are integrated of order one I(1) or alternatively, these said variables are stationary at first difference while the LURB is integrated of order zero or it is stationary at level.

3.8) Estimation Methodology:

As established from the results of ADF test mentioned in the Table 2 of unit root of the time series data for estimating model 2 by using Auto Regressive Distributive Lags (ARDL) approach. To accomplish the objective of the study we employ the model proposed by Pesaran et al. (2001), namely the Auto Regressive Distributive Lags methodology which has some benefits over the Engle-Granger (1987), Johansen (1988) and Johansen and Juselius (1990) approaches to co-integration. As the ARDL approach is based on the loose definition of the co-integration that if we obtained order of integration including I(0), and I(1), this approach is feasible but the basic assumption of this methodology states that none of the variable have order of integration more than one (Ouattara. 2004). The ARDL methodology to co-integration enables us to find out the

long term and short term impacts of the variables at a time. The use of ARDL approach facilitate us without showing the explanatory variables that contains integration order I(0), or I(1) or both, in contrast to the other approaches notably the Engle-Granger and Johansen methodology that concerns with the long term association among the stated variables whose order of integration is purely I(1).

This approach to co-integration has made progress over the time and preferred over the other approaches because it is more efficient in controlling the dynamic causes of bias and small samples. Pesaran and Shin (1999) and Haug (2002) assessed that the OLS estimators in UECM are consistent in short run and small samples size. Long-run parameters are super consistent. Moreover, the ARDL approach to co-integration also helps to control or avoid the problem of the endogeneity [(Pesaran, M. H., & Shin, Y. 1998); (Ghatak, S., & Siddiki, J. U. 2001; (Narayan, P. K. 2004): (Narayan, P. K. 2005)]. As this study finds that urbanization is stationary at level but financial development, industrialization, and energy consumption are stationery at the first difference so this study employs ARDL approach to estimate the energy consumption model.

Therefore, the unrestricted error correction model in ARDL methodology is documented as:

$$\Delta ENRG_t = \beta_1 + \beta_2 ENRG_{t-1} + \beta_3 FD_{t-1} + \beta_4 IND_{t-1} + \beta_5 URB_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta ENRG_{t-i} + \sum_{j=0}^{q} \beta_7 \Delta FD_{t-j} + \sum_{k=0}^{r} \beta_8 \Delta IND_{t-k} + \sum_{l=0}^{s} \beta_9 \Delta URB_{t-l} + \mu_t \quad \text{---------- (4)}$$

Where ENRG, FD, IND and URB are energy consumption, financial development, industrialization and urbanization respectively. β_2 , β_3 , β_4 and β_5 are long-run coefficients and μ_t is white noise error term and p, q, r, s are lag lengths. SBC (Schawarz Bayesian Criterion) is exercised to choose the lags in the ARDL model. We use the ARDL approach of checking co-

integration to observe the long-run equilibrium relationship among variables. For this purpose we test the null of no co-integration ($H_0 : \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$) against the alternative using the F-test with critical values, developed by Pesaran et al. (2001). There are multiple merits of using this approach as it can be applied irrespective of the order of integration of the various series, while the other widely used techniques require unique order of integration of series i.e. either the I(0) or I(1). Furthermore, if we transform the ARDL bound testing with simple linear transformation we will left with a Dynamic unrestricted error correction model.

The coefficient of lagged level variables whether they are significant or not can be checked by this approach that use F-test for joint significance. This analysis for long-run co-integration can proceeds by using two critical bounds namely upper bound and lower bound, where the upper is applied when the series is I(1) and lower is applied when series is I(0). If the value of lower bound is greater than F-stat then we do not reject the null hypothesis about no co-integration and if F-stat exceeds the upper bound value then we reject our null hypothesis and conclude that series is stationary. Moreover, if the two bounds contain the value of F-statistic then no decision will be made, and various diagnostic tests are used to check the robustness of the ARDL model by observing the normality of error term, heteroskedasticity, functional form and presence of serial correlation. The results of this study express that there exists long term relationship among ENRG, FD, IND and URB as null hypothesis of no co-integration is rejected and alternative hypothesis of co-integration accepted. The value of F-statistics 8.08 exceeds the upper bound critical value of 3.87 which is shown in Table 3.

Table 3: Bounds Co-integration Test:

Test	F-Statistics
F-Test	8.08***

Note: Lower critical bounds value is 2.88 and Upper critical bounds value is 3.87obtained from Pesaran (2001).
*** significant at 1% level, ** significant at 5% level * significant at 10% level

Chapter No.4

EMPIRICS: ESTIMATION, RESULTS AND DISCUSSION

4.1) Introduction:

The present study uses ARDL estimation technique to assess the association among industrialization, energy consumption, urbanization and financial development in Pakistan. This chapter is structured as follows: summary statistics of the data are presented in section 4.2. Estimation, results and discussion of the short term and long term analyses are elaborated in sections 4.3.1 and 4.3.2, respectively. Lastly, diagnostic and misspecification tests of residual analysis for models validation are reported in section 4.4.

4.2) Summary Statistics:

Table 4 provides descriptive statistics of the variables used in the study.

Table 4: Descriptive Statistics

Variables	Mean	Maximum	Minimum	Std. Dev.
ENRG (Energy use in kilogram of oil per capita).	394.58	509.60	279.72	72.45
FD (domestic credit to private sector as percentage of gross domestic product).	24.19	29.78	16.03	3.18
IND (industrial value added as a percentage of gross domestic product).	23.27	27.10	20.19	1.56
URB (Urban population as a percentage of total population).	31.34	37.86	25.35	3.50

These results indicate that on average, energy consumption in Pakistan hovered around 394 kg of oil equivalent per capita approximately, during 1972-2013. Minimum per capita energy consumption 279.72 was in 1972 while maximum energy consumption is seen in 2007. Financial development, urbanization have high variation than industrialization with the average of 24.19 percent of GDP, 31.34 urban population percentage of total population, 23.27 industry value added percentage of GDP while their respective standard deviation are3.18, 3.50 and1.56. Minimum and maximum values of financial development, urbanization and industrialization are recorded as 16.03 percent and 29.78 percent, urbanization have 25.35 percent and 31.34 percent while industrialization is documented as 20.19 percent and 27.10 percent respectively. Explanation of descriptive statistics as per decade is given in the table 5.

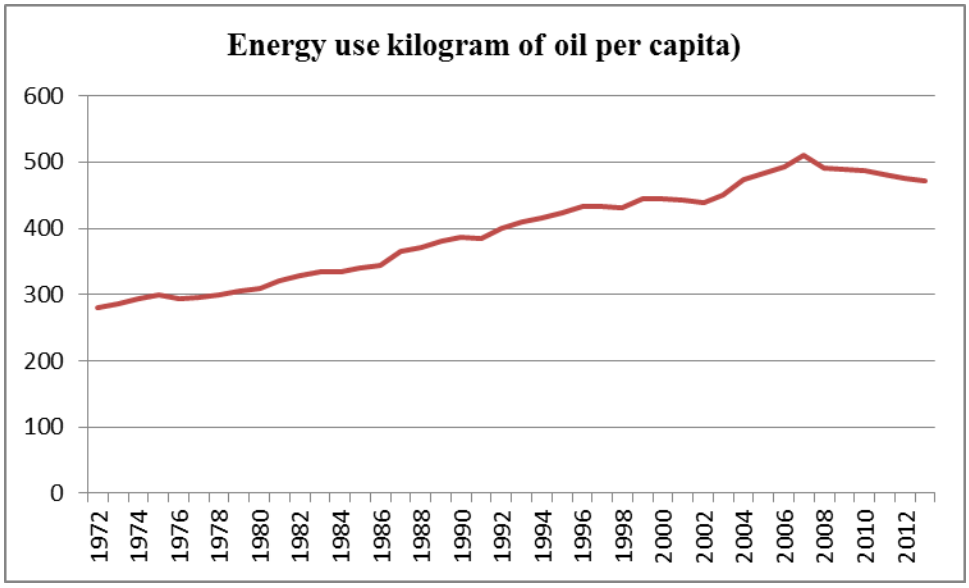
Table 5: Descriptive Statistics as per Decade:

Variable	1972-79	1980-89	1990-99	2000-09	2009-13	1972-13
ENRG	293.93	342.86	415.80	471.86	478.96	394.58
FD	23.47	25.92	24.27	25.39	18.12	24.19
IND	22.80	23.26	24.36	23.38	21.23	23.27
URB	26.51	29.21	31.71	34.60	37.22	31.34

The table shows decadal analysis of the variable over the time, which depict that energy consumption have an increasing trend over the time and for period from 1972-2013 it stands on average at 394.5868 kg of oil equivalent per capita. The analysis of financial development reveals that for the first four decades it had a mix trend that is very small changes were occurred while in the last decade it faces a sharp decline and the domestic credit to private sector percentage of GDP was recorded on average 24% approximately over the time. Industry value

added as a percentage of GDP also has a mixed trend and on average stands over the time hovered around 23%. The process of urbanization is very rapid up to the time and for the time period used in the study it has a clear increasing trend over the four decades while overall proportion of urban population to total population was recorded at 31% approximately. Graphical explanation of descriptive statistics is given as:

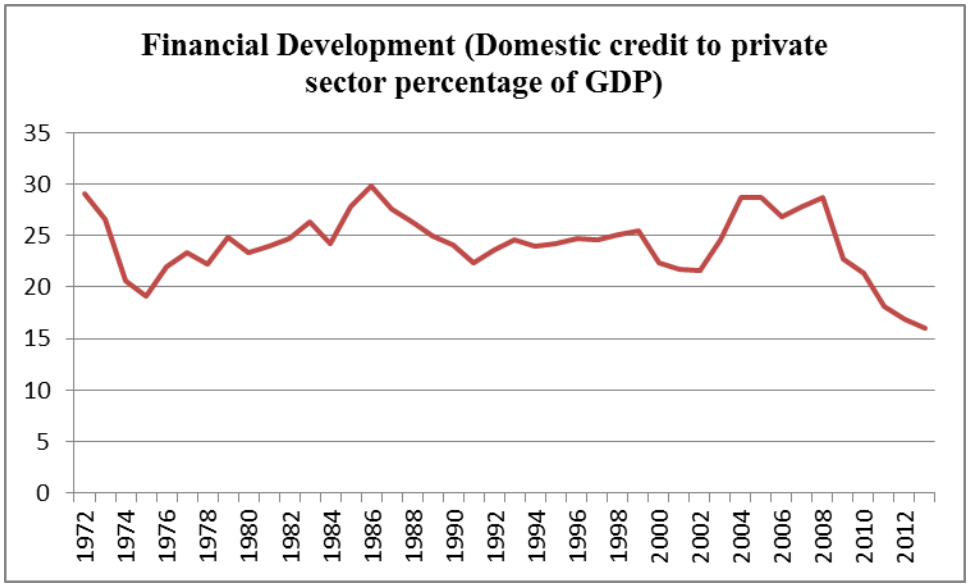
Figure 1: Energy use (ENRG):



The graphical analysis of the key variables at level[2] also leads to the same conclusion, and the above graph of energy use kilogram of oil per capita used as a proxy of energy consumption depicts that there is increasing trend in energy consumption in the country over the time.

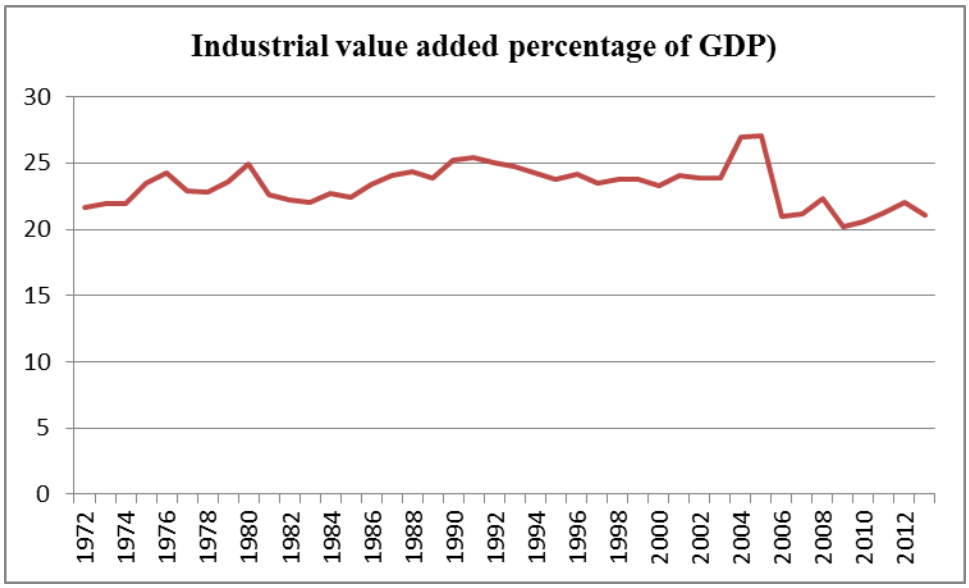
[2] Data in level form.

Figure 2: Financial Development (FD):



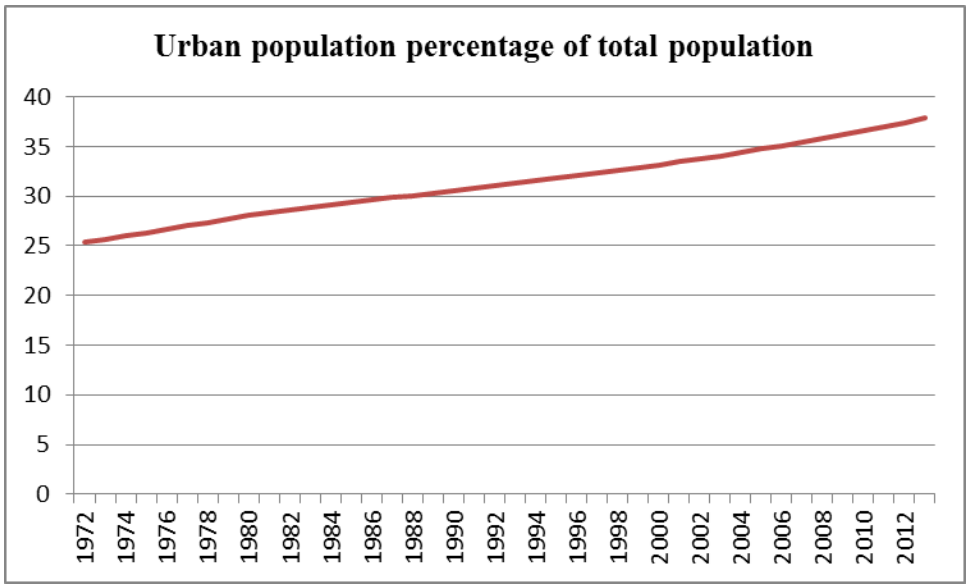
The figure reflects that there is no clear trend of financial liberalization in the country in financial sector, and there are many fluctuations in the growth of financial sector over the time. The last few years have declining trend which may lead to cause decline in the energy consumption in the country due to political instability started in 2007.

Figure 3: Industrialization (IND):



The growth of Industrial sector is somewhat constant over the time and this fact is further stimulated by observing the industrial share in the GDP which remains constant about 20% to 25%, and the figure also reflects the same fact.

Figure 4: Urbanization (URB):



The graph of urbanization shows that there is rising trend in the growth of urban population ratio to total population, and this is the major source that led to raise energy consumption in the economy.

4.3) Estimation Results:

The estimation results of the present study are comparable with the existing literature. Model estimation is done by using 'ARDL' estimating technique. Equations with dependent variables 'Energy Consumption' (ENRG) are estimated with three different independent variables that include financial development (FD), industrialization (IND), and urbanization (URB).

4.3.1) Error-Correction Model (ECM) Results:

This section elaborates short term dynamics of the energy consumption model. Results of short-run dynamics of energy consumption are documented in table 6.

Table 6: Short-Run Results of Energy Consumption Model:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.87E-07	0.0135	4.35E-05	1.0010
D(LENRG(-1))	-0.192	0.136	-1.413	0.1672
D(LFD)	0.007	0.025	0.308	0.7595
D(LFD(-1))	-0.066	0.030	-2.201**	0.0350
D(LIND)	0.130	0.048	2.678***	0.0116
D(LIND(-1))	-0.179	0.044	-4.015***	0.0003
D(LURB)	0.469	1.312	0.357	0.7230
ECM(-1)	-0.299	0.050	-5.974***	0.0000
R-squared	0.5931			
Durbin-Watson stat	1.9430			
Prob(F-statistic)	0.0000			

Note: *, ** and *** denotes significance at 10%, 5% and 1% respectively.

The dynamics of short-run are examined by obtaining the results from ECM approach. According to the theory of the ECM, the sign of the coefficient of the ECM lagged term should be negative and highly significant. This term ECM_{t-1} depicts how fast the series converges to its long term equilibrium path and also about the speed of the adjustment process. Banerjee *et al*. (1998) showed that the coefficient of the lagged ECM term with high significance lead to confirm the presence of long term equilibrium association in the variables. The present analysis of the variables with the help of ECM shows that the speed of adjustment coefficient is -0.2998 along the dynamic path, which indicates significant at 1% level. The coefficient of ECM_{t-1} term with negative sign is clear cut indication that if the series deviates from the equilibrium path, it will quickly converges to its equilibrium path with the adjustment speed of 0.2998, which depicts that the discrepancy of preceding period in equilibrium path is corrected with an adjustment speed of 29.98 percent per year.

4.3.2) Long-run dynamics:

The results of the long term association among ENRG, FD, IND and URB in the case of Pakistan are given in Table 7.

Table 7: Long-Run Results of Energy Consumption Model:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.538	0.126	-3.645***	0.001
LENRG	0.299	0.080	3.721***	0.0008
LFD	0.330	0.029	3.307***	0.0025
LIND	0.964	0.068	4.250***	0.0002

Table 7—(*Continued*)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LURB	1.584	0.142	3.339***	0.0023
R-squared	0.593			
Durbin-Watson stat	1.943			
Prob(F-statistic)	0.001			

Note: *, ** and *** denotes significance at 10%, 5% and 1% respectively.

It can be clearly viewed from table 6 that urbanization, industrialization and financial development have significant positive impact on energy consumption. Our findings are consistent with Saitoh, T. S. *et al.* (1996), Sun, J. (1998), Lean, H. H. (2012) and Al-Mulali*et al*. (2012). Long-run coefficient sign of financial development indicates that it has significant positive impact on energy consumption. The reason is that financial development makes the availability of credit for investment in projects. Higher financial development indicates the developed financial sector and equity markets which aid investment. Sadorsky, P. (2010) analyze the financial sector by linking with investment activities and economic development. The author finds that financial markets enables the investors to get high returns from projects that also attracts foreign direct investment by enhancing investors' confidence. The second is the efficiency effect coming from financial development which raises funds, assets and liquidity for appropriate ventures. Therefore, the impact of FD on ENRG is positive (Shahbaz, M., *et al.* 2012). The study argues that the estimates of energy demand that do not include the impact of FD as an explanatory variable will lead to give under-estimated energy demand.

The sign of industrialization coefficient shows significant positive impact on ENRG. The plausible explanation of significant positive coefficient sign is that industrialization stimulates economic activities which raise demand for energy. Similarly, these economic activities have positive impact on energy consumption by increasing industrial share in GDP. Therefore industrial growth causes high demand for upgraded machineries and new technologies gets more energy to operate, leading to increase in ENRG. (Aqeel, A., *et al.*2001; Morimoto, R., *et al.* 2004; Odhiambo, N. M. 2009).

The sign of the coefficient of urbanization from Table 5 also indicates significant positive impact on ENRG. The plausible explanation of positive coefficient sign is that urbanization is also a determinant of economic growth because more people living in urban areas stimulate economic and housing activities which trigger many structural changes in the economy. Shahbaz and Lean (2013) assert that energy usage increases due to high demand of household appliances caused by rising urban population, so it is inferred out that energy consumption accelerated in Pakistan due to urbanization and it has direct and significant impact on energy consumption. Therefore, it raises the demand for consumer goods such as televisions, refrigerators, and auto-mobiles etc. Thus it contains important implications to the energy consumption. (Mishra, V. *et al* 2009).

4.4) Diagnostic Tests:

The ARDL estimation technique is based on the assumption that disturbance is uncorrelated, and furthermore, model is correctly specified, and parameters are structurally stable. To identify any misspecifications in our estimated model due to presence of serial correlation, we have employed Breusch-Godfrey serial correlation LM Test. Model specification

and structural stability of parameters are checked by employing Ramsey and CUSUMSQ tests. Results of Breusch-Godfrey serial correlation LM Test and Ramsey test are reported in Table 8.

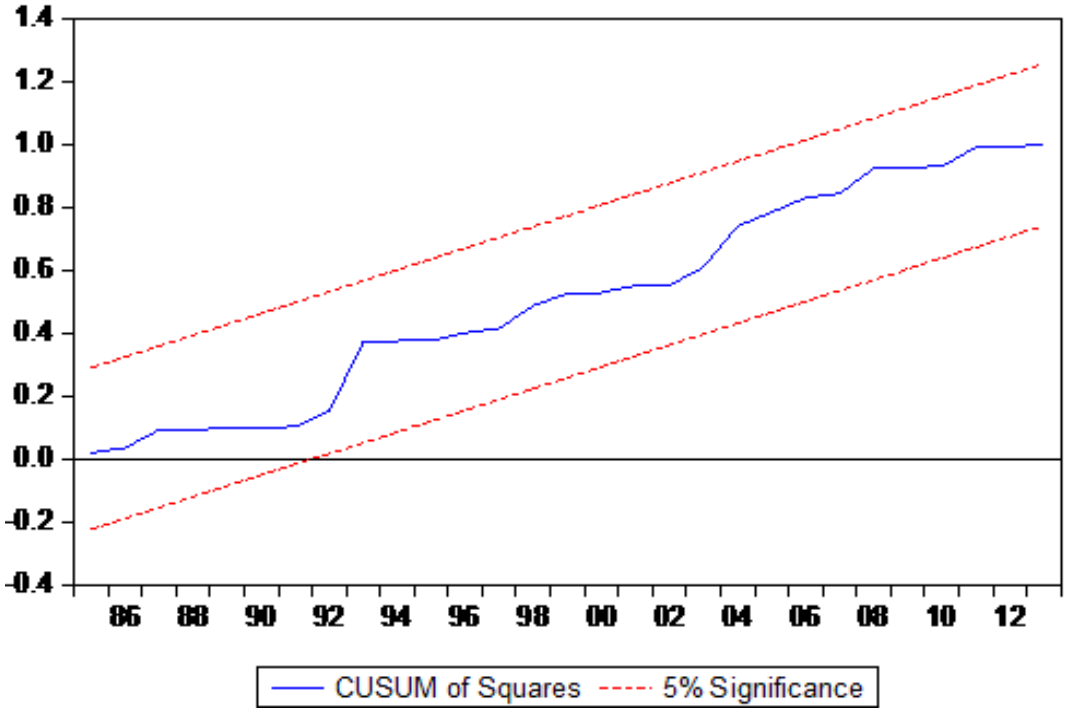
Table 8: Results-diagnostic Tests of Energy Consumption Model

Test	Test Statistic	Prob.	Critical value
Serial Correlation LM Test	0.120	0.887	3.84
Ramsey Reset Test	0.114	0.909	3.84

In the light of above results, it is stated that there is no serial correlation present in the data and model is independent from misspecification.

The graphical representation of the CUSUMSQ test is given in the Figure 5 below. As the results of the CUMSUMQ suggest, Figure 5 also show that results are within the bounds.

Figure 5: Cumulative Sum of Square Residuals of Energy Consumption Model (CUSUMSQ):



The results of diagnostic tests indicate that model has no auto-correlation and the parameters of the model are stable. Moreover, the graph of CUSUMSQ test also confirms that structural parameters are stable as the recursive residuals lie within the two critical lines.

Chapter No. 5

SUMMARY AND CONCLUSION

This study uses time series data to determine the short term and long term association among ENRG, FD, IND and URB for the period of 1972-2013 for Pakistan. The ARDL estimation technique is employed. Breusch-Godfrey Serial Correlation LM Test is applied to check the residual autocorrelation for the validity of the model (Carkovic and Levine 2005). The major conclusions are reported below.

The present study finds that FD, IND and URB have significant positive impact on ENRG in the long term. In addition, this study also estimates the coefficient of the speed of adjustment that indicates how quickly the equilibrium can be achieved.

The rest of this chapter continues to summarize the major findings that are documented in section 5.1. Some policy implications are given in section 5.2. Lastly, future research directions of the study are elaborated in section 5.3 of this chapter.

5.1) Conclusion:

Energy consumption possesses a vast strand of the literature but composition of hypothesis stands with significant importance as it is concerned with a country's probability of increasing demand of energy. The present study empirically estimates the long term association among the FD, IND, URB and ENRG by using ARDL approach. In addition, short-run association is also examined through error correction mechanism. The result of this study are supported by the views of Saitoh, T. S. *et al* (1996), Sun, J. (1998), Lean, H. H. (2012) and Al-Mulali, U. *et al*. (2012). Empirical findings of this study confirm the financial development,

industrialization and urbanization have significant positive impact on ENRG, highlighting the importance for the development of the domestic energy resources that require fulfilling the growing demand for the energy. Empirical findings also confirm that co-integration exists among the ENRG, FD, IND, and URB variables. It is also evident that these variables increase the ENRG in Pakistan, especially in the long term.

Literature suggests that financial development may have positive or negative impact on energy consumption. In the context of this study, findings of the coefficient sign of financial development show that it has significant positive impact on energy consumption in line with Sadorsky, P. (2010) and Shahbaz, M., & Lean, H. H. (2012). It is also supported by the literature which suggests that higher financial development spurs the financial sector that raises the investment activities and economic development. Therefore, it raises the energy consumption.

The Coefficient of industrialization exhibits significant positive impact on ENRG. Aqeel, *et al.* (2001) describe that industrialization grows the economic development thus, share of industrialization to GDP increases that will raise demand for energy in the country. Urbanization's coefficient also highlight as a main determinant of the economic growth. Mishra, V. *et al.* (2009) state that urbanization develops the economic activities therefore, energy consumption increases.

The findings of the study indicate significant positive short-run and long-run relation among all the variables. It emphasized the need to take steps for renewable and alternative energy resources in the long-run which will help to fulfill the shortage of energy in Pakistan.

This study contributes to the literature by analyzing the FD, IND, URB and ENRG linkages for Pakistan. It is an important study as it has more scope for policy intervention.

5.2) Policy Implications:

The present study finds that co-integration present among the variables therefore it emphasis the needs to take these measures that can fulfill the growing demand for energy. Finding of the significant positive coefficient sign of FD suggests that government should implement monetary policy tools and incentive policies that will stimulate the economic activities. Hence it will raise the economic activities and ENRG. Therefore, government and policy makers emphasize the need to invest in these financial institutions that encourage energy sectors to fulfill the demand for energy.

Significant positive coefficient sign of industrialization underlines the importance of industrial sector. As share of industrial sector is larger than agriculture sector in Pakistan, so government and policy makers should provide the environment that will encourage the investors to invest in small and heavy industries because the wave of IND will raise economic activities and raise the ENRG. Therefore, steps should be taken to explore the new sources of energy that can fulfill the growing demand for energy.

Findings of the coefficient of urbanization suggest that government and policy makers should emphasize on the projects or proposals which provides more facilitates in the rural areas that may control rapid urbanization and conserve the energy as well.

5.3) Future Research Directions:

By keeping in mind this background, future research should be done to have a deep look on the energy consumption issue at the country level using micro data analysis such as house hold level, industrial level regarding seasonal variations because this will help to investigate the determinants for the demand of energy, as it can describe a more elegant picture. It can also be

investigated empirically to determine the causality among these variables that can support the government and policy makers to do energy conservation policies in the line of Lean, H. H. et al. (2012).

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