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## Investigation of Energy Inflation Dynamics in Pakistan: Revisiting the Role of Structural Determinants

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### ABSTRACT

Enormous fluctuation has been observed in energy prices in recent years. This strong volatility in energy prices implies grave inferences for Pakistan's economy as shown by its substantial dependence on imported fuels. In Pakistan, energy prices play a critical role in inflation determination also concluded in the study at hand. The index of energy inflation was constructed, and the role of various control variables such as board money, taxes, oil prices, energy import, and GDP has been elaborated. Current study endeavors to examine the determinants of energy inflation in Pakistan by using time-series data for 1991 to 2019. Unit root was tested by utilizing ADF, furthermore, the Bound test suggested ARDL cointegration for empirical analysis. Therefore, an increase in the demand for energy in economic activities in developing countries indicates an energy demand hence implies energy inflation. The government of Pakistan must focus on the role of these factors to control inflation and to enhance the welfare in the country.

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### 1. Introduction

Energy inflation is one of the most important issues to be discussed as it is playing a significant role in the development process. The energy demand for households, transport, and for the generation of more energy is creating the issue more severe as the demand is on the rise with a rise in the demand for energy (Hart, 2018). Therefore, energy inflation is mostly demand-driven inflation while the role of the supply is not as significant. Additionally, high energy costs make businesses less willing to do innovative investments (Giebel & Kraft, 2018).

Furthermore, Energy inflation is characterized by extreme volatilities (Carriero et al., 2019). Oil and gasoline are the major components of the energy demand in Pakistan. While few of the oil-producing countries lead to an immediate surge in prices and have significant control over the prices, leads to supply shocks. The oil shocks of the 1970s push many economies into a recession.

Current research at hand endeavors to determine the factors of energy inflation in Pakistan. Many empirical pieces of evidence investigated that energy inflation leads to high energy prices. Ample of literature had concentrated on the relationship between energy inflation and energy prices but (Haider et al., 2013) investigated the determination of energy inflation in Pakistan. Energy is considered one of the most important determinants of growth, as many economic activities depend upon energy usage. Energy inflation is the most important issue for Pakistan and it is an important challenge for the government to stabilize the price.

## **2. Literature Review**

Ahmed et al. (2014) studied the determination of recanting inflation in Pakistan. The results demonstrated a long-run relationship among the selected variables and the output gap of fiscal policy inflation was highly significant. Higher inflation is the consequence of the higher energy prices that has a vital impact on the economy.

Mohanty and Klau (2001) identified the determinants of inflation in emerging market economies. Researchers used the data from 1980 to 1990 and applied the augmented dickey-fuller test to check the unit root while ARDL was applied for empirical estimations. It was concluded that demand factors were less relevant in the determination of inflation.

Ciner (2001) examined the dynamic linkages between oil price and the stock market. By utilizing the 1979 to 1983 data the estimation was performed by vector autoregressive model and Granger causality. A nonlinear relationship between oil price and the stock market was found. Beck et al. (2006) analyzed the regional dynamics of inflation across the Euro area in comparison with the US. This study concluded that disaggregate regional inflation was important in explaining the aggregate inflation rate.

Henriques and Sadorsky (2007) examined the oil price and stock price of alternative energy companies. Using the Vector autoregressive model, an empirical relationship between energy stock price, technology stock price, oil price, and the interest rate was concluded. (Dua & Gaur, 2009) examined the determinants of inflation in the open economy framework. The analysis was made for eight Asian countries, Japan, Hongkong, Korea, Singapore, China, India, Thailand, and the Philippines. Data for 1990 to 2005 was used in this study. The results showed that the developed and developing countries have almost the same determinants of inflation.

Yiping et al. (2010) investigated the factors that determined inflation in china. The annual data was used from 1998 to 2009. These variables consumer price index, output gap, housing prices, real interest rate, stock prices included in the current study. The results showed the output and excess liquidity had a large effect on inflation and housing prices had a small effect. (Celik & Akgul, 2011) identified the change in oil prices in the Turkish economy. The time-series data was used from 2005 to 2009 and concluded that fluctuations in oil price caused to increase in the consumer price index. Altowajri (2011) investigated the determination of inflation in Saudi Arabia with annual data from the period of 1996 to 2010. The results showed the inflation in Saudi Arabia was driven by the

foreign factor as the main source of inflation.

Baldric (2012) examined the relationship between economic growth and energy consumption. The time-series data used the period from 1980 to 2009. The results show that there was a co-integration between biomass energy consumption and economic growth in five countries Brazil, Bolivia, Chile, Colombia, and Guatemala and there was no co-integration between biomass energy consumption and economic growth.

Tafti (2012) examined the determinants of inflation in the Islamic Republic of Iran. The quarterly time series data was used for the period from 1971 to 2005. They have used the vector autoregressive method in the present study. Inflation was the dependent variable and import price index; gross domestic products were independent variables. The results showed the response of the consumer price index to shock in GDP was weak and the response of the consumer price index shock in the import price index and liquidity were positive.

Kasidi and Mwakanemela (2013) identified the impact of inflation on economic growth in Tanzania. The time-series data was used in the period from 1990 to 2011 in the current study. Researchers applied the co-integration for parameter estimation and the dickey fuller test for unit root. The results suggest that inflation hurt economic growth and no long-run relationship between inflation and economic growth in Tanzania. Forster and Tillmann (2013) strongly supported core inflation as an indicator of underlying inflationary pressure. Baghestani (2014) investigated the inflation expectation provides useful information of change in energy prices and concluded that inflation expectations were useful information for crude oil, gasoline, and heating oil prices. Saleem (2008) examined the measured volatility of inflation in Pakistan by using monthly data. They concluded that the relationship between inflation and money variables was positive. Khan and Ahmed (2009) analyzed the energy demand. The period was used from 1972 to 2007 in the present study. The log-run relation from GDP to energy consumption and short-run relation from energy consumption to GDP was analyzed.

Bashir et al. (2016) studied the supply and demand lateral of inflation for Pakistan. The conclusion stated that inflation was controlled by govt. policies. Noor and Chaudhary (2009) identified the causes of high inflation in Pakistan. This study determined that the income of service sectors increases and demand for goods increases as the price level upward move. Ahsan et al. (2011) illustrated that supply-side factors had an important impact on food prices and marketplace forces show a significant role in growth. (Abdullah & Kalim, 2012) showed that food inflation expectation had important in determining food price inflation in the long run and short run. Nawaz et al. (2013) inspected electricity demand in Pakistan and concluded that coal, gas, and other sources will change the relationship between electricity consumption and electricity prices.

Lodhi et al. (2013) analyzed the impact of electricity production, gross capital formation on FDI. This period was used from 1976 to 2010 in the current study. The autoregressive distributed lag model was applied to empirical analysis. The finding of the study illustrated the significant association for growth.

Haider et al. (2013) investigated the determination of vitality of prices in Pakistan. The panel observations were used from 1973 to 2012 in the study at hand. The explained energy inflation is used with the oil price, exchange rate, and govt. revenue as control variables. as independent

variables. Augmented dickey- fuller and Philips person tests were applied for the detection of unit root. The result showed that the government was highly desirable for overall welfare in the country. Ahmed et al. (2014) studied the determination of recent inflation in Pakistan. The results showed a long-run relationship between the selected factors and the output gap. The consumer price index had a positive long-run association so monetary policy affects inflation.

Aziz et al. (2016) identified the impact of higher energy prices on consumer welfare for Pakistan. The time-series data was used from 1987 to 2012. The results show that the current study was important for energy price and income price and the electricity prices were affecting any disturbance in global prices. This study concluded that Pakistan should invest in coal, natural gas, electricity generation, and diesel oil to make a stable growth.

Hossain and Islam (2013) investigated the determination of inflation in Bangladesh. The results showed a positive relationship between money supply and inflation but the interest rate, fiscal deficit, and the nominal exchange rate does not affect inflation. Hanif et al. (2017) analyzed the global commodity price and domestic inflation. The time-series data was used in this period from 1992 to 2014. Findings of the research stated that that the global price changes had positively impact inflation in a small open economy. Global commodity price was changing overall inflation.

### **3. Data and Methodology**

Recent research is based upon investigating the root causes of energy inflation in Pakistan with 1991 to 2019 annual time series data. Various sources were used to collect the data, IFS, PBS, and Pakistan economic survey. The variables of the research include the Energy inflation index, Board money, Energy import, Oil price, Gross domestic products, and Tax revenue.

#### **3.1 Empirical Model Specification**

The model of the energy inflation determinants are as follows:

$$EI\ INDEX = f(EIM, OP, M2, TAX, GDP)$$

$$EI\ INDEX = \beta_0 + \beta_1 (EIM) + \beta_2 (OP) + \beta_3 (M2) + \beta_4 (TAX) + \beta_5 (GDP) + e$$

Where the energy inflation index energy is EIINDEX, energy import (EIM), oil price (OP), Board money (M2), taxes (TAX), and gross domestic product (GDP).

#### **3.2 Theoretical Methodology**

Many studies studying the time series data have used techniques and different techniques as the OLS and many other co-integrating techniques. Engle-Ganger and Johansen (1988) and Johansen-Juselius (1989) co-integration techniques both measure the long-run association among the different variables that did not incorporate the series with the unit root. As we have data set that is a mix and a combination of the stationary and the non-stationary data the ARDL approach proposed by Pesaron et al. (1997) gives unbiased and efficient estimators. ARDL approach provides freedom from the problem of autocorrelation and endogeneity (Pesaran et al., 2001).

### **4. Results and Dissuasion**

#### **4.1 Descriptive Statistics**

Descriptive statistics is defined as applied to present the quantitative description of the data set. The data of Energy Inflation Index (EI Index), Energy import (EI), Board money(M2), Oil price

(OP), Tax and Gross Domestic Products m(GDP) for the period 1991 to 2019. The averages, standard deviation, Skewness, kurtosis of the variables are shown in the table below.

**Table 5.1: Descriptive Analysis of the Data**

	EIINDEX	EIM	M2	OP	TAX	GDP
<b>Mean</b>	0.000	23.377	14.186	129.897	11.668	4.093
<b>Median</b>	-0.407	23.509	13.916	87.170	11.000	4.328
<b>Maximum</b>	2.932	27.697	20.500	280.970	14.400	7.706
<b>Minimum</b>	-2.092	17.773	4.300	41.300	9.100	1.014
<b>Std. Dev.</b>	1.474	2.318	3.919	81.865	1.592	1.831
<b>Skewness</b>	0.363	-0.343	-0.410	0.616	0.135	0.338
<b>Kurtosis</b>	1.955	3.087	3.215	1.911	1.617	2.562

**Source:** Author's valuation using E- views 9.5.

Table 5.1 shows the descriptive statistics of variables that include Mean, Minimum, Maximum, Std. Dev., Skewness, and Kurtosis are elaborated in detail.

#### 4.2 Correlation Analysis

Correlation analysis is done to ensure degree of association (ranges from -1, +1) and to observe the degree of multicollinearity among the regressors.

**Table 5.2: Correlation Analysis of the Data**

	EIINDEX	EIM	M2	OP	TAX	GDP
<b>EIINDEX</b>	1.000					
<b>EIM</b>	-0.012	1.000				
<b>M2</b>	-0.172	-0.050	1.000			
<b>OP</b>	0.919	-0.038	-0.073	1.000		
<b>TAX</b>	-0.579	0.064	-0.228	-0.756	1.000	
<b>GDP</b>	-0.065	-0.518	-0.171	-0.092	0.036	1.000

**Source:** Author's evaluation using E- views 9.5

Table 5.2 is represented the correlation between the variables. The energy inflation index is positively correlated with the oil price. EIINDEX is negatively correlated through M2, Energy import, Tax, and GDP. EI is positively correlated with energy import and taxes and negatively correlated with the other variables. M2 is correlated with M2 and negatively correlated with the oil price, GDP, taxes, energy import. Oil prices are positive correlated with the energy inflation index, oil and negatively correlated with the GDP, M2, energy import, and taxes. Taxes are positively correlated with energy import, GDP and negatively correlated the other variables, GDP is correlated with taxes and other variables are negatively correlated.

#### 4.3 Unit Root Analysis

To detect the presence of unit root, an Augmented Dickey-Fuller test was used. Furthermore, it illustrates a non-varying variance and mean in the time series and elaborated as 1(o) and the non-stationary have a varying variance and mean.

**Table 5.3: Unit Root Analysis of the Data**

	<b>Trend and intercept</b>	<b>Intercept</b>
EIINDEX		-0.775 (0.810)
$\Delta$ (EIINDEX)		-3.659 (0.011)
EIM	-3.603 (0.013)	
M2	-3.182 (0.034)	
OP		-1.370 (0.845)
$\Delta$ (OP)		-4.087 (0.018)
TAX		-1.294 (0.617)
$\Delta$ (TAX)		-5.397 (0.000)

**Source:** Author's estimation using E – views 9.5.

Table 5.3 shows that the Energy inflation index has a unit root and the value is stationary at first difference. Energy imports and money supply do not have unit roots and the data is stationary. Oil prices and taxes are nonstationary and stationary at their first difference.

#### 4.4 Co-Integration Analysis (Bound Test)

Cointegration is referred to the presence of the long-run association between variables of the study, when the series is not stationary there is a need to check it for co-integration.

**Table: 5.4: Bound Test Results**

<b>Test Statistic</b>	<b>Value</b>	<b>K</b>
<b>F-statistic</b>	12.380	5
<b>Critical Value Bounds</b>		
<b>Significance</b>	<b>Io Bound</b>	<b>I1 Bound</b>
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

**Source:** Author's estimation using E- views 9.5.

Table 5.4 represents the cointegration in the long run between variables. The calculated value of F-statistics 12.380 which is superior to other values. The F-statistic illustrates that there is exists a long-run co-integration in this research.

#### 4.5 Short-Run Analysis

**Table 4.5 ARDL Co-integration results- Short-run analysis**

Variable	Coefficient	Std. Error	Prob.
D(EIM)	0.133	0.056	0.0559
D(GDP)	0.097	0.036	0.037
D(GDP(-1))	0.111	0.033	0.015
D(M2)	-0.023	0.017	0.221
D(M2(-1))	0.063	0.022	0.028
D(OILPRICE)	0.009	0.002	0.006
D(OILPRICE(-1))	-0.008	0.002	0.015
D(TAX)	0.091	0.075	0.274
D(TAX(-1))	-0.150	0.073	0.087
CointEq(-1)	-0.912	0.154	0.001

**Source:** Author's evaluation using E- views 9.5.

Table 5.5 illustrated the short-run estimation of the parameters. Energy imports have a positive influence on overall energy inflation. The value of the coefficient in the short-run and is positive. The influence of Gross Domestic Product growth is also elaborated in the short-run an upsurge in GDP will enhance energy demand hence, lead to demand-pull energy inflation.

This is a great improvement and a country will be in progress (Haider et al. (2013)) because the association between energy import and energy inflation is positive. Money supply hurts energy inflation in the short run. Oil prices also have an optimistic influence on energy prices. The oil price increase will increase energy inflation in the short run. Taxes have an encouraging connection with energy inflation as taxes may be applied the prices will go up resulting in inflation in Pakistan in the short run. The value of the error correction term is -0.912367 illustrates that any value that is in disequilibrium will lead to equilibrium by 91% every year.

#### 4.6 Long-Run Analysis

**Table 5.5 ARDL Co-integration results- Long-run analysis**

Variable	Coefficient	Std. Error	Prob.
EIM	0.143	0.050	0.028
GDP	0.077	0.061	0.255
M2	0.120	0.031	0.008
OP	0.019	0.002	0.000
Tax	0.068	0.086	0.456
C	2.238	2.208	0.350

**Source:** Author's evaluation using E- views 9.5.

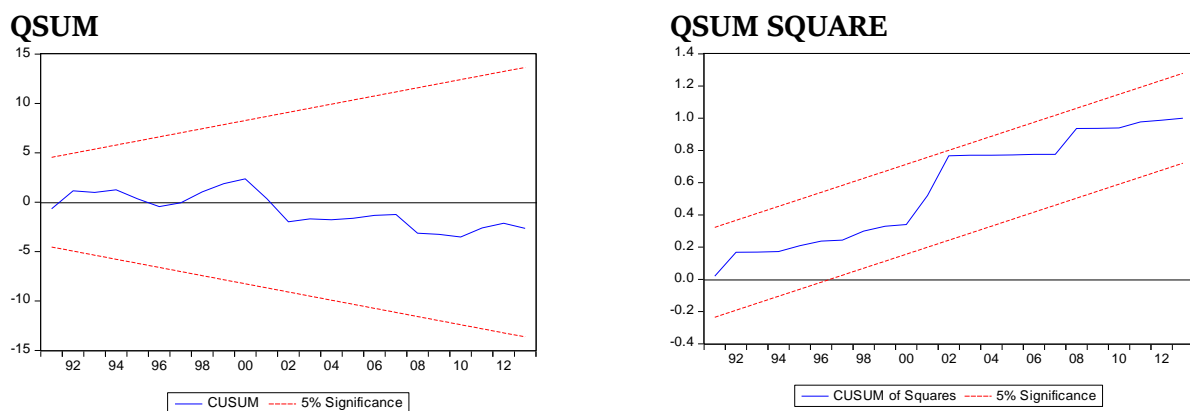
Table 5.7 elaborated the Long-run analysis of the data. The coefficient value of energy import is 0.143081 and it is positive. The value of the coefficient of energy import shows that a one-unit rise in GDP will rise energy inflation and Energy Import is showing a positive and significant. Energy import is the significance and positive impact in Pakistan this significant impact on prices is coincide with (Haider et al., 2013).

The value of the coefficient is 0.07728 and demonstrates that a one-unit rise in GDP will increase energy inflation by 0.07728 units. An increase in GDP will enhance the demand for energy and leave a positive demand-pull impact on the prices (Noor and Chaudhary (2009). The value of oil price is 0.018659, which is positive. It means that the rise in oil prices will increase energy for energy inflation and probability is 0.0000 in long run rightly point out that it is major cause inflation will determine which policymakers must consider as described by (Dhakal et al., 1994).

The money supply of coefficient value 0.120314 is positive. One unit rise in Money supply will increase energy inflation in Pakistan. Money has always been an important variable in determining energy inflation. The association between energy inflation and money supply is positive and the probability is 0.0082 in long run (Khan and Schimmelpfennig, 2006). The coefficient value of taxes is 0.068074 that is significant. Hence the taxes show a positive relationship with energy inflation. It means that an increase in taxes will increase energy inflation in Pakistan (Raza et al (2013).

**4.7 Stability of Test**

Model stability is estimating the CUSUM and CUSUM stability test in Autoregressive Distributed Lag (ARDL) technique the test of results shows that the coefficients of the current model are stable, as illustrated by the CUSUM and CUSUM statistic graphs.



**Source:** Author’s evaluation using E- views 9.5.

In beyond figure investigator has observed that the model is steady at a 5% level of significance.

**5. Policy Recommendations and Conclusion**

The energy demand for various sectors uses and the generation of more energy is critical in determining energy inflation, consequently, energy inflation is significantly considered as demand-driven inflation having the minimal role of the supply side. Additionally, high energy costs make unrest in the socio-economic system of a country. Furthermore, Energy inflation is characterized by extreme volatilities as oil and gasoline are the major components of the energy demand in Pakistan. Enormous fluctuation in energy prices implies grave inferences for Pakistan’s economy as shown by its substantial dependence on imported fuels. In Pakistan, energy prices play a critical role in inflation determination also concluded in the study at hand. The role of various control variables such as taxes, board money, energy import, oil prices, and GDP has been elaborated. Therefore, a rise in demand for energy in economic happenings indicated implies energy inflation. Pakistan’s government must focus on the role of these aspects to regulate inflation and to improve wellbeing in the country.



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