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ABSTRACT
This study is an attempt to revisit the causal relationship between coal consumption and economic growth in case of Pakistan. The present study covers the period of 1974-2010. The direction of causality between the variable is investigated by applying the VECM Granger causality approach. Our findings have exposed that there exists bidirectional Granger causality between economic growth and coal consumption. The Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ) diagrams have not found any structural instability over the period of 1974-2010.
Keywords: Pakistan; Economic Growth, Coal Consumption

1. INTRODUCTION

Energy sector is in hot debates now a days; wherever we go, we hear about the significance and importance of energy. The growth literature reveals that economic growth may be improved by the efficient and optimal use of energy resources. It improves the efficiency of the inputs; therefore, the returns to both investors and factors of production increase which improve their living standards. The energy infrastructure has not been focused by the authorities in Pakistan; therefore, it is into its dismal form now days. Moreover, it is not managed appropriately for the both current and future needs. This has inculcated severe circumstances for the whole nation. The entire nation is suffering from the energy shortfall from the past many years and this is due to the negligence of government authorities. During the previous decade; economic growth was quite acceptable and it had increased the demand for energy products especially demand for electricity consumption. Unfortunately, we have not seen any deliberate attempt of the authorities to install new capacity in order to generate energy to meet both present and future demands. Consequently, the gulf between demand for energy and supply of energy is increasing. This has evolved a very serious energy crisis in Pakistan. This crisis is spreading like a cancer and cutting the roots of the industry in Pakistan.

On ground, more than 50% units (both small and large) shut their business during summer season because of energy shortfall. Looking at the last 25 years; we have observed that the new capacity of generation of energy has increased around 40 times but yet it is less than that of increase in demand for energy. Over the period of time, economic activities have improved which have ultimately enhanced per capita energy consumption. There are various factors which have given an upward trend to the demand for energy. Increase in per capita income; agriculture and service sectors growth, industrialization, urbanization, and rural electrification are among some of the prime factors which have contributed to demand for energy in Pakistan. The existing literature demonstrates many instruments or proxies for energy; and electricity consumption is more frequently used proxy for energy. In this paper, we have tried to explore an alternative proxy for energy. The prime focus of this paper is to reveal the attention of the authorities towards some of the alternative sources of energy production than that of oil. As the cost of energy production through oil is much higher compared to the cost of energy production via coal.

In the olden ages, coal was used as principal source of energy for hundreds of years. Even till 1960s, among the fundamental sources of energy, coal was the single largest energy source. Coal consumption contributed to industrial revolution and use of electricity was increased because of coal consumption. With the passage of time, oil and gas were discovered at large scale. These discoveries of oil and gas had opened up the doors for energy production via oil and gas sources. Therefore, switchover from coal to oil and gas for energy production started taking place at huge scale. At present, cost of energy production with oil is far higher as compared to the cost of energy production with coal. Therefore, at present, this switchover from oil to coal will decrease the cost of production and fiscal deficit in Pakistan. Moreover, many developed and developing countries have already reverted back to coal.

Coal is the most abundant, economical and affordable resource of energy supplies across the world. The world coal resources are larger than that of the world resources of oil and gas. The world coal resources will end up in about 147 years; whereas the world resources of gas and oil will end up in about 63 years and 41 years respectively. This reveals that the demand for coal resource will increase in the coming days (Wolde-Rufael, 2010). The world coal consumption was 127.5 quadrillion Btu in the year 2006 which will increase to 190.2 quadrillion Btu in the year 2030. It is also observed that out of the total production of coal: 4 percent is consumed by the households and commercial sectors; industrial users consume 34 percent coal, and remaining 62 percent is consumed by the electricity producing units respectively. Moreover; the world consumption of coal will increase to 28 percent in year 2030 (Energy Information Administration, 2009). Pakistan is among medium human developed countries (Human Development Report, 2013). Pakistan has blessed with rich coal resources at Tharparker; mountains of precious metals at Balochistan, Gawader Port. Dr. Samar Mubarak (December 27th, 2010) disclosed that the coal reserves at Tharparker have been 175-185 trillion tones. It can produce 50,000MW of electricity for decades and 100 million barrels of oil for 500 years[1]. Therefore, by using all such resources, the cost of production may come down, and it will ultimately contribute to more economic growth. Therefore; in the light above discussion, we

[1] Also, Reko Diq, is a small town in Chaghi; Balochistan, Pakistan. It has 5th largest gold mine. This town is famous for its vast gold and copper reserves.

have come to the point that coal consumption is the most significant and economical energy source for Pakistan, and we have found little literature on the relationship between coal consumption and economic growth in case of Pakistan. So; this article is an attempt to investigate the relationship between coal consumption and economic growth in Pakistan. Moreover; the earlier studies in addition to coal consumption considered labor force and capital formation as additional determinants of domestic production. This study is unique in terms of its model specification by incorporating unemployment, urbanization, service sector value added, and fiscal deficit along with coal consumption as the factors of domestic production in Pakistan.

2. LITERATURE REVIEW

There are few studies available in existing investigating the relationship between coal consumption and economic growth. For example, Chandran and Tang, (2013) apply CO_2 emissions function by incorporating coal consumption to investigate the relationship between CO_2 emissions, economic growth and coal consumption in India. They find cointegration between the variables. Their causality analysis reveals that coal consumption is Granger cause of economic growth. Bloch et al. (2012) investigate the causal relationship between economic growth and coal consumption by applying vector error correction models and innovative accounting technique for a case of China using demand and supply side functions over the period of 1965 – 2008 and 1997 – 2008 respectively. Their empirical findings expose that coal consumption causes aggregate output. The demand side analysis reveals the bidirectional causality between aggregate output and coal consumption. Nasiru (2012) examines the relationship between coal consumption and economic growth for Nigeria over the period 1980-2010 by using a two-step residual-based approach to cointegration and Granger causality test. The empirical findings confirm the presence of cointegration between coal consumption and economic growth. The causality analysis reports that coal consumption is Granger cause of economic growth. Li and Leung (2012) probe the causality between real GDP and coal consumption for 31 provinces of China over the period of 1985–2008. They have applied panel unit root test and panel cointegration approach for stationary properties and long run relationship between the variables. Their empirical findings have disclosed that there exists long run relationship between economic growth and coal consumption and feedback effect is also found

between both variables in the central and coastal regions but real GDP Granger causes coal consumption in the Western region. Jinke and Li (2011) investigate the relationship between economic growth and coal consumption for India and China. They have used Granger causality test based on error correction mechanism. They find that coal consumption Granger causes economic growth in India but unidirectional causality running from economic growth to coal consumption is found in case of China. Behname (2011) examines the causal relationship between coal consumption and economic growth for long-run in case of Greater Middle East zone. Their empirical evidence reveals the neutral effect between coal consumption and economic growth.

Kumar and Shahbaz (2012) reinvestigate the causal relationship between economic growth and coal consumption in case of Pakistan. They have used endogenous two-break unit root test in order to test unit root problem and the ARDL bounds testing approach to examine long term relationship between the variables. They have also applied dynamic and fully modified ordinary least square in order to compare the robustness of the estimates and the VECM Granger causality is used to test the direction of causality over the period of 1971–2009. Their empirical evidence has confirmed the presence of long run relationship among the variables. They have also noted that coal consumption, capital and labor are contributing factors to economic growth. The feedback effect is found between coal consumption and economic growth and same inference is validated by Shahbaz and Dube, (2012). Shahbaz et al. (2012) probed the relationship between energy (renewable and non-renewable) consumption and economic growth by applying the bounds testing approach to cointegration. The direction of causal relationship between the variable is investigated by applying the VECM Granger causality framework. They found that renewable and non-renewable energy consumption boost economic growth while the feedback effect is found between renewable energy consumption and economic growth and same is true for non-renewable energy consumption and economic growth.

Wolde-Rufael, (2010) reassesses the link between coal consumption and real gross domestic product by incorporating capital and labor as additional determinants of economic growth and coal consumption over the period of 1965–2005. The causality analysis reveals that coal

consumption Granger causes economic growth in India and Japan but coal consumption is Granger cause of economic growth in China and South Korea. The author has also reported the feedback effect between both variables in case of South Africa and the United States. Jinke et al. (2009) explore the causality relationship between both variables in case of developing economies. They find that coal consumption has the neutral impact on economic growth. Zahid, (2008) investigates the relationship between energy consumption and economic growth in Pakistan, India, Sri Lanka, Bangladesh and Nepal and reports the neutral effect between coal consumption and economic growth in Pakistan[2]. Alam and Butt, (2002) investigate the relationship between energy consumption and economic growth by applying production in case of Pakistan. They note that the variables are cointegrated for long run relationship and causality analysis reported that energy consumption and economic growth are interdependent. But, Aqeel and Butt (2001) report that economic growth Granger causes total energy consumption.

3. DATA SOURCE AND METHODOLOGICAL FRAMEWORK

3.1. Data Source

We have obtained the data of real per capita GDP, unemployment per capita, urban population per capita and real service sector value added per capita from world development indicators (CD-ROM, 2013). Pakistan economic survey of Pakistan (various issues) is combed to collect data for fiscal deficit per capita. The study covers the period of 1974–2010.

3.2. Methodological Framework

We have followed the log-linear specification to investigate the impact of coal consumption, unemployment, urbanization, fiscal deficit and services sector growth on economic growth in case Pakistan. The empirical equation is modeled as following:

$$lnY_i = \alpha_i + \alpha_{C_t} lnC_t + \alpha_{U_t} lnU_t + \alpha_{UB_t} lnUB_t + \alpha_{F_t} lnF_t + \alpha_{S_t} lnS_t + \mu_i \qquad (1)$$

[2] Khan et al. (2008) also reported that coal consumption does not Granger causes economic growth and same is true from opposite side.

Where, lnY_t is natural log of real GDP per capita, lnU_t is natural log of unemployment per capita, $lnUB_t$ is for natural log of urbanization per capita, lnF_t natural log of is real fiscal deficit per capita, lnS_t is natural log of real service value added per capita and μ_i is error term.

3.3. Estimation Technique

Estimation procedure comprises of four steps: in the initial step we will examine the random walk problem existing in a data series by using Ng – Perron, (2001) unit root test. This step will also update us about the order of integration of the data series. The equations from (2-3) will serve the purpose. These equations are presented as below:

$$\overline{MZ_a} = (T^{-1} y_T^d - \hat{\lambda}^2) \left[2T^{-2} \sum_{t=1}^{T} y_{t-1}^d \right]^{-1} \quad (2)$$

$$\overline{MSB} = \left[\frac{T^{-2} \sum_{t=1}^{T} y_{t-1}^d}{\hat{\lambda}^2} \right]^{1/2} \quad (3)$$

$$\overline{MZ_t} = \overline{MZ_a} x \overline{MSB} \quad (4)$$

As Ng – Perron test uses GLS de – trending method; therefore, it becomes more robust than that of the conventional unit root tests for instance: Dickey and Fuller, (1981) ADF test and Phillip Perron (1988) test. NG – Perron (2001) test discards the difficulty of distortions in the size of the disturbance term which has large and negative MA or AR roots.

We will explore the long term relationship among economic growth, coal consumption, unemployment, urbanization, fiscal deficit and service sector value added by applying the ARDL bounds testing approach developed by Pesaran et al. (2001). This approach is suitable for the small data set. We can apply it, if variables are having mixed order of integration. We are in favor of cointegration if our calculated F–statistics is greater than upper critical bound (UCB)

and vice versa. There is no decision about cointegration between the variables if our calculated F–statistic is lying between lower and upper critical bounds. The F-statistic is calculated using following version of unrestricted error correction method (UECM):

$$\Delta LEG_t = \alpha_{C_{11}} + \alpha_{11} LEG_{t-1} + \alpha_{12} LCC_{t-1} + \alpha_{13} LUN_{t-1} + \alpha_{14} LURB_{t-1} + \alpha_{15} LFD_{t-1} + \alpha_{16} LSER_{t-1} + \beta_{11} \sum_{i=1}^{p} \Delta LEG_{t-i} + \beta_{12} \sum_{i=0}^{p} \Delta LCC_{t-i} + \beta_{13} \sum_{i=0}^{p} \Delta LUN_{t-i} + \beta_{14} \sum_{i=0}^{p} \Delta LURB_{t-i} + \beta_{15} \sum_{i=0}^{p} \Delta LFD_{t-i} + \beta_{16} \sum_{i=0}^{p} \Delta LSER_{t-i} + \eta_t \quad (5)$$

where Δ is difference operator and η_t is error term. Moreover; if long term relationship among the variables exists then there should estimate the causal relationship between the variables as well (Morely, 2006). We apply the VECM Granger causality approach to examine the direction of causality between coal between coal consumption and economic growth in short run and in long run. We have developed the following equations (6-11) in order to test direction of causality using the VECM Granger causality framework as following:

$$\Delta LEG_t = \beta_{C_{11}} + \beta_{11} \sum_{i=1}^{p} \Delta LEG_{t-i} + \beta_{12} \sum_{i=0}^{p} \Delta LCC_{t-i} + \beta_{13} \sum_{i=0}^{p} \Delta LUN_{t-i} + \beta_{14} \sum_{i=0}^{p} \Delta LURB_{t-i} + \beta_{15} \sum_{i=0}^{p} \Delta LFD_{t-i} + \beta_{16} \sum_{i=0}^{p} \Delta LSER_{t-i} + \gamma_{11} ECM_{t-1} + \varepsilon_{11} \quad (6)$$

$$\Delta LCC_t = \beta_{C_{21}} + \beta_{11} \sum_{i=0}^{p} \Delta LEG_{t-i} + \beta_{12} \sum_{i=1}^{p} \Delta LCC_{t-i} + \beta_{13} \sum_{i=0}^{p} \Delta LUN_{t-i} + \beta_{14} \sum_{i=0}^{p} \Delta LURB_{t-i} + \beta_{15} \sum_{i=0}^{p} \Delta LFD_{t-i} + \beta_{16} \sum_{i=0}^{p} \Delta LSER_{t-i} + \gamma_{21} ECM_{t-1} + \varepsilon_{21} \quad (7)$$

$$\Delta LUN_t = \beta_{C_{31}} + \beta_{11} \sum_{i=0}^{p} \Delta LEG_{t-i} + \beta_{12} \sum_{i=0}^{p} \Delta LCC_{t-i} + \beta_{13} \sum_{i=1}^{p} \Delta LUN_{t-i} + \beta_{14} \sum_{i=0}^{p} \Delta LURB_{t-i} + \beta_{15} \sum_{i=0}^{p} \Delta LFD_{t-i} + \beta_{16} \sum_{i=0}^{p} \Delta LSER_{t-i} + \gamma_{31} ECM_{t-1} + \varepsilon_{31} \quad (8)$$

$$\Delta LURB_t = \beta_{C_{41}} + \beta_{11}\sum_{i=0}^{p}\Delta LEG_{t-i} + \beta_{12}\sum_{i=0}^{p}\Delta LCC_{t-i} + \beta_{13}\sum_{i=0}^{p}\Delta LUN_{t-i} + \beta_{14}\sum_{i=1}^{p}\Delta LURB_{t-i} + \beta_{15}\sum_{i=0}^{p}\Delta LFD_{t-i} + \beta_{16}\sum_{i=0}^{p}\Delta LSER_{t-i} + \gamma_{41}ECM_{t-1} + \varepsilon_{41} \quad (9)$$

$$\Delta LFD_t = \beta_{C_{51}} + \beta_{11}\sum_{i=0}^{p}\Delta LEG_{t-i} + \beta_{12}\sum_{i=0}^{p}\Delta LCC_{t-i} + \beta_{13}\sum_{i=0}^{p}\Delta LUN_{t-i} + \beta_{14}\sum_{i=0}^{p}\Delta LURB_{t-i} + \beta_{15}\sum_{i=1}^{p}\Delta LFD_{t-i} + \beta_{16}\sum_{i=0}^{p}\Delta LSER_{t-i} + \gamma_{51}ECM_{t-1} + \varepsilon_{51} \quad (10)$$

$$\Delta LSER_t = \beta_{C_{61}} + \beta_{11}\sum_{i=0}^{p}\Delta LEG_{t-i} + \beta_{12}\sum_{i=0}^{p}\Delta LCC_{t-i} + \beta_{13}\sum_{i=0}^{p}\Delta LUN_{t-i} + \beta_{14}\sum_{i=0}^{p}\Delta LURB_{t-i} + \beta_{15}\sum_{i=0}^{p}\Delta LFD_{t-i} + \beta_{16}\sum_{i=1}^{p}\Delta LSER_{t-i} + \gamma_{61}ECM_{t-1} + \varepsilon_{61} \quad (11)$$

where ECM_{t-1} is lagged error correction term. Moreover; Engle – Granger (1987) were of the view that the estimated results of Vector Auto Regression (VAR) at first difference are not efficient and reliable. Banerrjee et al. (1998) suggested to incorporate the lagged term of error correction term in the equation of the ARDL in order to improve the consistency of the results. The inverse and significant sign of lagged error term will reveal convergence from short term fluctuations to long term stable equilibrium. Finally; we will test the hypothesis that whether there prevails stable relationship among the variables or not? For this purpose we will use Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ) diagrams. These diagrams will update us about structural stability.

4. EMPIRICAL ESTIMATION AND INTERPRETATION OF THE RESULTS

We have not applied the ADF and PP unit root tests due to their low prediction power. These unit root tests are suitable long span data. The Ng-Perron unit root test is suitable for small data and provides consistent and efficient empirical results regarding integrating properties of the variables. The results of Ng-Perron unit root test are reported in Table-1. The results reveal that all the variables are non-stationary at level. The variables are stationary at first difference with intercept and trend i.e. economic growth, unemployment, coal consumption, urbanization, fiscal deficit and

services sector value added. The shows that all the series have unique order of integration and lead us to apply the ARDL bounds testing to examine long run relationship between the variables.

Table–1: Unit Root Analysis

Ng-Perron Test Statistics									
Dependent Variable	I (0)				Dependent Variable	I (1)			
	MZ_a	MZ_t	MSB	MPT		MZ_a	MZ_t	MSB	MPT
$lnEG_t$	-8.4889	-2.0575	0.2424	2.8964	$\Delta lnEG_t$	-18.1607*	-3.0007	0.1652	1.3948
$lnCC_t$	-2.9383	-1.1804	0.4017	8.2593	$\Delta lnCC_t$	-33.9147*	-4.1124	0.1213	0.7389
$lnUN_t$	-13.4539	-3.3951	0.1448	1.1430	$\Delta lnUN_t$	-30.6126*	-3.9047	0.1276	0.8237
$lnURB_t$	-5.4652	-1.6506	0.3020	4.4899	$\Delta lnURB_t$	-14.9787*	-2.7326	0.1824	1.6511
$lnFD_t$	-11.2800	-3.2572	0.1531	1.1678	$\Delta lnFD_t$	-40.5019*	-4.4251	0.1093	0.8099
$lnSER_t$	-10.2744	-2.1454	0.2088	2.8452	$\Delta lnSER_t$	-22.3515*	-3.1922	0.1428	1.5997
Note: * shows significance at 1% level of significance.									

Table–2: The ARDL Bounds Testing Analysis

Estimated Models			$LEG_t = f(LCC_t, LUN_t, LURB_t, LFD_t, LSER_t)$	
Optimal lags			(1,0,0,0,1,1)	
F – statistics			4.4752**	
W – statistics			26.8510**	
Significance Level	*Critical Bounds For F – Statistics*		*Critical Bounds For W – Statistics*	
	Lower Critical Bound	*Upper Critical Bound*	*Lower Critical Bound*	*Upper Critical Bound*
5 per cent	2.9819	4.3270	17.8914	25.9618
10 per cent	2.4864	3.7057	14.9182	22.2340
DIAGNOSTIC TESTS				
F – Statistics	1.9482*	*Serial Correlation*	0.6298 [0.427]	
		Functional Form	1.2368 [0.266]	
DW – Statistic	1.8860	*Normality*	1.4121 [0.494]	
		Heteroscedasticity	2.0726 [0.150]	
Note: ** and *** demonstrates significance level at 5% and 10% levels respectively. Also the value				

within [] represents probability.

Before, applying the ARDL bounds testing to examine cointegration between the variables, we have to select the appropriate lag length for the computation of F-statistic. The F-statistic varies at different lag orders (Shahbaz and Lean, 2012 a, b). Afterwards; we compute F-statistic to examine whether cointegration exists or not. The results reported in Table-2 reveal that our computed F-statistic is more that upper critical bound at 5% level once we treated coal consumption, unemployment, urbanization, fiscal deficit and service sector value added as forcing variables. This indicates the presence of cointegration among the variables. So we find that there is a long run relationship among economic growth, coal consumption, unemployment, urbanization, fiscal deficit and service sector value added. The diagnostic tests expose that there is no issues of serial correlation and heteroscedasticity, the error term of the model is normally distributed and the functional form of the model is correctly specified.

4.1. The VECM Granger Causality Analysis

After confirming long run relationship among the variables; we have tested the direction of causality by applying the VECM Granger causality test. It is recommended by Granger, (1969) that if variables are cointegrated then causality should be found at least from one direction and the VECM Granger causality is suitable approach to test the direction of causal relationship between the variables. Table-3 shows the results of the VECM Granger causality approach.

Table-3: The VECM Granger Causality Analysis

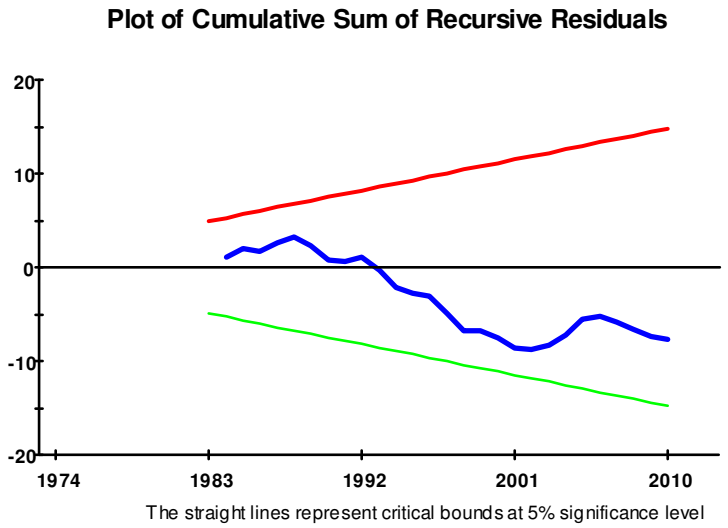
Direction of Granger Causality							
Dependent Variable	**Short Run**						**Long Run**
	$\Delta lnEG_t$	$\Delta lnCC_t$	$\Delta lnUN_t$	$\Delta lnURB_t$	$\Delta lnFD_t$	$\Delta lnSER_t$	ECM_{t-1}
	F – Statistics						
$\Delta lnEG_t$	–	8.7440***	2.7511*	2.0185	1.9268	5.0720**	-0.6569***
$\Delta lnCC_t$	2.9403*	–	0.1289	3.1336*	2.5017	6.4987***	-1.0919***
$\Delta lnUN_t$	0.5067	0.1904	–	1.4230	1.6609	0.4976	-1.1983***

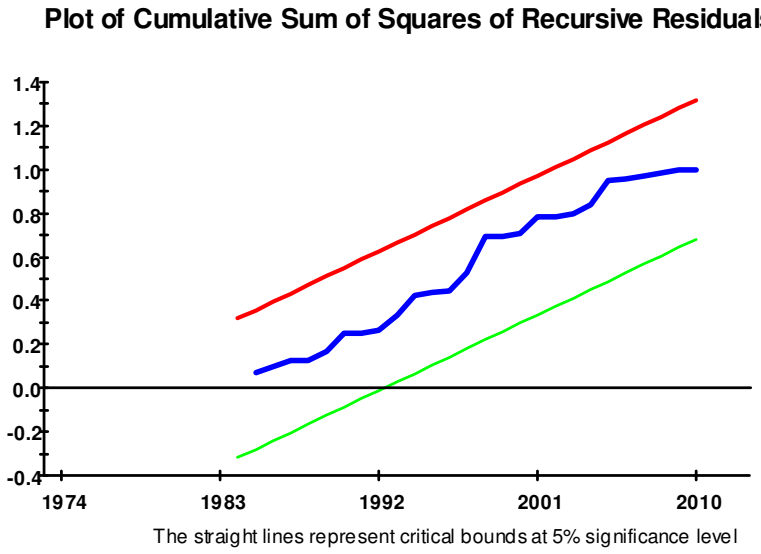
$\Delta lnURB_t$	0.6809	1.3365	0.9774	–	3.5927**	5.1587 **	-0.1498
$\Delta lnFD_t$	1.8451	0.3072	0.8619	2.5440*	–	3.4045**	-0.8181***
$\Delta lnSER_t$	5.5791**	2.7588*	1.1573	2.7536*	5.0611**	–	-0.8552***
Note: *, ** and *** demonstrates significance level at 10%; 5% and 1% respectively.							

The empirical findings of Table–3 reveal that in long run, we have found that the bidirectional causal relationship exists between coal consumption and economic growth. We have further found bidirectional causal relationship between service sector value added and economic growth and same is true for service sector value added and coal consumption. The feedback effect has also found between service sector value added and fiscal deficit and same is true between unemployment and services sector. Besides this; the results has disclosed that unemployment Granger causes coal consumption and coal consumption Granger causes unemployment. Afterwards; the findings also unveil that there exists bidirectional causality between unemployment and economic growth and, same is true for unemployment and fiscal deficit. There is also bidirectional causality between fiscal deficit and economic growth and same is true between fiscal deficit and coal consumption. Moreover; urbanization Granger causes economic growth, coal consumption, unemployment, fiscal deficit and services sector but reverse is not found.

Furthermore; in short run, we find the feedback effect between economic growth and coal consumption. The findings also show that the relationship between services sector value added and economic growth is bidirectional and same is true for coal consumption and services sector value added. Urbanization Granger causes coal consumption, whereas, urbanization and fiscal deficit have bidirectional causal relationship and, same is true for urbanization and services sector value added. The findings reported in the Table–3 have exposed that unidirectional causality is found running from unemployment to economic growth. Moreover; the bidirectional causality has found between fiscal deficit and services sector value added. Finally; by using Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ) diagrams we have not found any structural instability over the time in the model.

Graphical Representation





5. CONCLUSION AND POLICY IMPLICATIONS

The present study reinvestigates the causal relationship between coal consumption and economic growth in addition with other determinants of economic growth and coal consumption in case of Pakistan. The Ng – Perron unit root test is applied to examine integrating properties of the variables. The ARDL bounds testing approach is used to investigate long run relationship among

economic growth, coal consumption, unemployment, urbanization, fiscal deficit and service sector. The direction of causality between economic growth and coal consumption is investigated by applying the VECM Granger causality over the period of 1974-2010. Our results show cointegration among economic growth, coal consumption, unemployment, urbanization, fiscal deficit and service sector value added. The estimated results reveal that there exists bidirectional causal relationship between coal consumption and economic growth and, service sector value added and economic growth both in short run and in long run and, same is true for service sector value added and coal consumption, and service sector value added and fiscal deficit. Moreover, we have found bidirectional causal relationship between fiscal deficit and urbanization and, service sector value added and urbanization only in short run, but in long run, urbanization Granger causes fiscal deficit and same is true from urbanization to service sector value added. There exists bidirectional causality between unemployment and economic growth in long term, but in short term, unemployment Granger causes economic growth.

The empirical findings of this study reveal that there exists bidirectional causality between economic growth and coal consumption both in short run and in long run and on the basis this finding economic growth and coal consumption are complementary to each other. Therefore; this study proposes that government must reveal its attention towards the exploration of alternative and economical energy resources such as coal. Government must ensure entrepreneurs to increase coal supply in order to promote growth activities in the country and if economic growth starts taking place then it will further induce the exploration of an alternative and cheap energy resource in order to curtail cost of production. The reduction in cost of production will encourage business communities to reinvest their profits in order to speed up the process of capital formation to achieve t sustainable growth path in long run.

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REFERENCES

1. Alam, S., Butt, M. S., (2002). Causality between energy and economic growth in Pakistan: an application of cointegration and error-correction modeling techniques. Pacific and Asia Journal of Energy, 12, 151-165.
2. Aqeel, A., Butt, M. S., (2001). The relationship between energy consumption and economic growth in Pakistan. Asia-Pacific Development Journal, 8, 101-110.
3. Bannerjee, A., Dolado, J. and Mestre, R. (1998). Error-Correction Mechanism Tests for Co-integration in Single Equation Framework. *Time Series Analysis , 19* (3), 267-283.
4. Behname, M. (2011). Studying the Relationship between Coal Consumption and Economic Growth in the Greater Middle East. *Department of Economics of the University of Shiraz, Iran East.* Retreived From: http://ssrn.com/abstract=1867871.
5. Bloch, H., Rafiq, S., Salam, R. (2012). Coal Consumption, CO2 Emission and Economic Growth in China: Empirical Evidence and Policy Responses. *Energy Economics , 34*, 518-528.
6. Bowers, W., Pierce, G. (1975). The Illusion of Deterrence in Isaac Ehrlich's Work on the Deterrent Effect of Capital Punishment". *Yale Law Journal , 85 (2)*, 187-208.
7. Cameron, S. (1994). A Review of the Econometric Evidence on the Effects of Capital Punishment. *Journal of Socio-economics* , 197-214.
8. Chandran, V. G. R., Tang, C. F., (2013). The dynamic links between CO2 emissions, economic growth and coal consumption in China and India. Applied Energy, 104, 310-318.
9. Dickey, D. A., Fuller, W. A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica , 49* (4), 1057-1072.
10. Ehrlich, I. (1977). The Deterrent Effect of Capital Punishment Reply. *American Economic Review , 67*, 452-58.
11. Ehrlich, I. (1996). Crime, Punishment and the Market for Offences. *Journal of Economic Perspectives , 10*, 43-67.
12. Energy Information Administration. (2009). *Annual report 2008. U.S Department of Energy*.
13. Engle, R., Granger, C. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica*, 55(2), 251-276.

14. Farooq, M. U., Sabir, D. H., Tahir, S. H., Rasheed, M. K. (2013). Key Factors Affecting GDP in Pakistan Over the Period 1975-2011. *Journal of Economics and Sustainable Development, 4* (1), 142-149.
15. Fatima, G., Ahmed, A. M., Rehman, W. U. (2011). Fiscal Deficit and Economic Growth: An Analysis of Pakistan's Economy. *International Journal of Trade, Economics and Finance , 2* (6), 501-504.
16. Fatima, G., Ahmed, M., Rehman, W. U. (2012). Consequential Effects of Budget Deficit on Economic Growth of Pakistan. *International Journal of Business and Social Science , 3* (7), 203-208.
17. Hassan, M. S., Wajid, A., Ahmed, K. (2012). Urbanization as a Way to Open Economy: Empirical Evidence from Pakistan. *World Applied Sciences Journal , 20* (7), 931-940.
18. Hussin, F., Yik, S. Y. (2012). The Contribution of Economic Sectors to Economic Growth: The Cases of China and India. *Research in Applied Economics, 4* (4), 38-53.
19. Huynh, N. D. (2007). Budget Deficit and Economic Growth in Developing Countries: The case of Vietnam. *Kansai Institute for Social and Economic Research (KISER).*
20. Hye, M. A., Riaz, S. (2008). The Causality between Energy Consumption and Economic Growth: The case of Pakistan. *The Lahore Journal of Economics, 13*(2), 45–58.
21. Jaradat, M. A. (2013). Impact of inflation and unemployment on Jordanian GDP. *Interdisciplinary Journal of Contemporary Research in Business , 4* (10), 317-334.
22. Jinke, L., Feng-Hua, W., Hualing, S. (2009). Differences in Coal Consumption Pattern and Economic Growth Between Developed and Developing Countries. *Procedia Earth and Planetary Science , 1*, 1744-1750.
23. Jinke, L., Li, Z. (2011). A Causality Analysis of Coal Consumption and Economic Growth for China and India. *Natural Resources , 2*, 54-60.
24. Johansen, S., Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Co-integration - with Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.
25. Khan, A. A., Ahmed, U., Energy demand in Pakistan: a disaggregated analysis. The Pakistan Development Review, 4, 1-27.

26. Khan, M. A., Ahmed, U. (2009). Energy Demand in Pakistan: A Disaggregate Analysis. *Pakistan Development Review,* 4, 347–455.
27. Kumar, S., Shahbaz, M. (2012). Coal Consumption and Economic Growth Revisited: Structural Breaks, Cointegration and Causality tests for Pakistan. Energy Exploration & Expoliation, 30(3), 499-522.
28. Li, R., Leung, G. C. (2012). Coal Consumption and Economic Growth in China. *Energy Policy , 40*, 438-443.
29. Morley, B. (2006). Causality between Economic Growth and Migration: An ARDL Bounds Testing Approach. *Economics Letters, 90:* 72 – 76.
30. Nasiru, I. (2012). Coal Consumption and Economic Growth in Nigeria: A Two-Step Residual-Based Test Approach to Cointegration. *European Scientific Journal , 8* (9), 140-155.
31. Oladeji, S. I. (1994). Absorption of Educated Manpower into Nigeria's Informal Sector. *Diagnostic Studies Series 1, NMB, Lagos.*
32. Perron, P., Ng. S. (1996) "Useful Modifications to some Unit Root Tests with Dependent Errors and their Local Asymptotic Properties," *Review of Economic Studies,* 63, 435-463.
33. Pesaran, M. H., Richard, J., Shin, Y. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics , 16*, 289–326.
34. Rama, M. (1998). How Bad is Unemployment in Tunisia? Assessing Labour Market, Efficiency in a Developing Country. *Research Observer* 13(1), 59-78.
35. Ramzan, M., Saleem, S., Butt, I. M. (2013). Budget Deficit and Economic Growth: A Case Study of Pakistan. *Interdisciplinary Journal of Contemporary Research in Business, 5* (1), 911-926.
36. Shahbaz, M., Aviral, T., Nasir, M. (2013). The Effects of Financial Development, Economic Growth, Coal Consumption and Trade Openness on Environment Performance in South Africa. *Energy Policy, 61, 1452-1459.*
37. Shahbaz, M., Dube, S., (2012). Revisiting the Relationship between Coal Consumption and Economic Growth: Cointegration and Causality Analysis in Pakistan," Applied Econometrics and International Development, 12(1), 1-13.

38. Shahbaz, M., Lean, H. H., 2012a. Does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia. Energy Policy 40, 473-479.
39. Shahbaz, M., Lean, H. H., 2012b. The dynamics of electricity consumption and economic growth: A revisit study of their causality in Pakistan. Energy 39, 146-153.
40. Shahbaz, M., Zeshan, M., Afza, T., (2012). Is energy consumption effective to spur economic growth in Pakistan? new evidence from bounds test from level relationship and Granger causality tests. Economic Modelling, 29, 2310-2319.
41. Stephen, B. A. (2012). Stabilization policy, Unemployment Crises and Economic Growth in Nigeria. *Universal Journal of Management and Social Sciences, 2* (4), 55-63.
42. The 2013 Human Development Report – "The Rise of the South: Human Progress in a Diverse World. http://hdr.undp.org/en/reports/global/hdr2013/
43. Umo, J. U. (1996). Introductory Overview in J. U. Umoh (ed.) *Towards Full Employment Strategy in Nigeria,* National Manpower Board, Lagos.
44. Vandemoortele, J. (1991). Employment Issues in Sub-Saharan Africa, *AERC Special Paper No. 14*, August, AERC Nairobi
45. Velnampy, T., Achchuthan, S. (2013). Fiscal Deficit and Economic Growth: A Study on Sri Lankan Economic Perspective. *Developing Country Studies , 3* (3), 166-174.
46. Wolde-Rufael, Y. (2010). Coal Consumption and Economic Growth Revisited. *Applied Energy , 87*, 160-167.
47. World Bank (2013). World Development Indicators [CD Rom 2013]. *World Bank, Washington, D.C.*
48. Zahid, A., Energy-GDP relationship: a causal analysis for five countries of South Asia. Applied Econometrics and International Development, 1, 167-180.
49. Zaman, B. U., Farooq, M., and Ullah, S. (2011). Sectoral Oil Consumption and Economic Growth in Pakistan: An ECM Approach. *American Journal of Scientific and Industrial Research , 2* (2), 149-156.