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# The Inflationary Effect of Energy Prices: An Empirical Analysis Using Toda Yamamoto Model

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***Abstract* – Increased energy prices are considered one of the sources of accelerating inflation since energy is an important factor of production for most of the commodities. This study scrutinizes the inflationary effects of cost of energy in Bangladesh. Time series data on consumer price index, electricity price, and oil price have been used for econometric analysis. Since Augmented Dicky Fuller and Philips Perron stationarity tests show a combination of 1st and 2nd order of integration, Toda Yamamoto (T-Y) test has been applied to detect the cointegrating relationship among the variables. The test results show that both electricity and oil price combinedly affect the inflation. Although electricity prices individually do not affect inflation but, oil price affects the inflation significantly. Hence, it is suggested that government can minimize the energy price by eliminating corruption and inefficiency in the energy sector, by using more renewable energies, and by energy diversification.**

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## 1. Introduction

One of the important economic indicators that has a profound impact on an economy's stability and expansion is inflation. Policymakers of developing economies like Bangladesh, consider the causes of inflation to formulate the monetary policy. Among many variables, money supply and energy costs are recognized as main determinants of inflation [1]. The manufacturing costs of goods and services are heavily dependent on all types of energy costs, which ultimately affect the price level in the economy [2]. A change in money supply can simultaneously affect inflation through the mechanics of demand-pull inflation and the dynamics of monetary policy [3].

The Bangladeshi economy has experienced significant growth over the past few years, which was accompanied by increased energy consumption and a corresponding rise in energy price. The energy sector of the country depends on imported oil and locally produces natural gas. The rise in global oil price profoundly affects the country's inflation to a great extent [4]. Moreover, the financial setup of the economy, particularly the money supply control by the central bank, has a significant impact upon the inflation rate [5]. The relation between energy cost and inflation in Bangladesh has been examined using various econometric models, showing the impact of global energy cost on national inflation rates [6]. Similarly, the connection between money supply and inflation in the economy has been analyzed, that reveals increased money supply can increase the general price level of goods and services [7].

Contemporary research has focused on the importance of considering both unpredictable energy prices and money supply dynamics in determining inflation rates in Bangladesh [8], [9]. A comprehensive study on inflationary patterns in South Asia with special reference to Bangladesh, states that both energy prices and money supply play role in determining inflationary effects [10]. For the growing economies, which are highly sensitive to global energy prices, often result in domestic inflation, the nexus between energy cost and commodity price level has been an important issue [11].

Studies in the context of developing economies show increases in the money supply raise the rate of inflation, particularly when accompanied by growing energy prices [12]. The joint impact of increased energy prices and money supply is considered an important driving force for inflation for most of the developing economies [13], [14]. Experimental proof from different non-industrial nations recommends that energy cost instability, joined with far-reaching monetary approaches, presents huge difficulties for expansion control [15], [16].

On the contrary, in developed nations, the connection between energy costs and expansion has been factual, showing that changes in worldwide oil costs fundamentally influence homegrown expansion rates [17]. According to another research, monetary policy responses to shocks in energy prices can vary significantly across developed economies, influencing inflation outcomes in complex ways [18]. Studies have featured those changes in the cash supply that can communicate with energy value unpredictability to influence expansion, with national banks expecting to adjust these elements cautiously [19]. The combined effect of rising energy costs and broad money-related strategies has been a subject of revenue, particularly in how these variables add to inflationary tensions in cutting-edge economies [19], [20].

Although a considerable volume of research investigates the determinants of expansion in creating economies, the exchange between energy costs and cash supply with regards to Bangladesh remains underexplored. Past investigations have overwhelmingly centered around the general impacts of macroeconomic factors on expansion without diving profoundly into the unmistakable jobs of energy cost variances and financial strategy. For instance, there has been research on whether shocks to the global oil price cause inflation in Bangladesh. There is insufficient empirical evidence regarding the way these energy price dynamics interact with the money supply within the country to influence inflationary pressures.

Moreover, existing studies on inflation in Bangladesh tend to treat energy prices and money supply as isolated factors rather than exploring their combined effects. This approach overlooks the potential for these variables to interact synergistically or antagonistically, leading to more complex inflationary outcomes. Furthermore, with the ongoing global energy market volatility and Bangladesh's increasing dependence on energy imports, it is critical to understand how these external shocks, coupled with domestic monetary policy actions, impact inflation in a developing economy like Bangladesh.

Historically, inflation in Bangladesh is usually higher than in most other countries of the world. Figure 1 shows the inflation rates in Bangladesh from the year 2005 to the year 2023. The lowest inflation, 5.4% was observed in the year 2009 whereas the highest rate was 11.4% in 2011, and the average inflation is about 7% within this period. Another important attribute of inflation in Bangladesh is high fluctuations of rates over the years, which is also harmful for the business and commerce [21].

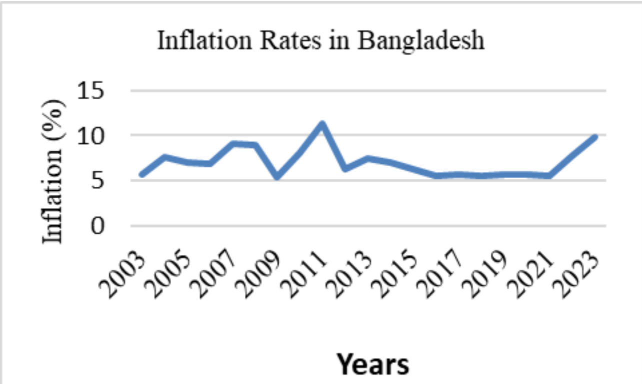


*Figure 1. Inflation rates in Bangladesh: 2003-2023[21], [22]*

The most recent inflation rate is 9.9% which is also very high. It is assumed that besides other factors, the rise of electricity prices 2 to 3 times in recent years, and a significant rise in petroleum prices in 2023 had a key influence in increasing inflation of the country.

Furthermore, while monetary policy has been widely studied on in more extensive terms [23], there is a lack in experimental examination on how changes in the cash supply explicitly add to expansion when considered close by energy cost variances. Given the fast-financial development and primary changes in Bangladesh, this gap presents a potential chance to rethink the determinants of expansion in the ongoing monetary setting. In order to address those gaps, this study offers a thorough experimental examination of the inflationary impacts of both energy costs and cash supply inside the Bangladeshi economy.

By coordinating these factors into a brought-together scientific system, this examination plans to offer novel experiences into their consolidated effect on expansion, consequently adding to the current collection of information and illuminating more viable strategy intercessions. In particular, this study intends to investigate the inflationary effect of energy costs, such as electricity price and petroleum prices on the Bangladeshi economy.

## 2. Literature Reviews

A wide range of research has been conducted to examine the connection between inflation and energy prices in both developed and developing nations, that show a considerable variation depending on economic condition. It is important to understand this relationship for formulating effective economic policy for Bangladesh, an emerging economy with unstable monetary policy and growing energy demand. Recent studies have shown how inflation in the country is affected by energy prices and other factors. A study investigated the impact of oil prices on food price inflation utilizing the Autoregressive Distributed Lag (ARDL) model. According to the test, the variables have a positive and linear association [24]. Another study shows that for the two largest economies of the world, the USA and China, inflation rises due to geopolitical oil price uncertainty besides other factors such as the Euro crisis, national election, trade rivalry, Brexit, etc. [25].

In a similar study, the researchers have explored how global oil price volatility affects inflation in South Asian countries. Both manufacturing and transportation costs rise when oil prices increase, which results in higher inflation. It is interesting to note that, the negative oil price shock does not affect inflation significantly [26]. Monetary policy influences the price level, as explained in [27], [29]. Besides money supply, macroeconomic conditions and global energy prices can affect inflation. To determine the relationship between economic activity, inflation, and oil prices, [28] utilized the Vector Autoregression (VAR) model. According to the research, an increase in the price of oil causes inflation, which in turn causes other economic activities to instantly decline.

The financial markets are more experienced and financial strategies are well established in the developed economies where these relationships offer many considerations for monetary policy. Energy costs significantly affect inflation in affluent economies, influencing both manufacturing and selling expenses. A study of [17] found that the impacts of oil price shocks have shifted over time, with steadily minor effects on prices and wages, along with production and employment.

Another study examined the impact of oil price changes in OECD countries, which proved that the cost of energy can change inflation significantly [30].

The study also found that the inflationary effect of energy prices is higher in the economies where the energy reliance is comparatively higher.

Another study adds to the expanding body of literature by offering new empirical information regarding the correlation between energy price fluctuations and inflation in developed nations. This study incorporates recent data and advanced econometric techniques to provide a clearer picture of how these dynamics have evolved in the current economic environment and with a depth of recent studies examining the impact of energy prices on inflation [16], [17]. This study provides another useful dimension to the literature on inflation by examining the interaction of energy prices and money supply. Integration of Money Supply Dynamics, it investigates how changes in the cash supply can balance the impacts of energy cost shocks on expansion, giving experiences into the complicated exchange between money-related arrangements and energy market vacillations [31].

A dynamic simulated Autoregressive Distributed Lag (ARDL) model was used in a recent study that investigated the inflationary implications of gas and oil prices in the UK [32]. Inflation is impacted by both oil and gas costs, although gas prices have a greater impact. Global energy prices have been also examined on the domestic economy of Turkey, which confirmed an inflationary effect [33]. In a similar study, increases in energy prices are contrasted to rises in gross wages and salaries, as well as increases in import prices resulting from other external shocks [34]. The results of the analysis find that the Croatian economy appears to be susceptible to shocks in energy price increases.

Most of the studies cited above underline that oil prices have a profound impact on inflation. Very few researches were conducted that determine the relationship between electricity price and inflation. One study attempted to understand the relationship between inflation and electricity tariff impacts [2]. The result shows that for the majority of the countries surveyed in Europe, electricity prices pass through to inflation, and the effects have become both sturdy and significant. It has also identified the fact that when a major portion of electricity is generated from renewable sources, inflation is likely to be lower. Another research shows that electricity price shocks have a faster transmission to inflation, with the maximum effect being more than three times the prior period [35].

The research offers practical implications for policymakers by highlighting the need for coordinated monetary policies that consider both energy price trends and money supply changes.

The findings underscore the importance of integrating energy price forecasts into monetary policy decisions to effectively manage inflation and maintain economic stability [36], [37]. This study provides context-specific insights relevant to developed countries like Bangladesh by addressing the gaps in the literature regarding how advanced economies can adapt to global energy price fluctuations while managing domestic monetary conditions.

## 3. Data and Methodology

This section describes the data sources, variables, and analytical procedures used to evaluate the inflationary effect of energy prices under the Toda–Yamamoto causality framework. First, it discusses the dataset and the variables, then it outlines the analytical procedures for evaluating for stationarity, the appropriate specification of models, and the undertaking of causality testing.

### *3.1. Data and Variables*

This study used three time series yearly data from year 2003 to 2023. Consumer price index (CPI), is used as dependent variable, whereas electricity price per unit and oil price per unit were used as independent variables. CPI is used instead of inflation since inflation is a percentage whereas all other variables are numbers. Moreover, as per the data source, inflation is calculated based on percentage change of CPI [21], [22]. Thus, CPI is representative to inflation. Table 1 summarizes the variables used for the data analysis.

*Table 1. Specification of the variables*

| Variable | Symbol | Definition | Source |
|---|---|---|---|
| Consumer Price Index | CPI | Wholesale price of a certain basket of consumer products, where base year is 2010= 100 | World Bank |
| Electricity price | ELP | Minimum electricity price per kWh | Bangladesh Energy Regulatory Commission |
| Oil price | OILP | Diesel price per liter | Bangladesh Petroleum Corporation |

### *3.2. Methodology*

First, the nature of data has been observed from the measures of central tendency, measures of dispersion and the line charts of each time series data.

From the observation it was identified whether the data have any trend and or intercept. Then unit root tests were conducted to check the level of stability of data. Based on the results of unit roots with a combination of 1st and 2nd order difference, the Toda-Yamamoto method (1995) was found to be appropriate for causality test. Finally, normality and stability tests have been done to justify the reliability of the test results. Data has been analyzed using EViews 10 software. Tests used in the study are described below.

### *3.3. Stationarity Test*

Because it is necessary to select an appropriate forecasting model, a stationarity test is significant [38]. When the probability distribution of a time series $Y_t$ stays constant over time, it is considered as stationary. The average, variance, and autocovariance of a stationary time series stay constant over time [39]. The validity of the results of classical regression analysis for a given time series is determined by the concept of stationarity, which is highly significant. On the other hand, only the time under study may be used to examine the behaviour of a time series that has been determined to be non-stationary. As a result, each set of time series data has the potential to be stationary for a given time but not for other periods. Without stationarity time series, regression results could be useless [40]. Several unit root tests are used to verify stationarity; among those Augmented Dicky Fuller (ADF) and Philips and Perron (PP) tests are widely used.

***ADF unit root test***: The non-stationarity of a time series data occurs when there is a unit root. The equation below indicates that a time series with α = 1 has a unit root.

$$Yt = \alpha Yt_{-1} + \beta Xe + \varepsilon \tag{1}$$

where, $Y_t$ denotes the measurement of series data during “t” period. $X_e$ represents an exogenic variable and ε is the mathematical error.

ADF unit root test is conducted using equation (2)

$$\Delta Y_t = \mu + \beta_t + \alpha\, Y_{t-1} + \sum_{i=1}^{k} c_i\, \Delta y_{t-i} \tag{2}$$

where, μ represents a constant term, $\Delta y_t$ means 1st order difference of $Y_t$ or $Y_t - Y_{t-1}$, α is coefficient of $Y_{t-1}$, t means number of year and $\varepsilon_t$ is mathematical error.

### *3.4. PP Unit Root Test*

The Phillips-Perron test corrects test statistics and is more resilient to heteroscedasticity and unspecified autocorrelation in the errors than the Augmented Dickey-Fuller test. The following formula is used for PP test:

$$\Delta Y_t = \alpha + \theta Y_{t-1} + \varepsilon_t \qquad (3)$$

where, $\alpha$ is a constant, $\theta Y_{t-1}$ is an element of a linear trend, and $\varepsilon_t$ is the error term which heteroskedastic.

### *3.5. KPSS Unit Root Test*

Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test is a kind of unit root test that determines whether a given series is stationary around a deterministic trend [33]. It breaks down a series into three independent parts: A stationary error ($\varepsilon_t$), a random walk ($r_t$), and a deterministic trend ($\beta_t$). Equation (4) shows the components.

$$X_t = r_t + \beta_t + \varepsilon_t \qquad (4)$$

The variable will either have a constant term for an intercept or show stationarity with respect to a fixed level if it is stationary [41].

### *3.6. Toda Yamamoto Test*

The Toda-Yamamoto causality test is designed to evaluate the null hypothesis that states there is no "Granger-cause" between two time series. If past values of both time series (X and Y) predict Y significantly better than historical values of Y alone, then X is a Granger cause of another time series (Y) [42].

In a Vector Autoregression (VAR) model, it is essential to take time series data non-stationarity into account. Even in situations where the variables may not be stationarity, the T-Y test includes lag interval for the test of causation. In the absence of stationarity, normal Granger Causality tests may produce biasness in results. This is compensated for by the Toda-Yamamoto procedure by using extra lagged terms and changing the variables as needed. In a VAR framework, T-Y addresses the probability of interactive causalities between data sets, in contrast to normal Granger causality that assume a linear causal alliance [43].

The first step in T-Y Granger Causality test procedure is to select the appropriate lag length, k. The 2nd step is to find the $d_{max}$, or maximum order of integration [44]. When the stationarity tests confirm that the data are stationary at level data, including first and 2nd order data, the maximum difference value, $d_{max}$, will be 2. For a valid model, the lag order $k$ ($k \geq d_{max}$) should be at least equal to $d_{max}$. The next step is to estimate a VAR model of order ($k + d_{max}$). To determine causality, a Block Exogeneity Wald test must be run. The fundamental econometric model, represented by equation (6), must be changed into the VAR system that is described below to perform the Granger Causality test using the the T-Y model:

$$CPI_t = \alpha_0 + M + \Upsilon_{1t} \qquad (5)$$

$$ELP_t = \beta_0 + M + \Upsilon_{2t} \qquad (6)$$

$$OILP_t = \lambda_0 + M + \Upsilon_{3t} \qquad (7)$$

Where,

$$M \equiv \sum_{i=1}^{k} \alpha_{1i}\, CPI_{t-i} + \sum_{i=k+1}^{k+dmax} \alpha_{2i}\, CPI_{t-1} + \sum_{i=1}^{k} \beta_{1i}\, ELP_{t-i} + \sum_{i=k+1}^{k+dmax} \beta_{2i}\, ELP_{t-i} + \sum_{i=1}^{k} \lambda_{1i}\, OILP_{t-i} + \sum_{i=k+1}^{k+dmax} \lambda_{2i}\, OILP_{t-i} \qquad (8)$$

## 4. Analysis and Results

The initial results analyze the descriptive statistics, stationary test and diagnostic checks of the variables. To validate the model, trends in CPI, electricity and oil are analyzed and statistical tests are executed.

Table 2 presents descriptive statistics, where the mean value of CPI is 132.1048 on a 100 index (in the year 2010). It has increased by about 4 times within the observation period of 21 years. Whereas electricity price increased by almost 3 times within the same period with a mean value of BDT 5.08 per kWh and oil price has increased to about 6 times with a mean of BDT 57.57 per liter. All variables have substantial standard deviation compared to the mean. The skewness of data between a range of -1 to +1, reveals a good normality condition of the given variables [45]. CPI and oil price have too peaked distribution as kurtosis of the both are more than 2 and electricity price has a moderate peak with a value of 1.35.

*Table 2. Descriptive statistics*

| | CPI | ELP | OILP |
|---|---|---|---|
| Mean | 132.1048 | 5.080000 | 57.57143 |
| Median | 127.2000 | 5.900000 | 65.00000 |
| Maximum | 237.2000 | 7.800000 | 114.0000 |
| Minimum | 60.00000 | 2.500000 | 20.00000 |
| Std. Dev. | 52.94496 | 2.058893 | 25.51974 |
| Skewness | 0.348787 | -0.300441 | 0.651274 |
| Kurtosis | 2.011848 | 1.347635 | 3.186400 |

The trends of the time series are portrayed in Figure 2. All the variables have intercepts and upward trends over time.

Consumer price index has relatively smooth growth whereas electricity price and oil price have irregular growth trends. That means some of the variables may not be stationary at level data.

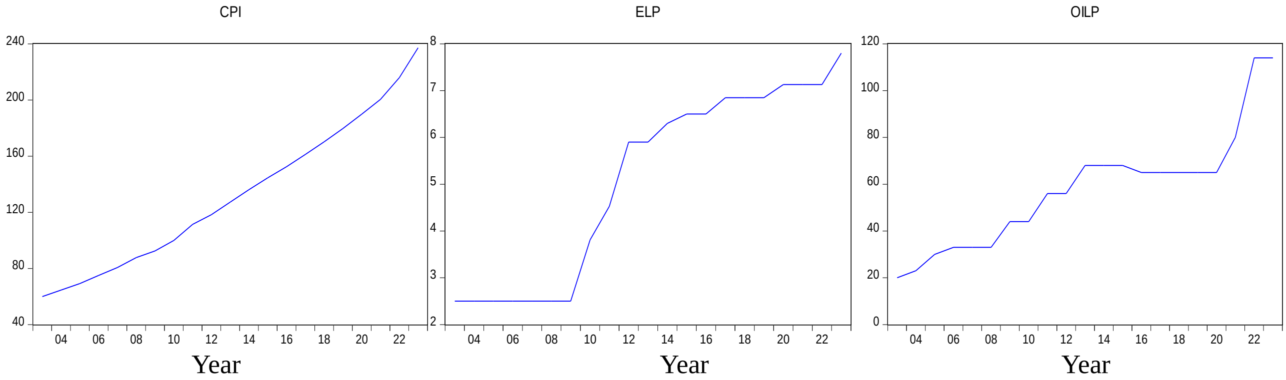


*Figure 2. Trends of CPI, electricity price, and oil price in Bangladesh: 2003-2023*

ADF and PP unit root tests were performed to examine the stationarity of data. Results of those tests are presented in Table 3. According to both ADF and PP tests, consumer price index and electricity price are stationary at 2nd order whereas oil price is stationary at 1st order of integration.

Since there is a combination of 1st and 2nd order integration, T-Y model is used to detect the cointegrating relationship among the variables.

*Table 3. Univariate unit root test results*

| ADF Test | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Level** | | I(1) | | I(2) | | **Order of Integra-tion** |
| | *t*-Statistic | Probability | *t*-Statistic | Probability | *t*-Statistic | Probability | |
| CPI | 2.0787 | 1.0000 | -0.7052 | 0.9575 | -4.0378 | 0.0268 | I(2) |
| ELP | -2.8130 | 0.2107 | -3.1748 | 0.1187 | -7.0671 | 0.0001 | I(2) |
| OILP | -3.2689 | 0.1068 | -3.8274 | 0.0378 | - | - | I(1) |
| **PP Test** | | | | | | | |
| | *t*-Statistic | Probability | *t*-Statistic | Probability | *t*-Statistic | Probability | |
| CPI | 1.5918 | 1.0000 | -0.7218 | 0.9558 | -4.0089 | 0.0282 | I(2) |
| ELP | -1.8040 | 0.6645 | -3.2258 | 0.1090 | -7.0671 | 0.0001 | I(2) |
| OILP | -1.6581 | 0.7317 | -3.8274 | 0.0378 | - | - | I(1) |

The first step of T-Y model test is to determine the maximum order of integration, which is found from ADF and KPSS tests. The KPSS test results is summarized in Table 4.

From both the tests, three types of orders are found, such as level data, 1st order and 2nd order of integration. So, the highest order of integration, $D_{max}$ is 2.

*Table 4. KPSS test results*

| Variables | Critical value at 5% level | Test statistic | | Order of Integration |
|---|---|---|---|---|
| | | Level | 1st Difference | |
| CPI | 0.1460 | 0.1996 | 0.1275 | I(1) |
| ELP | 0.1460 | 0.0993 | - | I(0) |
| OILP | 0.1460 | 0.0742 | - | I(0) |

VAR lag length (k) selection is required before performing the T-Y test. Using sequential modified prediction error, Akaike information criterion, Schwarz information criterion, and results are show Hannan-Quinn information criterion, test statistics were calculated at 5% level of significance. LR, Final in Table 5. As per all criteria, the optimum leg length, k is 2.

*Table 5. Lag length selection*

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -191.7181 | NA | 160059.3 | 20.49664 | 20.64576 | 20.52188 |
| 1 | -104.0944 | 138.3531 | 41.51314 | 12.22047 | 12.81695 | 12.32142 |
| 2 | -89.97162 | 17.83934* | 26.48652* | 11.68122* | 12.72508* | 11.85789* |

** Denotes lag order calculated by different methods*

For T-Y test, three specifications are necessary, such as maximum order of integration ($d_{max}$), lag length (k), and lag for T-Y test. From previous analysis, dmax = 2, and k =2 were found.

So, lag for T-Y test = $D_{max}$ + k = 2 + 2 = 4. Toda Yamamoto test results are shown in Table 6.

The Chi-square probability of all independent variable is 0.00 (less than 5%) means, both electricity and oil price combinedly affect dependent variable consumer price index.

The Chi-square probability of electricity price is 0.0899 (greater than 5%) means it does not affect the CPI significantly. On the other hand, Chi-square probability of oil price is 0.0002 (less than 5%), which means oil price significantly affect the CPI.

A probable explanation of the test results may be drawn from the graphical patterns of the variables (Figure 2). Electricity price did not change at all from the year 2003 to 2009, but price increased sharply from 2010 to 2012, and price increased slowly and more frequently from 2013 to 2023.

*Table 6. Toda Yamamoto Test results*

| VAR Granger Causality/Block Exogeneity Wald Tests | | | |
|---|---|---|---|
| Dependent variable: CPI | | | |
| Excluded | Chi-sq | df | Prob. |
| ELP | 4.817240 | 2 | 0.0899 |
| OILP | 17.33784 | 2 | 0.0002 |
| All | 25.07657 | 4 | 0.0000 |
| Dependent variable: ELP | | | |
| Excluded | Chi-sq | df | Prob. |
| CPI | 1.249329 | 2 | 0.5354 |
| OILP | 2.428422 | 2 | 0.2969 |
| All | 4.797888 | 4 | 0.3087 |
| Dependent variable: OILP | | | |
| Excluded | Chi-sq | df | Prob. |
| CPI | 1.460647 | 2 | 0.4818 |
| ELP | 0.418115 | 2 | 0.8113 |
| All | 1.722242 | 4 | 0.7867 |

In response, the CPI did not change similarly as electricity price, rather it has increased almost at a steady state throughout the period.

Thus, it can be inferred that the change in electricity price could not affect the CPI or inflation significantly.

On the other hand, oil price had a relatively higher rising trend than electricity price except from year 2016 to 2020.

Probably for this reason, it has affected the CPI more significantly. When electricity and oil prices are considered together, it is observed that oil price increased during between 2003 and 2009, while electricity price remained stable.

In contrast, electricity price increased a lot between 2016-2020, whereas oil price did not change.

That means the average price of both the energy sources was growing in line with CPI growth. That is why there is a combined effect of the both energy prices on CPI or inflation.

### *4.1. Normality Test*

In Figure 3, the test statistic of Jarque-Bera is found to be 0.53398 and probability is o.76568.

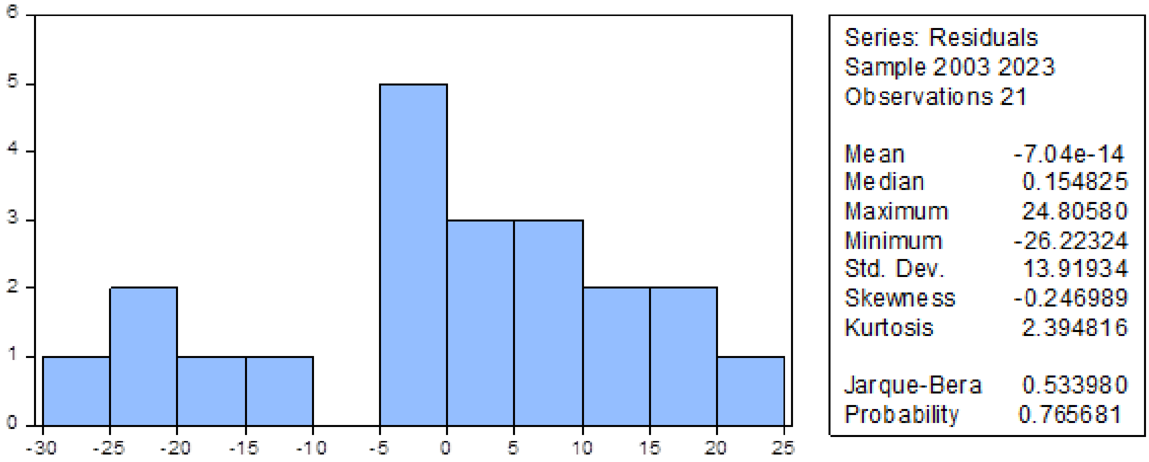


*Figure 3. Normality Test*

As the probability is greater than 5%, the null hypothesis that “the data is normally distributed” is accepted. The normality of data indicates that appropriate statistical tests for data analysis have been performed [46].

The results of two methods of heteroskedasticity tests are summarized in Table 7. According to serial correlation test the probability of Chi-square is 0.0006, a value less than 5%. That means there is autocorrelation in the residual of data.

That means, there is a probability of occurring type α error or probability of denying the null hypothesis when it is correct.

The Heteroskedasticity test shows the probability of Chi-square is 0.053, a value greater than 5%. That means there is no Heteroskedasticity or the data are homoscedastic. Homoscedastic data generates more reliable regression outcomes [47].

*Table 7. Serial Correlation and Heteroskedasticity Test*

| | | | |
|---|---|---|---|
| **Breusch-Godfrey test for Serial Correlation** | | | |
| F-value | 19.77633 | Probability F(2,16) | 0.0000 |
| Observed *R-squared | 14.95168 | Probability Chi-Square(2) | 0.0006 |
| **Breusch-Pagan-Godfrey test for Heteroskedasticity** | | | |
| F-value | 3.493027 | Probability F(2,18) | 0.0523 |
| Observed *R-squared | 5.871561 | Probability Chi-Square(2) | 0.0531 |
| Scaled explained SS | 3.008478 | Probability Chi-Square(2) | 0.2222 |

### *4.2. Model Stability Tests*

The blue line crosses the critical bands with 5% level of significance in the CUSUM test as shown in the first part of Figure 4, which means that there is a probability of having a systematic deviation in the regression coefficient or the residuals may have structural breaks.

On the other hand, the blue line is within the critical band lines in the CUSUMSQ chart. It means the regression coefficient will remain stable in the long run.

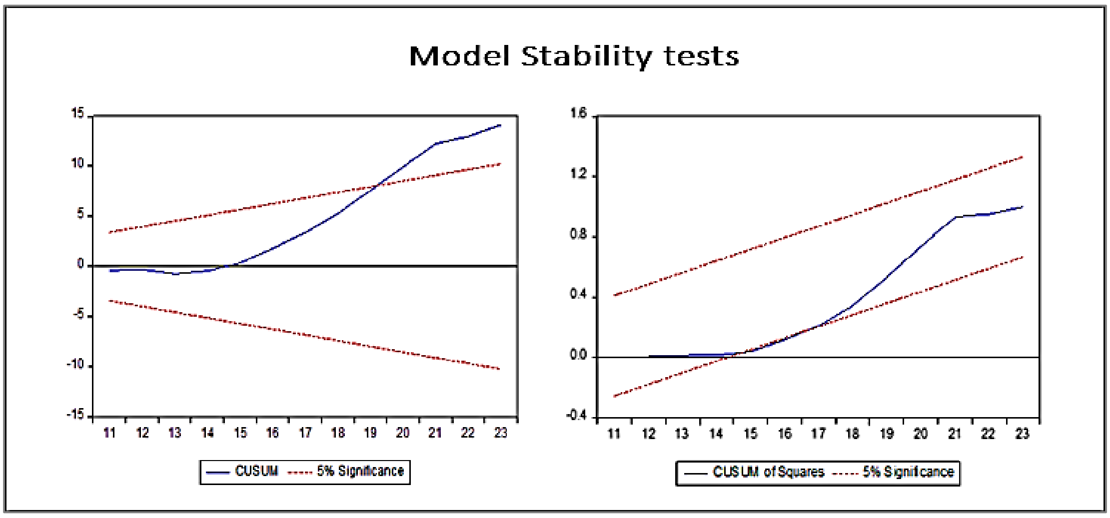


*Figure 4. CUSUM and CUSUMSQ model stability test*

## 5. Conclusion

High inflation, at present which is more than 9%, is one of the major problems of Bangladesh economy. It is often assumed that increasing energy price is one of the causes of accelerating inflation in the country as energy is an important factor of production for most of the commodities. Thus, the area of investigation of this study is how energy prices have impacted inflation in the economy. Time series data on consumer price index, electricity price, and oil price from the year 2003 to 2023 have been used for econometric analysis using EViews software. The line charts show that all the variables have intercepts and upward trends over time. Consumer price index has relatively smooth growth whereas electricity price and oil price have irregular growth trends. ADF and PP stationarity tests have been conducted in order to check for stationarity of the data. According to both tests, consumer price index and electricity price are stationary at 2$^{nd}$ order whereas oil price is stationary at 1$^{st}$ order of integration. Due to the mixed order of 1st and 2$^{nd}$, the Toda Yamamoto test is used to determine the cointegrating relationship between the variables.

The findings of T-Y test show that the Chi-square probability of all independent variable is 0.00 (less than 5%) which means, both electricity and oil price combinedly affect dependent variable consumer price index. The Chi-square probability of electricity price is 0.00899 (greater than 5%) means, it does not affect the CPI significantly. On the other hand, Chi-square probability of oil price is 0.0002 (less than 5%), which means oil price significantly affects the CPI. In summary it can be stated that although both electricity and oil price combinedly affect inflation, the impact of electricity price is insignificant whereas impact of oil price is statistically significant.

The residual diagnostic tests confirm that the data are normally distributed and are homoscedastic. Model stability tests reveal that the time series may have systematic change in the regression coefficient but the model will have long run stability.

Since energy price is very sensitive to inflation which is linked to living cost of all economic classes of people, the energy division should handle energy price change very carefully. In fact, price is increased when energy production cost rises. From the view point of policy making, energy price should not be increased when the real income level of mass population decreases or poverty rate increases. To fill up the gap between cost and price, the government may provide subsidy temporarily at that situation and that practice is common in Bangladesh for many years. When the inflation is at a steady state, energy price may be increased at a reasonable rate. Energy experts also believe that cost of energy production can be minimized by eliminating corruption and inefficiency in the energy sector. Besides, more use of renewable energy sources and energy diversification may contribute to reduction in energy price. Rising foreign exchange rates or crisis of foreign exchange reserve often causes high price of imported oil. To insulate from this risk, government can use forward contract when it is available at a favorable rate to import oil at a bulk amount instead of buying oil from the spot market.

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