

Role of Energy in Economic Growth of Pakistan (1972-2015)

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Abstract

This paper highlights the importance of energy in the determination of growth for economy of Pakistan. This study has been taken for the period of 1972-2015. Along with energy consumption some other important variables are also put into investigation. The Johansson co-integration estimation technique has been used to estimate the required impact. The results show that energy consumption contributed positively and significantly to long run economic growth. While the said impact is statistically significant in the short run, the study suggested on the basis of results that energy sources should be explored to boost which may possible to satisfy the energy need of the country and to get guaranteed economic growth in the long run. Therefore, Government should pay special attention toward the country's energy sector to stabilize the economy which assures prosperity in the country.

Key Words

Energy Consumption,
Economic Growth,
Johansen Co-Integration
and Pakistan.

Introduction

Increasing trends in the world population especially in developing countries create different challenges for governments and policy makers. To provide different facilities for the bulk of additional population added to the total population every year put pressure on natural resources (Afzal, 2007 and Ali et al 2013 and 2015). The basic needs' satisfaction of the contemporary world is directly and indirectly connected to the energy sector's inputs. Therefore, the energy sector's proper utilization and management may be one of the solutions to feed and secure the world's inhabitants. Energy has the ability to bring efficiencies in different sectors of the economy like the agricultural, industrial and services sectors Khan (2007) and Wahid et al. (2015).

Growth theorists of the 19th and 20th century have determined different determinants of economic growth but ignored the importance of energy in economic growth. Classical economists elucidated the importance of labor and capital while New-classical economists stressed on capital labor ration, technology and human capital for increasing production (Stern, 2004). The contemporary theoretical and empirical literature identifies different factors which affect economic growth in different economies, and energy is one the most important among it. Modern research suggests that economic development cannot be achieved without proper energy supply especially in developing countries (Wahid et al, 2015), and energy plays a considerably greater role in economic development in developing countries than other factors (IEA, 2005). However, the discovery and exploration of various energy deposits help in employment generation of a country and improve their economic conditions by fulfilling the requirements of the agricultural, industrial and services sectors. Availability of and accessibility to energy sources have great contribution in the determination of capital flow (inflow and outflow) like oil, electricity and chemicals etc., and make a significant contribution toward economic growth (Odaluru, 2009).

Shahbaz and Hooi (2011) estimated relationships between economic progress and electricity consumption in Pakistan. The results of the study showed that long-run relationships exists between economic progress and independent variables consisting of electricity consumption, capital and labor. Along with capital and labor also electricity consumption has positive effect on economic growth and their coefficients were statistically significant at 5 percent level of significance. Two ways causal relation were found between electricity utilization and economic growth. Further the study recommended that instead of energy preservation polices, government should inject more fund to energy sector and explore alternative resources of energy along with adoption of suitable

technology to enhance energy production to meet future demand of energy for persistent economic development. Odularu (2009) measured the link between economic performance of Nigeria and energy consumption. Crude oil, electricity and coal were taken as energy components. Co integration technique was applied and results derived that positive relationship exists between economic growth and energy consumption. All the three components of energy have positive effect on economic expansion, and negative relation existed between lagged value of energy consumption and economic expansion. The study recommended that more attention should be given to increase energy supply to promote economic growth. Pao (2009) showed the causality between electricity utilization and GDP. The study illustrated that real GDP and electricity consumption were co integrated. There was unidirectional causality from economic growth to electricity consumption in both short and long run as well, but not vice versa. Different models were used to forecast electricity consumption in Taiwan; amongst these methods the SARIMA model was best to forecast electricity consumption in short period. Alam (2006) in his work on 'economic growth with energy' attained energy is important factor of production, further energy impels the work that exchange raw materials into final goods in the production process and also enhance economic growth of a country. Sari and Soytoş (2004) have examined that how much variation occurs in GDP growth explained by change in energy consumption and employment level in Turkey. The 21% forecast variation of GDP will explain by total energy consumption and energy consumption has also positive effect on employment in Turkey. The study urged that the policy makers have taken keen interest to allocate handsome amount for investment in energy sector in budget. Riaz (1984) estimated that economic growth of Pakistan and energy consumption has significant relationship. This paper also developed the energy sector optimization model for the economy of Pakistan, which consists of different energy components, such as oil, electricity, gas, coal and non-commercial fuel. The model has used to forecast energy balances.

Attainment of sustainable development is not possible without the use of energy. For developing countries to get stability in growth domestic energy sector should be explored and developed properly. Pakistan is one of the developing countries which have been facing the problem of unmatched energy crisis since the decade of 1990s. The diversion in domestic energy demand and supply made worsen the situation. Such deficit can be covered through energy import, which raising the need for import of oil that put considerable burden on domestic country (Elizabeth, 2012).

Pakistan has experienced a consistent energy consumption mix. A consistent increase of about 4.5 per annum since 1990-1991 till 2012. The nature of energy mix changed regarding oil and gas share to total energy consumption. The consumption of oil in energy mix dropped from 48% to 32% during the period of 1997-2011 and further dropped to 29% in 2012. The other sources of energy increase as compare to oil while a moderate decrease was recorded in 2015. International Oil prices (energy inflation) have huge contribution in the determination domestic inflation rate. It considerably affects the standard of living by about 20% in oil importing economies (Thoresen, 1982). Such a shortfall in energy put pressure on balance of payment of the country. The shortfall in energy supply not only augmented import bills, but also badly affected other aspects of the economy i.e. output and employment balance of payment deterioration, exchange rate and living standard (Asif, 2011). Although, in some developing economies, oil prices have limited contribution in the inflation rate because crude oil prices are the main source of inflation determination (Alvarez et al., 2011). Pakistan experienced an indirect effect of Oil price and having a weak inflationary effect. However, energy inflation is consistent and exhibited a smooth rise. Though, the economy has been experienced rise in electricity prices over the years. But, a sudden rising in prices occur in the last few years.

In 1980s, 86 % of the total energy was satisfied from domestic resources and the remaining 14% was imported. This gap in export and import was get broaden to about 47% in 2000 (Stat Bank of Pakistan, 2006). This gap was further widened in the next few years, which have been severely affecting several segments of the economy. In 2009-10 consumption was recorded of about 63.1 MTOE (million ton oil equivalent) and production was 48.01 MTOE. During the decade of 2000's, the supply of different sources of energy like coal, electricity, gas and petroleum raised by 9.3%, 3.5%, 6.3% and 1.1% respectively per year. Transport and household sector exhibited increasing trend for gas with an increase of about 14% and 0.8%. The share of coal in energy use mix was 11% in the same period of time. Pakistan is rich with Coal energy source. Its amount is estimated to 185 billion tons. These reserves are mostly lies in Thar, having estimated amount is 175 billion tones (Economic Survey of Pakistan, 2010-11).

To fuel economic growth through increase agriculture productivity, get persistent growth from industrial sector energy supply should be supplied. But unfortunately, Pakistan is not in situation to provide it properly to each of the sectors. The country is also failed to explore and utilize its natural resources. The key sources of deficiency in energy are the ill-planning and mismanagement in policies by the government (SBP, 2006 and Economic Survey of Pakistan 2009-10).

Management and policy makers have the task to forecast correctly the energy demand and supply to equate consumption and production, which is crucial for the future growth and development of a country. According to official forecasting for the decade of 2010 (2010-20: year wise) made by the National Transmission and Dispatch Company (NTDC), the consumption of electricity for year 2019-20 will be 35048MW compared to the consumption in 2009-10 of 17847MW (NTDC, 2009-10). The cause of high demand for electricity consumption is due to rapid increase in consumers of electricity. In 2010 the total domestic consumers were 0.172 billion, whereas in 2020 it will be 0.209 billion (NTDC, 2008). The gap between total demand and supply of electricity will be -13651 MW in 2020, while it was -3338 MW in 2008 (IPP, 2008).

Different studies have been conducted in split form on determinants of energy demand, energy supply and relationship between economic growth and energy consumption, and forecasting of energy demand. The empirical results of different studies are mixed. Pakistan case is also not different in this respect. Results of some of the studies show positive and significant relationships among determinants and demand for and supply of energy, while other show negative and significant effect. The present study is different from other studies conducted regarding the impact energy consumption on economic growth, because all the sectors of the economy have given equal importance in the determination of economics growth. Each sectors of the economy put into investigation i.e. labour market (Labour force), financial market (domestic investment), foreign sector (FDI, foreign debts and Trade openness), agricultural sector (Productivity per Acer) and energy consumption.

Methodology

Theoretical Framework

Classical and Neo-classical growth theory had exposed the importance of saving, investment and population growth in the determination of economic growth. They ignored the importance of energy in production. Hitherto, energy economists declared that energy is important factor of production and also considered as key input in production process. Neo-classical economists stressed on increase in technology along with other factors to increase production, in this outlook energy has key use in real capital and economic activities. Hence dropping energy input from production function will be the indication of deficiency in judgment. Energy required for greater output, labor productivity and capital accumulation. Alam (2006) explored that energy is necessary for the attainment of economic growth, further energy impels the work that exchange raw materials into final goods in the production process and also enhance economic growth of a country.

The central theme of Solow growth model is that long run growth elucidates by the pace of technological advancement, which appear exogenously. The new growth theory has developed against of neo-classical exogenous growth model. Romar endogenous growth model was first developed in 1986 which indicated advance technology are necessary for long run economic growth, hence technology and capital operate due to the use of energy. In nutshell the energy and economic growth relationships vary significantly beside the different phases of growth and development.

The study used comprehensive model which shows along with physical capital, trade openness, external debt and total cropped area an increase in availability of energy considerably affect aggregate output of the economy.

Data

In this study, annual data is used on different variables in favor of empirical analysis for the period ranging from 1970-2015. The data required for the study is obtained from various sources. The data for total energy consumption, labour force employed, total external debt and total cultivated area taken from Economic Survey of Pakistan various issues. Data of GDP and GFCF are collected from World Development Indicator (World Bank).

The Mode

The model used in this study is based on some of the past studies conducted by Lee et al (2010), Odularo (2009), Pao (2009), Paul and Bhattacharya (2004), Riaz (1984), Sari and Soyatos (2004) and Toman and Jemelkova (2002). They focused on the variables which is combined in the following expression.

$$\ln EG = \beta_1 + \beta_2 \ln TEC + \beta_3 \ln GFCF + \ln TED + \beta_5 \ln TO + \beta_6 \ln EMPLOY + \beta_7 \ln TCA + \mu t \quad (39)$$

Where

ln= Natural log

EG = Economic Growth

TO = Trade Openness

TED = Total External Debt

TEC = Total Energy Consumption (MTOE)

GFCF = Gross Fixed Investment

EMPLY = Employment Rate

TCA = Total Crop Area (Million hector)

The data used in this research is of time series nature; therefore, unit root tests are necessary to test for the order of unit root. For the same purpose Augmented Dickey Fuller (ADF) and Phillips Peron (PP) tests are used. After the results of ADF and PP tests the selection of suitable technique for estimation is made.

Results and Discussions

Unit Root Tests

The first step in any time series study is the testing of unit root tests. The results of the unit roots test AFD and PP is given in the following table.

Table 1. ADF and PP Tests Results

Variables	ADF test Statistics		PP-test Statistics		Order of Integration (at 5% level of significance)	Order of Integration (at 10% level of significance)
	Level	1st Difference	Level	1st Difference		
lnGDP	-1.207 (0.605)	-4.02* (0.004)	-1.202 (0.645)	-4.059* (0.000)	I(1)	I(1)
lnTEC	-1.986 (0.135)	-4.105* (0.000)	-1.985 (0.145)	-4.104* (0.000)	I(1)	I(1)
LnDI	-2.017 (0.502)	-4.019* (0.000)	-2.103 (0.448)	-4.017* (0.000)	I(1)	I(1)
LnTED	-1.892 (0.38)	-5.510* (0.000)	-1.886 (0.360)	-5.502* (0.000)	I(1)	I(1)
lnEMP	-1.638 (0.283)	-4.615* (0.002)	-1.798 (0.308)	-4.411* (0.005)	I(1)	I(1)
LnTCA	-1.17 (0.502)	-3.895* (0.000)	-1.167 (0.448)	-3.901* (0.000)	I(1)	I(1)

*, ** represent 1% 5% level of significance

It is clear from the table that all the variables are of the same order i.e. I(1). In case of all the variables are of order I(1), therefore, Johansen co-integration approach should be used for the investigation of co-integrational relationship.

Co-integration

The Johansen co-integration technique is presented in Table-2. The parameters estimates of Trace statistics and Maximum Eigen are followed to disclose the vectors of co-integrational association between the variables. It is clear from the estimated values of both Trace Statistics and the Maximum Eigen at 5% level of significance, both of which is greater than the critical values. On the basis of results the existence of long run relationship is accepted and the null hypothesis is rejected. Three co-integrational are reported by the both Trace Statistics and the Maximum Eigen values at 5% percent.

Thus the results verify the existence of long run relationship between GDP and explanatory variables.

Table 2. Results of Johansen Co-integration

Null Hypothesis	Alternative Hypothesis	Trace Statistics	5 % Critical Value	Max-Eigen Statistics	Critical Value (5%)
R = 0	R ≥ 1	168.046*	125.615	53.794*	46.231
R ≤ 1	R ≥ 2	114.254*	95.754	42.149*	40.078
R ≤ 2	R ≥ 3	72.105*	69.818	36.716*	33.877
R ≤ 3	R ≥ 4	35.389	47.856	18.198	27.584
R ≤ 4	R ≥ 5	17.191	29.797	10.509	21.132
R ≤ 5	R ≥ 6	6.682	15.495	5.524	14.265
R ≤ 6	R ≥ 7	1.158	3.842	1.158	3.842

Multiple Regression Model Estimation

Usually time series data have non stationarity problem, in such case using OLS models on non-stationary data gives spurious or not reliable results (Granger and Newbold, 1974). If variables of the study are stationary and co integrated after applying suitable tests, then results obtained from OLS are not spurious. Therefore, the results obtained from OLS are consistent.

Estimation of Economic Growth

The results given in Table-3 indicate that TEC, GFCF and EPLY are statistically significant at 5% level of significance. TED, TO and TCA are statistically insignificant variables at 5% level of significance. This implies that external debt has not used effectively for development purposes and trade openness also has not effectively contributed to GDP of Pakistan because deteriorate terms of trade and Pakistan mass exports comprise of raw materials and semi-finished goods, while imports are contained final goods and services. Further total crop area is insignificant effect on GDP owing reasons that agriculture contributed only 21 % to GDP while major share by services (Economic Survey of Pakistan 2010-11).

According to results if 1% increases in TEC, GFCF, TED, TO, EPLY and TCA and other all variables remain unchanged, the GDP will increase by 0.994, 0.439, 0.020, 0.051, 0.949 and 0.428 percent respectively. Moreover, the signs of coefficient of variables are according to economic theory. Further regression results reveal that total energy consumption, gross fixed capital formation and employment are critical factors of economic growth of Pakistan. The value adjusted R² is 0.889, indicates that the model is good fitted. The estimate of Durbin Watson statistic is 1.8258 that declares the absence of severe autocorrelation.

Table 3. Regression Results

Dependent variable ln GDP			
Variable	Coefficient	T-Value	Prob.
Constant	-3.734	-1.351	0.188
lnTEC	0.994	5.190	0.000
lnGFCF	0.438	5.518	0.000
lnTED	0.0203	0.126	0.900
lnTO	0.0507	0.656	0.517
lnEMPLY	0.949	3.457	0.001
lnTCA	0.428	0.973	0.339
R ² = 0.889		F-Stat = 3658.178	
AdjR ² = 0.854		Prob(F-Stat)= 0.000	
Durbin-Watson = 1.826			

Error Correction Model Results

Table-4 shows the ECM results. In short run all explanatory variables have positive effect on GDP. Only two variables of GFCF and TO are statistically significant and the rest of variables are statistically insignificant at 5% level. The estimated value of ECT is negative. It is also statistically significant at 5% level of significance. Such estimated value long run equilibrium among variables of interest. In case of any shock there will be a convergence towards long run equilibrium with speed of 34% means 34 % of the disequilibrium will be converted to equilibrium in one year.

Table 4. Error Correction Model

Dependent variable D(lnGDP)			
Variable	Coefficient	T-Value	Prob.
Constant	0.055	2.603	0.016
D(lnTEC)	0.247	0.667	0.511
D(lnGFCF)	0.289	2.760	0.011
D(lnTED)	0.208	1.652	0.111
D(lnTO)	0.057	2.163	0.041

D(lnEMPY)	0.468	1.665	0.109
D(lnTCA)	0.278	1.411	0.171
ECT(-1)	-0.339	-2.114	0.045
R ² = 0.552		F-Stat = 4.219	
AdjR ² = 0.421		Pro (F-Stat) = 0.004	
Durbin-Watson = 1.667			

Conclusion

This study is concerned with energy consumption and economic growth in Pakistan. Data for the period of 1972-2015 was analyzed through the Johansson co-integration technique. Along with energy consumption some other important variables are also put into investigation. Present results of the present showed that energy consumption contributes positively and significantly to long run economic growth. The result of short run is positive but insignificant. The country could use energy consumption by putting energy into a productive environment to fuel economic growth. This study suggests that more and cheap energy sources should be explored to increase the benefits from energy supply and to guarantee economic growth. Proper policies may be more beneficial to make sure stable energy supply, this will help in the determination prosperity for the country. Suitable energy use and resources are beneficial for developing countries, and they can benefit from suitable energy sources.

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