Energy Short-fall and Poverty: Evidence from Pakistan

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Abstract
This study aims to assess the impact of energy short-fall on poverty in macroeconomic framework in Pakistan. The study has used the difference between energy demand and its supply as proxy for energy short-fall and poverty head count ratio as an indicator of poverty incidence. This study has employed ARDL bounds testing approach that confirms the existence of long run relationship between energy short-fall and poverty levels. Error correction term of the estimated model exhibits that approximately 47% of the departures from long run equilibrium value would be corrected each year. The findings show that GDP per capita and government expenditure exhibits negative impact on poverty. Whereas, energy short-fall, unemployment rate and inflation rate show strong positive impact on poverty level. The study concludes that energy sector reforms are required on priority basis to alleviate poverty in Pakistan.

Keywords: Energy Short-fall, Poverty, Pakistan, ARDL

I. Introduction
Poverty refers to deprivation of basic human needs (Todaro and Smith, 2012.). The requirement for basic needs expends with the improvement in living standard of general public. Energy has become an integral part of the basic human needs because of technological development, industrialization and globalization especially during the last century. Energy poverty has been defined as lack of access to basic and modern energy services at both household and business levels (WEO, 2010).

According to Amartya Sen, poverty is actually the lack of opportunities to improve living standard of the deprived section in an economy. Energy plays its role as a leading factor to expand and contract the range of opportunities (employment opportunities) and ways (enhancing productivities of other factors) to economic development and human well being (Dagoumas and Kitsios, 2014). It is a double-edged weapon due to its role as
not only a means to economic development but also as an indicator of the achievement of economic well being. Energy poverty can be accessed by lack of efficient use of energy resources at individual and national level.

There are different forms of poverty, such as, food poverty, income poverty, energy poverty etc. Out of these different forms of poverty, energy poverty has attained special attention due to its role as a constraint in available opportunities to the poor. These different types of poverty entrap one another as becoming cause and effect of its one form. The World Energy Outlook has proposed energy poverty as one of the important factors to different poverty traps in 2004. Thus, it is evident that energy poverty exacerbates economic poverty and economic poverty aggravates energy crisis that intensifies energy poverty in developing economies.

Figure 1 displays the flow chart of factors generating vicious circle of poverty trap with energy short-fall.

**Figure 1: Flow Chart of Vicious Circle of Energy Crisis and Economic Poverty.**

![Flow Chart of Vicious Circle of Energy Crisis and Economic Poverty](image)

Source: Authors' Sketch.

Owing to duality in energy such as its role as means and end, as input and output of economic progress we have captured the term “Energy Short-fall” from both consumption and production sides. In the settings of the current study, *Energy Crisis or Energy Short-fall* has been measured by taking the difference between energy consumption and production in kilo tones of oil equivalent. The central theme of this study is to explore the long run relation between poverty and energy crisis. In short the central questions addressed in this study are as follows; Does poverty increase or decrease in the course of energy crisis in developing economy of Pakistan? Does the
energy crisis imply any significant effect on poverty using macroeconomic framework in long run?

The rest of the paper is arranged as follows: Section II presents a brief reviews of literature, whereas, section III deals with methodological framework incorporating information about data, variables discussion and selected econometric approach. The empirical results are discussed in the section IV and the section V concludes the current research and provides some policy recommendations.

II. Literature Review

Although a surge of studies have conducted research on the energy crisis since the problem of energy short-fall started in the 1970s but a dearth of analysis has been observed about the role of energy crisis with poverty. The recently growing literature on energy has measured energy poverty in different ways. Most of these have focused on measuring its extent in household sector and at local or regional levels. A few studies have examined the implications of energy short-falls on economic poverty or of economic poverty on energy short-fall (or poverty).

Investigating the level and extent of energy poverty in Pakistan Sher, Abbas and Awan (2014) have calculated Multidimensional Energy Poverty (MEP) Headcount at provincial level. They found that residents of KPK are energy poor at first rank and Baluchistan residents come at second rank regarding energy poverty.

Undertaking the case of energy importing economy of Sri-Lanka, Naranpanawa and Bandara (2012) have explored the nexus between energy, growth and poverty. They have examined the impact of rising global oil prices on growth, employment in energy intensive industry and household level poverty. They have utilized two CGE models in “top down” mode to capture the sectoral implications of an external oil price shock. In order to measure the severity of poverty they have adopted FGT index. The analytical framework discloses that growth and industry employment are negatively affected by energy price hike and poverty is accelerating due to this hike in energy prices. Urban low income groups are affected badly as compared to rural low income groups. It is because the poor in rural areas are more dependent on less energy intensive agriculture sector that is comparatively less affected by energy price hike as compared to more energy intensive manufacturing sector that is mostly located in urban areas. Groh (2014) has also conducted a research to examine the extent of impact of energy crisis on different income groups. Using the primary data from Arequipa (Peru), it is observed that the low income groups have to pay penalty in face of poor energy access. This energy poverty penalty is exacerbating poverty and inhibiting development.

Concentrating on development policies, Wishanti (2015) has analyzed the role of energy in alleviating poverty and paving the path to achieve policy targets. The author has measured unequal access to energy as proxy for energy poverty. Analyzing the situation of Indonesian energy sector with development goals, the study concluded that the small and medium scale development policies of energy would be more efficient acknowledged by private-public integration and financial system.

Though there are not many studies that have directly estimated the impact of energy short-falls on poverty levels but there are many studies on the relationship
between energy crisis and other macroeconomic variables. Chaudhry et al. (2015) found that energy crisis (short-fall) have strong positive impact on inflation in Pakistan i.e. increase in energy short-fall increases inflation (higher price levels), thus, reducing real income and increasing poverty.

It is evident from the literature that there are not many studies that have measured the impacts of energy short-fall (crisis) on the extent of poverty in a developing economy. The present study tries to explore the link between energy short-falls and poverty in Pakistan.

III. Methodological Framework

The current section deals with the methodological issues such as selection of variables, collection of data and selection of appropriate econometric technique for estimation purposes.

A. Data Range and Sources

This study has employed the annual data covering time span from 1972-2011 for all variables of econometric model which is following:

\[ POV = f(ENS,GDP, GE, UNR, INFR) \]

Where,
- \( POV \) = Poverty (headcount ratio)
- \( GDP \) = Real per capita Gross Domestic Product
- \( GE \) = Real public expenditure,
- \( ENS \) = Energy Short-fall
- \( UNR \) = Unemployment rate
- \( INFR \) = Inflation rate.

Table 1: Description of Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Symbolic Representation</th>
<th>Unit of Measurement</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Short-fall</td>
<td>ENS</td>
<td>Kilotonnes of Oil Equivalent</td>
<td>World Development Indicators</td>
</tr>
<tr>
<td>Poverty</td>
<td>POV</td>
<td>Headcount (%)</td>
<td>Jamal (2006) and Pakistan Economic Survey (various issues)</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>UNR</td>
<td>Percentage</td>
<td>Pakistan Economic Survey (various issues)</td>
</tr>
<tr>
<td>Consumer Price Index Rate</td>
<td>INFR</td>
<td>Percentage</td>
<td>IMF (International Financial Statistics)</td>
</tr>
<tr>
<td>GDP Per Capita</td>
<td>GDP</td>
<td>Pak rupee</td>
<td>World Development Indicators</td>
</tr>
<tr>
<td>Real Govt. Expenditure</td>
<td>GE</td>
<td>Constant LCU (million)</td>
<td>World Development Indicators</td>
</tr>
</tbody>
</table>

B. Estimation Technique

The present study has employed Auto-regressive Distributed Lag (ARDL) approach by Pesaran et al. (2001). This approach is equally well applicable to small and large samples and thus provides unbiased and consistent results. As it is single equation
dynamic approach so it shields the findings from endogeneity bias. This method does not inevitably require the same order of integration for all variables. Moreover, ARDL approach incorporates bounds test using WALD test with $F$-distribution to find the long run relation among variables under consideration. It also provides Error correction term (ECT) exhibiting long run adjustment factor in short run model estimation.

IV. Results and Discussion

In the section the results are presented and the discussion on the empirical findings is made. In order to avoid spurious results the Phillips Perron test has been used to check the stationarity of the data. All variables such as POV, ENS, UNR, GDP and GE are found to be stationary at first difference except inflation rate (INFR) that is stationary at level. Table 2 provides the stationarity results of all variables using Phillips-Perron test.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Phillips Perron (PP) test</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty (POV)</td>
<td>C -1.29, C &amp; T -1.58, 1st Difference C -4.12**, C &amp; T -4.09**</td>
<td>I(1)</td>
</tr>
<tr>
<td>Energy Short-fall (ENS)</td>
<td>C -0.036, C &amp; T -2.45, 1st Difference C -5.24**, C &amp; T -5.18**</td>
<td>I(1)</td>
</tr>
<tr>
<td>Per capita gross domestic product (GDP)</td>
<td>C 0.36, C &amp; T -2.41, 1st Difference C -4.44**, C &amp; T -4.35**</td>
<td>I(1)</td>
</tr>
<tr>
<td>Real Government Expenditure (GE)</td>
<td>C 0.82, C &amp; T -1.84, 1st Difference C -7.47**, C &amp; T -7.90**</td>
<td>I(1)</td>
</tr>
<tr>
<td>Unemployment rate (UNR)</td>
<td>C -1.76, C &amp; T -1.92, 1st Difference C -6.31**, C &amp; T -6.42**</td>
<td>I(1)</td>
</tr>
<tr>
<td>Inflation rate (INF)</td>
<td>C -3.32**, C &amp; T -3.36*, 1st Difference C -8.71**, C &amp; T -8.23**</td>
<td>I(0)</td>
</tr>
</tbody>
</table>

Note: C indicates only intercept case and C & T denotes intercept and trend case. ** represents 5% significance level, * indicates 10% significance level, Source: Authors’ calculations

This mix integration order of variables justifies the use of Bounds Co-integration test to check long run relation between poverty and energy short-fall. Moreover, the Schwarz Bayesian Criterion (SBC) has been used in order to select the optimum lag order of ARDL model. This SBC has selected 2 as the maximum lag length of all variables. Table 3 reports the $F$-statistic based WALD test results of co-integration with its probability that confirms about the existence of long run relation between variables.

<table>
<thead>
<tr>
<th>F-Statistic (Probability)</th>
<th>Lag</th>
<th>Significance Level</th>
<th>Bounds Test Critical Values</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8.95 (0.0005)</td>
<td>2</td>
<td>5%*</td>
<td>Lower Bound I (0) 3.12</td>
</tr>
</tbody>
</table>

Note: k=5, (Pesaran et al., 2001, page: 301), Source: Authors’ calculations.

Once the existence of co-integration is confirmed, the following long run results using ARDL model has been obtained and are presented in table 4.

<table>
<thead>
<tr>
<th>Table 4: Estimated Coefficients of Long Run Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDL (1 2 0 2 0 1) selected based on Schwarz Bayesian Criterion</td>
</tr>
<tr>
<td>Dependent Variable is Poverty (POV)</td>
</tr>
<tr>
<td>Regressor</td>
</tr>
<tr>
<td>Energy Short-fall</td>
</tr>
</tbody>
</table>
The core variable of model energy short-fall (ENS) exhibits significant positive impact on poverty. As energy supply bottlenecks become greater and accelerating energy demand intensifies the energy short-fall then it results in increasing the poverty profile. Energy crisis as basic input factor downgrades the aggregate output. This short-fall lowers the employment generation capacity and living standard of people and thus deprives the masses from basic needs fulfillment. This also lowers the national income level and restricts a developing economy to match the pace of progress of the developed economies.

High level of real per capita (GDP) leads to lower the poverty incidence as represented by negative sign of GDP coefficient but this impact is insignificant. This weak relation shows that poverty alleviation requires other structural changes rather than just focusing on ways to increase GDP in developing economy of Pakistan. Real government expenditure (GE), a control variable, also implies significant inverse relation with poverty. The reason may be that when government increases its expenditures in providing public utilities like hospitals, transport, educational and communication infrastructure like roads etc., it increases the income by expanding the employment opportunities, thus, reducing the poverty. Increasing rates of unemployment (UNR) and inflation (INFR) speed up the poverty level as can be seen from positive and significant values of the variables. The relationship between unemployment and poverty is pretty straightforward. Being unemployed means less income and increased poverty levels.

International shocks in energy prices cast its spell into the energy importing domestic economy of Pakistan. This energy inflation spills over other types of inflation as well and thus results in hyperinflation. Increasing inflation rate flames up this situation by lowering the purchasing power. Table 5 presents the short run results with error correction term by estimating unrestricted error correction model.

The most important term in this table is the value of error correction (ecm) that is highly significant. The negative value of (ecm) confirms convergence towards stable long run equilibrium. Its value of the speed of adjustment shows that short run disequilibrium will be corrected each year by 47%.

### Table 5: Error Correction Model Estimates

<table>
<thead>
<tr>
<th>ARDL (1,2,0,2,0,1) selected based on Schwarz Bayesian Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable is dPOV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(ENS)</th>
<th>Per capita gross domestic product (GDP)</th>
<th>Real Government Expenditure (GE)</th>
<th>Unemployment rate (UNR)</th>
<th>Inflation rate (INF)</th>
<th>C</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>.9061E-3</td>
<td>.8312E-3</td>
<td>1.0901 [.286]</td>
<td>-.3847E-4</td>
<td>.1269E-4</td>
<td>3.0326 [.006]</td>
<td>1.5771</td>
</tr>
</tbody>
</table>
Regressors | Coefficient | Standard Error | T-Ratio [Probability]
--- | --- | --- | ---
dENS | -4.422E-3 | 2.862E-3 | 1.5448 [0.134]
dENC1 | -8.229E-3 | 3.372E-3 | 2.4407 [0.021]
dGDP | -4.300E-3 | 4.042E-3 | 1.0638 [0.297]
dGE | 1.178E-4 | 5.430E-5 | 2.1693 [0.039]
dGE1 | 3.051E-4 | 6.011E-5 | 5.0759 [0.000]
dUNR | 0.7484 | 0.3008 | 2.4884 [0.019]
dINFR | 0.2117 | 0.0764 | 2.7704 [0.010]
dC | 19.7804 | 8.6634 | 2.2832 [0.030]
dT | 0.0577 | 0.4071 | 0.1419 [0.888]
Ecm(-1) | -0.4746 | 0.0591 | 8.0320 [0.000]

Source: Authors estimations using Microfit 4.1

V. Conclusion

In the last decades, research on the implications of energy crisis on macroeconomic and welfare variables has remained an active area in economic literature. In this line present study provides empirical evidence of the argument that energy short-fall aggravates poverty incidence in developing economy like Pakistan. ECM model is applied to investigate the impact of energy crisis on poverty. Prior testing for long run relation among chosen variables, the Phillips-Perron test (PP) is used to examine stationarity. Bounds cointegration test confirms the existence of long run relationship between energy short-fall and poverty incidence in macroeconomic framework. Estimations of ARDL model support the argument of significant positive relation of energy short-fall with poverty. Moreover, results inspect that almost 47% deviations from long run stable equilibrium would be corrected annually.

On the whole, the sample from Pakistan exhibits that energy short-fall is one of the significant contributors of poverty trap. In today’s technologically advanced and globalized world energy reforms are needed on priority basis to kick out poverty and to improve living standard of energy hungry nation. Diversified energy supply requires funding at large scale. As energy sector is capital intensive so large scale funding needs increased budgetary allocation to this sector and foreign investment as well.

In poverty-energy crisis stricken economy of Pakistan the most favorable measure may be to exploit renewable energy resources to light up the path of its economic-social progress. In this regard China-Pak Economic Corridor (CPEC) has also granted a major portion of its budget to expand its energy generation capacity. Awareness programs may assist to cope with this crisis at individual level also. Energy infrastructural reforms may be implemented by public-private partnership with issuance of licenses to private sector to generate energy.
References


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