ABSTRACT

This paper investigates the major determinants of CPI inflation in Bangladesh by employing Johansen’s Cointegration technique and the associated Vector Error Correction Model using the annual data series from 1980 to 2016. The study examines a wide range of variables covering all major sectors, such as money supply, exchange rate (monetary sector), GDP (real sector), exports, imports (external sector), government expenditure, government revenue (fiscal sector) to find the major determinants of CPI inflation. The paper finds that GDP and imports are the two major sources of CPI inflation while government revenue and money supply have a moderate effect on CPI inflation in the long run. The study also reveals that exports, government expenditure, and exchange rate do not cause CPI inflation rather negatively affect CPI inflation in Bangladesh. In the short run, the previous year’s CPI inflation has a strong influence, while the previous year’s imports has a moderate influence on the current year’s CPI inflation in Bangladesh.

Contribution/ Originality: The study considers a wide range of macroeconomic variables (both supply side and demand side) that effects CPI inflation in the long run by using a robust econometric technique. It will help monetary and fiscal authorities to adopt appropriate policy measures to maintain stable inflation and output growth in Bangladesh.

1. INTRODUCTION

Since price stability is one of the core objectives of sound macroeconomic policy, monetary authorities strive to maintain stable and low inflation rate. The chronic price hike of essentials is a significant symptom of macroeconomic imbalances that should be controlled with an appropriate stabilization policy (Kiguel and Liviatan, 1988; Montiel, 1989). Lipsey et al. (1982, cited in Mortaza [2006]) observe that inflation makes consumers worse off by reducing purchasing power, eroding living standards and creating uncertainties. Cardoso (1981) points out that inflation affects long term economic growth negatively and aggravates poverty through pushing more people under the poverty line. That said, however, Bruno and Easterly (1998) do not find a cross sectional relationship between long run growth and inflation, thus assert that economic growth falls sharply during discrete high inflation. Taslim and Chowdhury (1995) recognize that unanticipated inflation might affect the economic activities and reallocate resources though redistribution of income and wealth. Tanzi and Blejer (1982) recognize that under inflationary
conditions it is difficult to maintain appropriate monetary policy for proper resource allocation. Therefore, inflation control is a basic policy target to achieve macroeconomic equilibrium in the current account of the external sector, monetary account and fiscal deficit account (Blejer and Cheasty, 1988). Although inflationary pressure varies across countries, most of the economic literatures are in consensus that high and unstable inflation is not conducive to economic growth and development (Adekunle, 1968). Nevertheless, developing countries aiming at high economic growth and more employment often make a trade off by allowing high inflation.

Inflation has been a persistent problem in the economic landscape of Bangladesh from the beginning of its independence in 1971 as the poor people are hit harder by inflation, which reduces their purchasing power without a higher income. Although the monetary authority had been able to control inflation at a tolerable level during 1990's compared to the neighbouring countries, overall, the country has experienced high inflation, which is a threat to its financial stability. Bangladesh has experienced 7.74 per cent CPI inflation in contrast to 5.03 per cent average GDP growth, on average, during the period of 1980-2016. Ahmed and Mortaza (2010) find that there is a long term negative relationship between inflation and economic growth in Bangladesh beyond the threshold inflation level of 6 per cent. Hayat and Kalirajan (2009) advocate that inflation threshold level for Bangladesh should be 4-6 per cent for price stability and sustained economic growth. As such, controlling inflation has become a crucial policy issue in Bangladesh for sustainable economic growth (Shahiduzzaman, 2006). Therefore, identifying the major sources of inflation is crucial to curb high inflation, ensure price stability and attain desired levels of economic growth.

2. LITERATURE REVIEW

There are debates about the sources of CPI inflation as different studies explain inflation from different points of views. There are mainly two schools of thought among economists regarding the causes of inflation. One school of thought is from the monetarist point of view and the other is from the structuralist point of view. The monetary point of view argues that inflation is always a monetary phenomenon, based on Milton Friedman's quantity theory of money, which suggests that the increase of money supply in access of real money demand will increase the price level in the long run. The Monetarists’ point of view supports the official IMF position regarding inflation, which suggests that inflation can be controlled by appropriate monetary and fiscal policies. This theory may be valid for developed countries where the market is efficient and structural bottlenecks are comparatively less than that of under-developed countries.

The structuralist point of view argues that inflation rises in the developing countries due to a strong push for development strategies without necessary structural reforms (Taslim, 1982). The study points out that the developing countries pursue rapid growth in the presence of structural constraints, such as market imperfections, imperfect knowledge, rigidities and mismatch between supply and demand across different sectors of the economy. These constraints offer resistances to the policies that are pursued to achieve the desired level of growth and any attempt to overcome those resistances by orthodox policies inevitably gives rise to inflation.

In conventional economic theory, the increase in price level is generally explained via two perspectives: demand-pull inflation, which is due to an increase in demand, and cost-push inflation, which is due to an increase in the cost of production. Demand-pull inflation is related with excess demand of private consumption, investment, government expenditure and net exports. However, the economists are divided in their opinion regarding the causes of increase in demand. The monetary economist believes that aggregate demand increases due to excess money supply in the economy, especially through budget deficit in the developing countries. On the other hand, the Structuralist or Keynesian economist emphasizes the rigidities in the economy mainly come through the labour
market (Keynes, 2006). They point out that the increase in spending beyond full employment level of output will create shortage of goods and services and thereby prices will increase.

Cost-push inflation may arise due to an increase in the cost of factors of production or through any kind of supply shock. In advanced countries, supply shocks generally come from an increase in the oil price or increases in wages that increases the cost of production. However, in addition to oil price and wage increase, there are numerous factors, such as exchange rate depreciation, higher interest rate, higher tariff, indirect taxation or removal of existing subsidies, political instability, natural disasters, which can increase the cost of production in the developing countries. Besides, in case of an open economy, the domestic price may rise due to transmission of trading partner’s inflation through terms of trade effect (changes in relative price of exports and imports) (Taslim and Chowdhury, 1995). While the higher interest rate discourages consumer spending, it increases the cost of borrowing and hence affects the cost of production in developing countries (Mortaza, 2006). Non-economic factors such as political instability, market syndication¹, and natural disaster can increase the cost of production in developing countries.

Inflation also can be explained by the ‘Rational Expectation theory’, which suggests that economic agents forecast inflation based on available information of the past and present (Lucas, 1972; Hansen and Sargent, 1980). For instance, if workers expect high inflation, they will demand a higher nominal wage to retain the same real wage. Therefore, a wage increase without productivity increase will increase the price level of products. Moreover, Taslim and Chowdhury (1995) explain that inflationary expectation alone can generate further inflation without any change in the labour market.

In empirical studies, Loungani and Swagel (2001) developed stylized facts about the inflation process in developing countries. Using annual data (1964 to 1998) of 53 developing countries, they find that factors related with fiscal imbalances such as money growth and exchange rate are more important for countries with the floating exchange rate regime than countries with the fixed exchange rate regime. They also find that internal factors predominantly affect the inflation process in developing countries with the fixed exchange rate regime.

Among the country specific studies, Lim and Papi (1997); Liu and Adefeji (2000); Laryea and Sumaila (2001); Khan and Schimmelpfennig (2006); Abdullah and Kalim (2009); Odusanya and Atanda (2010); Bashir et al. (2011); and Sahadudhhen (2012) have investigated the determinants of inflation in developing countries. Most of the studies have shown monetary variables, especially, money supply as a major determinant of inflation in these countries. For instance, Lim and Papi (1997) using data for the period 1970 to 1995 find that monetary variables, such as money supply and exchange rate depreciation, are major sources of inflation in Turkey. Using the time series quarterly data from 1989 to 1999 in the Islamic Republic of Iran, Liu and Adefeji (2000) show that excess money supply increases inflation, which ultimately intensifies asset substitution (from money to foreign exchange) and weaken real demand for money. They also find that permanent rise in real income increases the demand for money and reduces inflation in the long run. Using quarterly data from 1992 to 1998, Laryea and Sumaila (2001) show that money supply and exchange rate are the major determinants of inflation in Tanzania in the long run. They also find that output negatively affects inflation in Tanzania. They suggest for pursuing contractionary monetary and fiscal policy and increasing output to contain inflation. A study by Khan and Schimmelpfennig (2006) demonstrates that monetary factors, such as money supply and credit to the private sector, have a dominant role for long term inflation in Pakistan. A study to investigate the main determinants of food price inflation by Abdullah and Kalim (2009) finds that inflation expectations, per capita GDP, support prices, food imports and food exports positively affect food price inflation in Pakistan. In the analysis of inflation determinants of Nigeria, Odusanya and Atanda (2010) find that GDP growth, money supply growth, and imports are the main determinants of inflation in Nigeria. They suggest a contractionary monetary policy to reduce inflationary pressure in Nigeria. Using annual data from 1972 to 2010, Bashir et al. (2011) find that money supply, GDP, and imports are the main drivers for

¹Creation of false supply shortage through monopolistic control of essential food items such as sugar, onion, pulses, and edible oil etc.
rising CPI in Pakistan in the long run. A study conducted by Sahadudhhen (2012) finds that GDP and money supply are the main sources of inflation in India.

A number of empirical studies analyses the inflation process to identify the major factors responsible for inflation in Bangladesh. Taslim (1982) analyses inflation with respect to the structuralist-monetarist controversy. He tests three models: one from structuralist point of view, one from monetarist point of view and one hybrid model considering both views and finds that the hybrid model of inflation fits best for Bangladesh. The study concludes that money supply growth and devaluation of local currency are the major causes of inflation in Bangladesh.

In contrast, Begum (1991) formulates an inflation model for Bangladesh using a detailed approach focusing on both aggregate supply and aggregate demand. It finds agricultural and import bottlenecks, government expenditure, interest rate, wage rate, bank credit and expected inflation as significant sources of inflation in Bangladesh. The study concludes that agricultural bottlenecks, interest rate and credit affect inflation from the supply side through the cost push effect. On the other side, import bottlenecks, government expenditures, wage and expected inflation affect inflation from the demand side by stimulating demand. Investigating the relationship between money, price, output and exchange rate from 1974 to 1992, Chowdhury et al. (1995) conclude that (i) inflation in Bangladesh cannot be explained by only from monetarist point of view or structuralist point of view (ii) Monetary shocks have a strong impact on inflation but relatively in the short run.

Akhtaruzzaman (2005) analyses the factors responsible for inflation in Bangladesh by employing the Cointegration Technique and Vector Error Correction Model based on quarterly data from 1973 to 2002. The study finds that inflation is negatively related with real income and both the level and rate of depreciation of exchange rate, money supply growth, and deposit interest rate have significant role in explaining the inflationary process in Bangladesh. Using a similar kind of technique, Arif and Ali (2012) show that government expenditure and money supply have significant positive effect, while government revenue and exports have negative effect on inflation in Bangladesh based on annual data from 1978 to 2010. Using variables similar to Akhtaruzzaman (2005) and by employing an unrestricted VAR system, Mortaza (2006) shows that money supply and exchange rates positively affect, while the deposit interest rate negatively affects inflation in Bangladesh. Hossain and Islam (2013) by employing the Ordinary Least Square (OLS) method and by using annual data from 1990 to 2010 find that money supply and one year lagged value of interest rate have significant positive effect on CPI inflation in Bangladesh.

Khatun and Ahamad (2012) show both the short-run and long-run elasticities of the major determinants of inflation in Bangladesh by using an Unrestricted Error Correction Model version Autoregressive Distributed Lag (ARDL) bounds F-test based on data from 1981 to 2009. The study demonstrates that domestic rice production affects inflation negatively in the short-run but domestic petroleum price and broad money supply have low but positive impact on inflation in Bangladesh. The paper suggests for increasing domestic rice production and effective fiscal monetary coordination to curb inflation. Using an ARDL Cointegration Approach, Afrin (2013) analyses the relationship between fiscal deficit and CPI based on annual data from 1974 to 2010. She finds that fiscal deficit has long run inflationary effects and factors such as real GDP, inflation expectations and the exchange rate also affect inflation in Bangladesh.

The analysis of the previous empirical studies from 1982 to 2013 suggests that both demand-side and supply-side factors are relevant in explaining the inflation dynamics of Bangladesh. Prior studies, such as Taslim (1982); Begum (1991); Chowdhury et al. (1995) focused on both monetary and structuralist factors to explain the inflationary process in Bangladesh while recent major studies, such as Akhtaruzzaman (2005); Mortaza (2006); Khatun and Ahamad (2012) and Afrin (2013) focussed on either supply-side factors or demand-side factors in explaining inflation in Bangladesh. This paper attempts to fill the gap by taking account a wide range of variables from monetary sector (money supply, exchange rate), real sector(GDP), external sector(exports, imports), fiscal sector (government expenditure, government revenue) to cover both supply and demand side of the economy.
The objective of the study is to investigate the major determinants of CPI inflation in Bangladesh over a long period (1980-2016). This study contributes to the existing literature in several ways. First, the study considers a wide range of macroeconomic variables (both supply side and demand side) that are believed to affect CPI inflation in the long term by using a robust econometric technique. Second, the study adds to the empirical work of inflation determinants in Bangladesh by extending the coverage of the study to more recent data. Finally, the results of the study might provide a quantitative benchmark for the relative importance of various sources of inflation in Bangladesh. Thus, the study shall help financial and fiscal regulatory authorities to adopt appropriate policy measures to curb high inflation, ensure price stability and maintain sustainable economic growth.

The key findings of the paper is that GDP and imports are two major determinants of CPI inflation in Bangladesh in the long run, where GDP affects CPI through demand side by raising the aggregate demand and imports affect CPI through supply side by increasing the cost of production. Government revenue and money supply have moderate effects on CPI inflation in Bangladesh. On the other hand, Exports, exchange rate and government expenditure do not cause CPI inflation in the long run rather negatively affect CPI inflation. The results suggest that not only monetary policy but also fiscal policy is crucial for that maintaining price stability in Bangladesh.

The remainder of the paper is structured as follows: section 3 briefly explains the model, section 4 describes the data, section 5 explains the methodological issues, section 6 provides the results and discussions, and section 7 discusses about the validity and robustness of the model. Section 8 gives the conclusion and policy implications based on empirical results.

3. ECONOMETRIC MODEL

Identification of the sources of CPI inflation is important as high inflation poses the risk of destabilization of the economy due to its adverse effects on the economy. Proper specification of the model is important for the robustness of the results. The determinants of inflation vary across countries due to different structures of the economy. In developed countries, inflation is generally a monetary phenomenon i.e. inflation mainly comes from demand side factors while in developing countries, inflation is not a pure monetary phenomenon as there are structural bottlenecks (rigidities, market imperfections), which means that inflation can come from both the demand and supply side factors. Therefore, variables from all sectors, such as money supply, exchange rate (monetary sector), GDP (real sector), exports, imports (external sector), government expenditure, government revenue (fiscal sector) are considered to see whether CPI inflation moves with those variables and their extent of influence on CPI. The specified model is:

\[ \text{LCPI}_t = \alpha + \beta_1 \text{LBM}_t + \beta_2 \text{LGDP}_t + \beta_3 \text{LXP}_t + \beta_4 \text{LIM}_t + \beta_5 \text{LGE}_t + \beta_6 \text{LGR}_t + \beta_7 \text{LEX}_t + \varepsilon_t \]

where LCPI stands for log of Consumer Price Index (CPI) based on 2000 prices, LBM for log of broad money, LGDP for log of gross domestic product (GDP), LXP for log of exports, LIM for log of imports, LGE for log of government expenditure, LGR for log of government revenue, LEX for log of Exchange rate (BDT/US$), $\varepsilon_t$ for white noise, and $t$ for yearly time index.

The model is specified in log-log format so that we can get percentage-percentage relationship i.e. elasticity of CPI with respect to broad money, GDP, exports, imports, government expenditure, government revenue and exchange rate.

4. DATA

The study uses annual time series data (1980 to 2016) from World Bank and IMF World Economic Outlook October 2017 database as quarterly time series data for all variables are not available. GDP, Broad Money, Exports,
Imports, and Exchange rate data are collected from the World Bank while CPI, Government expenditure, Government revenue data are collected from IMF World Economic Outlook October 2017 database. Those data were verified with local sources such as Bangladesh Bank, Ministry of Finance, and Bangladesh Bureau of Statistics.

5. METHODOLOGY

Multiple structural breaks in the data are checked through global Bai-Perron test by allowing up to two break points to see if there any structural break exists in the data (since data series is small). The presence of unit root in the data is tested by using Augmented Dickey Fuller (ADF) test. Johansen Co-integration technique is used to find whether any long run relationship exists between CPI and its determinants (Broad money, GDP, exports, imports, government expenditure, government revenue and exchange rate) or not. When it is found that there exists long run relationship between CPI and other variables, then, a Vector Error Correction Model (VECM) for CPI inflation is estimated to show how the short run dynamics of inflation changes to hold the long run equilibrium relationship.

5.1. Stationary of the Data

Although classical econometric theory assumes that the macroeconomic data are stationary (means and variances are constant over time), graphical representation of economic data and historical record of economic forecasting reveal that most of the macroeconomic data are non-stationary (means and variances are not constant over time) as supported by Nelson and Plosser (1982). Engle and Granger (1987) define that a time series which is stationary in levels is integrated of order zero, denoted as I (0), while a time series that becomes stationary after first difference is called integrated of order one, denoted as I(1). The I(0) data series is mean reverting, as there is a tendency that the series frequently return to its mean and the series has a limited memory of its past behaviour which implies that the effects of a random innovation are only transitory. In contrast, I(1) data series wanders widely and it has long memory which implies that the effects of an innovation is permanent. Non-stationary variables drift from their mean due to the presence of a trend which is more often stochastic in nature (random walk process) induced by persistent accumulation of past effects and this process is called unit root process. There can be many reasons why the economic data may be non-stationary such as evolution of the economy, technological shock, legislative changes and political turmoil etc (Hendry and Juselius, 2001). For instance, technology encompasses the persistence of acquired knowledge through all point in time and therefore present technology is the accumulation of past discoveries and innovation. Therefore, the economic variables closely related with technological progress are likely to have stochastic trend. Any structural break such as structural change in global oil market is another example of non-stationarity of the data.

Non-stationary macroeconomic data with stochastic trend can lead to spurious regression as the data are trended which characterized by a fairly high R² statistic, a low Durbin-Watson (dw) statistic and a huge t-statistic (Granger and Newbold, 1974). Therefore, regression of the non-stationary variables may lead to false conclusion as the usual test statistics are misleading because the distributions of the conventional test statistics are very different from those derived under the stationarity assumption. Phillips (1986) also shows that the OLS estimator diverges in probability as the sample size increases and t-statistic and F-statistic do not have well-behaved asymptotic distributions and dw-statistic converges to zero. Therefore, we need stationary data for a valid economic interpretation of any empirical results generated from the statistical techniques. Hence, stationarity condition including any structural break of all the economic variables are checked before using them in statistical model.

5.2. Structural Break Test

Multiple structural breaks in the data are tested through Global Bai-Perron test of L optimized breaks against the null of no structural breaks based on Bai and Perron (2003a). Maximum two break points are allowed in the
test, as the sample size is small (37 only). Critical value $c = 0.25$ is used for checking one or two structural breaks according to Bai and Perron (2003b). Within the allowed structural breaks, the test does not find any structural break in the data.

<table>
<thead>
<tr>
<th>Maximum allowed break point</th>
<th>Selected Break</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>None</td>
</tr>
</tbody>
</table>

Source: Output generated by the author by using Global Bai-Perron test with Eviews 9 software

5.3. Unit Root Test

The stationarity of the time series data are checked through the Augmented Dickey Fuller (ADF) test based on Dickey and Fuller (1981). The simplest approach of the Dickey Fuller test for a unit root begins with AR (1) process where $y_t = \beta_0 + \rho y_{t-1} + \varepsilon_t$ where $\rho = 1$ means that stochastic variable $y_t$ has a unit root, $\varepsilon_t$ is normally distributed white noise term. This test is valid only if $\varepsilon_t$ is normally distributed. If there is serial correlation in the Dickey Fuller test equation i.e. the true model is not AR(1), then the test equation should be augmented by adding more lags i.e. we should use AR(p) to get rid of serial correlation. The ADF test uses an AR(p) process expressed in first difference of the variables for testing unit root:

$$\Delta y_t = \beta_0 + \beta_1 t + \gamma y_{t-1} + \sum_{i=0}^{p} \delta_i \Delta y_{t-i} + \varepsilon_t,$$

where $\Delta y_t = y_t - y_{t-1}$, $\beta_0$ is the intercept, $t$ denotes a linear time trend (deterministic). The lag length $p$ is chosen to avoid serial correlation in the error term. Specification of lag length is important issue in ADF test because if $p$ is too small, then the remaining serial correlation in error will bias the test but if $p$ is too large then the power of the test will supper. Schwarz Information criterion (SIC) proposed by Schwarz (1978) has been used to choose the lag length in the test. The null hypothesis that the series has a unit root i.e. $H_0: \gamma = 0$ is tested against the alternative hypothesis $H_1: \gamma < 0$. According to Dickey and Fuller (1981) under the null ($\gamma = 0$) the standard t-ratio does not have t-distribution, not even asymptotically. The reason behind this is the non-stationary process invalidates standard results on the distribution of the OLS estimator $\hat{\gamma}$. The distribution is skewed to the left so that the critical values are smaller than those for normal approximation of t-distribution are. Therefore, the calculated test statistic is compared with critical value based on simulations response surface regression by MacKinnon (1996). If the absolute value of the test statistic greater than the critical value, null hypothesis of unit root is rejected and the $y_t$ series is treated as stationary in level i.e. $y_t \sim I(0)$. The ADF test can be done based upon a regression with or without a trend. If a graphical representation of the series indicates that a clear positive or negative trend, it is appropriate to perform the ADF test with a trend.

The graphical representation shows that all the variables have drift and time trend at level. Therefore, at level, both constant and trends are included in the test equation to test the stationarity of the series. The estimated results show that the null hypothesis for all the variables cannot be rejected at 5 per cent significance level except...
LEX, which means all the variables except LEX are non-stationary at levels. The graphical representation of all variables except LEX at first difference does not show any time trend.

Table 2. ADF Unit root test results

<table>
<thead>
<tr>
<th>Variables at level, with constant &amp; trend</th>
<th>ADF test Statistic</th>
<th>p-value</th>
<th>Order of Integration</th>
<th>Variables at first difference with constant</th>
<th>ADF test Statistic</th>
<th>p-value</th>
<th>Order of Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPI</td>
<td>-2.715415</td>
<td>0.2373</td>
<td>I(1)</td>
<td>ΔLCPI</td>
<td>-3.090760</td>
<td>0.0368</td>
<td>I(0)</td>
</tr>
<tr>
<td>LBMI</td>
<td>-3.392787</td>
<td>0.0682</td>
<td>I(1)</td>
<td>ΔLBMI</td>
<td>-3.404407</td>
<td>0.0175</td>
<td>I(0)</td>
</tr>
<tr>
<td>LGDP</td>
<td>-2.891537</td>
<td>0.1773</td>
<td>I(1)</td>
<td>ΔLGDP</td>
<td>-4213287</td>
<td>0.0022</td>
<td>I(0)</td>
</tr>
<tr>
<td>LXP</td>
<td>-2.056259</td>
<td>0.5517</td>
<td>I(1)</td>
<td>ΔLXP</td>
<td>-9.858424</td>
<td>0.0000</td>
<td>I(0)</td>
</tr>
<tr>
<td>LIM</td>
<td>-2.552913</td>
<td>0.3115</td>
<td>I(1)</td>
<td>ΔLIM</td>
<td>-7.248361</td>
<td>0.0000</td>
<td>I(0)</td>
</tr>
<tr>
<td>LGE</td>
<td>-2.793257</td>
<td>0.2088</td>
<td>I(1)</td>
<td>ΔLGE</td>
<td>-6.522622</td>
<td>0.0000</td>
<td>I(0)</td>
</tr>
<tr>
<td>LGR</td>
<td>-2.641361</td>
<td>0.2660</td>
<td>I(1)</td>
<td>ΔLGR</td>
<td>-6.165026</td>
<td>0.0001</td>
<td>I(0)</td>
</tr>
<tr>
<td>LEX</td>
<td>-5.671140</td>
<td>0.0002</td>
<td>I(0)</td>
<td>ΔLEX</td>
<td>-6.502079</td>
<td>0.0000</td>
<td>I(0)</td>
</tr>
</tbody>
</table>

Source: Output generated by the author by using Augmented Dickey Fuller Unit root test with Eviews 9 software.

Therefore, all variables except LEX at first difference are tested with constant only while LEX at first difference is tested with constant and time trend. All variables at first difference reject the null hypothesis of unit root at 5 per cent significance level. Therefore, all the variables are stationary after the first difference.

5.4. Co-Integration

Unit root in macroeconomic time series data has spurred the development of the theory of non-stationary time series analysis because modelling the non-stationary time series data can provide a good approximation of long run behaviour of the economic variables (Stock and Watson, 1988a). Engle and Granger (1987) point out that if two or more non-stationary variables are integrated of the same order, there might be a linear combination among the variables that is stationary. For instance, if two time series $X_t$ and $Y_t$ are both I(1) variable, then there exists a $\beta$ such that $Z_t = Y_t - \beta X_t$ is I(0). If such a linear relationship exists, then $X_t$ and $Y_t$ are co-integrated and $(1, -\beta)'$ being called cointegrating vector for $(Y_t', X_t')'$. Stock and Watson (1988b) observe that cointegrated variables share at least one common trend provides a way to understand cointegrating relationship. As both $Y_t$ and $X_t$ are I(1), they will be dominated by long wave components but not $Z_t$ as it is I(0). This means that the long run components of $Y_t$ and $\beta X_t$ virtually cancel out each other to produce $Z_t$. The stationary linear combination is called co-integrating equation and can be used to interpret the long run relationship among the variables. In this case, the deviation from long run relationship will be temporary.

5.5. Johansen Cointegration Test

Although there are several methods for cointegration tests, the most general method is the multivariate test based on Vector Autoregressive Representation (VAR) model shown by Johansen (1988) and Johansen and Juselius (1990). This method develops a maximum likelihood estimation procedure to test for number of cointegrating equations. Johansen procedure starts with a VAR representation of $Z_t$ as follows:
where $Z_t$ is a $k$-vector of non-stationary variables, $A_t$ is a $k \times k$ matrix of parameters, $p$ is the number of lags, $W_t$ is a $d$-vector of deterministic variables (a constant or a constant and time trend), and $\varepsilon_t$ is a vector of innovation. This VAR ($p$) model can be written as the following VECM ($p-1$):

$$\Delta z_t = \pi z_{t-1} + \eta_1 \Delta z_{t-1} + \cdots + \eta_{p-1} \Delta z_{t-p+1} + \varnothing w_t + \varepsilon_t$$

where

$$\pi = -(I - A_1 - \cdots - A_p), \eta_i = -\sum_{j=z_i+1}^{p} A_j$$

Since $Z_t$ is non-stationary, $\Delta Z_t$ will be stationary but the right side of the equation contains both stationary and non-stationary processes. Hence $\pi$ must have reduced rank which implies that only a stationary linear combination of $Z_{t-1}$ can allow for stationarity of $\Delta Z_t$. According to Granger's representation theorem if the coefficient matrix $\pi$ has reduced rank ($r < k$), then $\pi$ can be decomposed into two matrices $\alpha \times \beta$, both of which are $k \times r$ such that $\pi = a \beta'$ and $\beta' z_t$ is $I(0)$ (Engle and Granger, 1987). Therefore, $r$ is the number of cointegration rank (co-integrating relations) and each column of $\beta$ is the cointegrating vector and $\alpha$ is the adjustment parameter in VEC model. Johansen approach estimates the above VECM by maximum likelihood, while imposing the restriction $\pi = a \beta'$ for a given value of $r$.

The first step in Johansen approach is to test the hypothesis of reduced rank of the long run impact matrix, $\pi$ by using trace test and maximum eigenvalue test. The trace test examines the hypothesis $H_0: r \leq r_0$ versus the alternative $H_1: r_0 < r \leq k$ using the following statistic:

$$\lambda_{trace}(r_0) = -T \sum_{j=r_0+1}^{k} \log(1 - \hat{\lambda}_j)$$

where $T$ is the number of observation and $\hat{\lambda}_j$ is the estimated eigenvalue of the $k \times k$ matrix. The maximum eigenvalue test examines the hypothesis $H_0: r \leq r_0$ versus the alternative $H_1: r = r_0 + 1$ based on the estimated $(r_0 + 1)$th largest eigenvalue using the following statistic:

$$\lambda_{max}(r_0) = -T \log(1 - \hat{\lambda}_{r_0+1})$$
Although both the trace and maximum eigenvalue test are a likelihood ratio test, they do not have usual $\chi^2$ distributions. Johansen (1991) finds that asymptotic distribution for likelihood ratio test statistic for cointegration is non-standard as the distributions depend on the deterministic components and whether these are restricted or unrestricted in the model. Verbeek (2012) points out that the appropriate distributions of cointegration test are the multivariate extensions of Dickey Fuller distributions and the percentile of the distributions depends on the assumptions made with respect to deterministic trend. Therefore, before testing for number of cointegrating vector, we need to make an assumption about the deterministic components as the series may have non-zero means and deterministic trends as well as stochastic trends. Moreover, cointegrating equations may contain intercepts and deterministic trends. Johansen test uses five deterministic trend assumptions: (i) the level data have no deterministic trends and the cointegrating equations do not have intercepts (ii) the level data have no deterministic trends and the cointegrating equations have intercepts (iii) the level data have linear trends and but the cointegrating equations have only intercepts (iv) the level data and the cointegrating equations have linear trends (v) the level data have quadratic trends and the cointegrating equations have linear trends (Johansen, 1995).

In the second step, Johansen procedure provides the maximum likelihood estimates of all possible unrestricted cointegrating relations $\hat{\beta}Z_t$ based on chosen normalization.

5.6. Vector Error Correction Model (VECM)

A VECM is a restricted version of VAR model designed for use with non-stationary series that are known to be cointegrated. The model has cointegration relations built into the specification so that it restricts the long run behaviour of the endogenous variables to converge to their cointegrating relationships by allowing short run adjustment dynamics. For instance, in a bi-variate system if both $X_t$ & $Y_t$ are I(1) variable and they have a cointegrating vector $\begin{pmatrix} 1 \\ -\beta \end{pmatrix}$, then there exists an error correction representation with the form $Z_t = Y_t - \beta X_t$ (Engle and Granger, 1987). The corresponding VECM will be:

$$\Delta X_t = \delta_1 + \sum_{j=1}^p \Theta_{1j} X_{t-j} + \sum_{j=1}^p \gamma_j Y_{t-j} + \alpha_1 Z_{t-1} + \varepsilon_1$$

$$\Delta Y_t = \delta_2 + \sum_{j=1}^p \Theta_{2j} X_{t-j} + \sum_{j=1}^p \gamma_{2j} Y_{t-j} + \alpha_2 Z_{t-1} + \varepsilon_2$$

where $Z_{t-1}$ is the error correction term and $\varepsilon_1 \& \varepsilon_2$ are white noises. In the long-run equilibrium, $Z_{t-1}$ is zero. However, if $X_t$ and $Y_t$ deviate from the long run equilibrium, $Z_{t-1}$ will be nonzero and in this case, each variable will adjust to partially restore the equilibrium relationship. The coefficient $\alpha_j$ accounts for the speed of adjustment, while $\Theta_{ij}$ represents short run dynamics coefficient of the $i$-th endogenous variable towards the equilibrium.

Therefore, when two variables have long run cointegrating relationship, error correction model can describe short run dynamics consistently with long run dynamics. In fact, short run dynamics depends on the deviation from long run relationship means that the time paths of the cointegrated variables are influenced by the extent of any
deviation from long run equilibrium. Therefore, the movement of at least one of the variables must respond to the magnitude of disequilibrium so that the system can return to the long run equilibrium (Enders, 2004).

6. RESULTS AND DISCUSSION

6.1. Cointegration Rank Results

In this estimation, the Johansen procedure is applied to a VAR (1) model to test for cointegrating relations. The lag length of VAR is chosen based on the Schwarz Information Criterion (SIC) as the sample size is small (Schwarz, 1978). To specify the deterministic trend, case-iii (which assumes that all the series in level have linear trends but the co-integrating equations have only intercepts) of the Johansen test are used. The reason behind the choice of this deterministic trend is that in the unit root test, critical values of Dickey Fuller statistics for all variables improve when a time trend is considered and all the series are stationary at first difference. Therefore, it is believed that all the variables have stochastic time trend at levels.

Table 3 demonstrates that trace test rejects the null hypothesis of no cointegrating equation (test statistic (=251.91) > critical value (=159.53)), at most 1 cointegrating equation (test statistic (=176.12) > critical value (=125.62)), at most 2 cointegrating equation (test statistic (=110.88) > critical value (=95.75)) at the 5 per cent significance level. Thus, trace test indicates that there are three cointegrating equations at the 5 per cent significance level.

Table 4 demonstrates that Maximum Eigenvalue test rejects the null hypothesis of no cointegrating equation (test statistic (=75.80) > critical value (= 52.36)), at most 1 cointegrating equation (test statistic (=65.23) > critical value (=46.23)), at most 2 cointegrating equation (test statistic (=46.14) > critical value (=40.08)) at the 5 per cent significance level. Thus, the test indicates that there are three cointegrating equations at the 5 per cent significance level.
As both Trace and Eigenvalue tests indicate that there are three cointegrating relationships among the considered variables, meaning that there is strong relationship among those variables.

6.2. Estimation of VECM

Since Johansen Cointegration test indicates strong relationship among the variables, a VECM has been estimated for LCPI, which is as follows:

Estimated VECM for LCPI:

\[
D(LCPI) = C(1)*(LCPI(-1) - 0.186*LBM(-1) - 1.438*LGDP(-1) + 0.463*LXP(-1) - 0.572*LIM(-1) + 0.353*LGE(-1) - 0.217*LGR(-1) + 0.698*LEX(-1) + 0.678) + C(2)*D(LCPI(-1)) + C(3)*D(LBM(-1)) + C(4)*D(LGDP(-1)) + C(5)*D(LXP(-1)) + C(6)*D(LIM(-1)) + C(7)*D(LGE(-1)) + C(8)*D(LGR(-1)) + C(9)*D(LEX(-1)) + C(10)
\]

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-0.036705</td>
<td>0.076046</td>
<td>-0.482672</td>
</tr>
<tr>
<td>C(2)</td>
<td>0.455255</td>
<td>0.160665</td>
<td>2.83563</td>
</tr>
<tr>
<td>C(3)</td>
<td>0.082429</td>
<td>0.093624</td>
<td>0.880433</td>
</tr>
<tr>
<td>C(4)</td>
<td>0.296037</td>
<td>0.217706</td>
<td>1.359804</td>
</tr>
<tr>
<td>C(5)</td>
<td>-0.101027</td>
<td>0.029271</td>
<td>-0.349732</td>
</tr>
<tr>
<td>C(6)</td>
<td>0.155818</td>
<td>0.076444</td>
<td>1.776698</td>
</tr>
<tr>
<td>C(7)</td>
<td>0.029020</td>
<td>0.096763</td>
<td>0.299902</td>
</tr>
<tr>
<td>C(8)</td>
<td>0.014875</td>
<td>0.041908</td>
<td>0.354951</td>
</tr>
<tr>
<td>C(9)</td>
<td>0.009633</td>
<td>0.078262</td>
<td>0.123082</td>
</tr>
<tr>
<td>C(10)</td>
<td>0.003772</td>
<td>0.004497</td>
<td>0.838799</td>
</tr>
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</table>

Source: Estimated VECM by the author with Eviews 9 software

As Johansen test shows that all the variables are cointegrated, the coefficient of error correction term for inflation equation should be negative and significant for quicker convergence to the long run relationship. In this case, the coefficient of error correction term, \( C(1) \) as -0.036705, which is negative but insignificant as the corresponding P-value is 0.6335. This means in response to a shock in the system, CPI inflation decline in order to correct 3.7 per cent of the deviation from long run equilibrium. Small and insignificant adjustment coefficient for error correction term indicates that fluctuation of CPI inflation is rectified slowly through adjustment of other variables. By specifying the long run determinants of inflation in the VECM, short run dynamics are also estimated with long run dynamics.

### Table 5. Short run adjustment coefficient

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CointEq1</td>
<td>-0.036705</td>
<td>0.238236</td>
<td>0.042999</td>
<td>-1.072246</td>
<td>0.199744</td>
<td>0.142792</td>
<td>0.584136</td>
<td>-0.340659</td>
</tr>
<tr>
<td>Std. Error</td>
<td>(0.07605)</td>
<td>(0.14373)</td>
<td>(0.05299)</td>
<td>(0.52884)</td>
<td>(0.23562)</td>
<td>(0.17491)</td>
<td>(0.14064)</td>
<td>(0.14064)</td>
</tr>
<tr>
<td>t-statistics</td>
<td>[-0.48267]</td>
<td>[1.65758]</td>
<td>[0.81141]</td>
<td>[-2.02756]</td>
<td>[0.84775]</td>
<td>[0.81638]</td>
<td>[1.57146]</td>
<td>[-2.42225]</td>
</tr>
</tbody>
</table>

Source: Output generated by the author by using Vector Error Correction Model with Eviews 9 software

From Table 5, it is seen that the error correction term is statistically significant in at least two (LXP and LEX) of the eight equations, which provides evidence of cointegration between LCPI and other seven variables (LBM, LGDP, LXP, LIM, LGE, LGR, LEX).

VECM for LCPI shows that previous year’s inflation affects the current year’s inflation in the short run. The coefficient of the previous year’s LCPI differential, D(LCPI(-1)) is 0.46, and corresponding P-value is 0.009 (i.e. significant at 1 percent level). It means that 1 per cent CPI inflation in the previous year contributes 0.46 per cent CPI inflation in the current year. This indicates that price expectations (the previous price) have a substantial role in price formation in Bangladesh, which means the price level is sticky and rigid to the adjustment by any policy.
The estimated model shows that the coefficient of the previous year’s import differential is 0.14, and corresponding P-value is .087, i.e. significant at 10 per cent level. It means that 1 per cent increase in import causes 0.14 per cent CPI inflation in the short run. This indicates that import has a role in the short run for explaining CPI inflation in Bangladesh.

6.3. Estimation of Long Run Relationship

Table 6. Normalized cointegrating coefficients (standard error)

<table>
<thead>
<tr>
<th></th>
<th>LCPI</th>
<th>LBM</th>
<th>LGDP</th>
<th>LXP</th>
<th>LIM</th>
<th>LGE</th>
<th>LGR</th>
<th>LEX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.000000</td>
<td>-0.186363</td>
<td>-1.437819</td>
<td>0.462700</td>
<td>-0.572135</td>
<td>0.553334</td>
<td>-0.217430</td>
<td>0.698129</td>
</tr>
<tr>
<td></td>
<td>(0.09970)</td>
<td>(0.21022)</td>
<td>(0.04612)</td>
<td>(0.10282)</td>
<td>(0.14265)</td>
<td>(0.03787)</td>
<td>(0.11447)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Output generated by the author by using Vector Error Correction Model with Eviews 9 software

Long run inflation model:

\[
\text{LCPI} = 0.19^*\text{LBM} + 1.44^*\text{LGDP} - 0.46^*\text{LXP} + 0.57^*\text{LIM} - 0.35^*\text{LGE} + 0.22^*\text{LGR} - 0.70^*\text{LEX} - 0.68
\]

The long run inflation model, which represent long run relationship between CPI and other variables has been deduced from normalized cointegrating equation \((\text{LCPI} - 0.19^*\text{LBM} - 1.44^*\text{LGDP} + 0.46^*\text{LXP} - 0.57^*\text{LIM} + 0.35^*\text{LGE} - 0.22^*\text{LGR} + 0.70^*\text{LEX} + 0.68 = 0)\) by reversing sign of all variables other than the LCPI.

The above estimate shows that GDP has strong positive impact on CPI inflation in Bangladesh. The coefficient of LGDP is 1.44, which indicates that for a 1 per cent increase in GDP increases the consumer price index by 1.44 per cent holding other variables constant in the long run. The positive coefficient of GDP implies that GDP affects CPI through demand side i.e. when the economic output increases, real income of consumers increases, and with higher real income demand of goods and services goes up more than available supply. Higher demand of goods and services than available supply pushes the price up to clear the market. This demand-pull inflation is evident from the fact that per capita income of Bangladesh has grown more than 4.78 times due to consistent economic growth (Bangladesh achieved 5.03 per cent GDP growth on average) over the period of 1980-2016 (World Bank).

The long run estimate demonstrates that imports is another major source of inflation in Bangladesh after GDP as it also has significant positive impact on CPI inflation. The coefficient of imports is 0.57, which implies that for 1 per cent increase in imports causes 0.57 per cent CPI inflation holding other variables constant. The positive coefficient of import indicates that import costs due to higher import tariff or high international commodity prices transmit into the local economy, increases the cost of production, and pushes the local price level high. According to Bangladesh Bank data, Bangladesh mainly imports raw materials for its Ready Made Garments (RMG) industry, petroleum products (used as energy inputs to the local industries) and food items from the global market. Therefore, an increase in fuel price in the international market increases the price of fuel in the local market, which eventually increases cost of energy inputs of the local industries and increases their cost of production. If tariff rate is considered, Bangladesh’s average applied tariff rate stood at 13 percent in 2016 from 105 percent in 1989. Despite that, this rate is the highest in South Asia and much higher than the countries in Southeast Asia (World Bank). Moreover, inefficiency of the ports causes longer lead-time for importing raw materials of the local industries. According to World Bank data, it requires 33.6 days on average to import goods in Bangladesh, while it takes 13 days in Sri Lanka, 18.4 days in Pakistan, 21 days in Vietnam and 21.1 days in India. It takes more than two weeks to release the goods from Chittagong Port, which is the country’s premier port, whereas these goods are supposed to be delivered within 48 hours (The Daily Star (TDS), 2017). Thus, higher cost of production associated with higher fuel prices or higher import tariff or longer lead-time ultimately pushes the prices of goods and services and gives rise to inflation. This finding is consistent with the previous study conducted by Majumder (2006) which finds that

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import cost has strong positive impact on CPI inflation in Bangladesh through the imports of final goods (direct impact) and intermediate goods (indirect impact).

The long run results illustrate that government revenue has a moderate positive effect on CPI inflation in Bangladesh after GDP and Imports. The coefficient of government revenue is 0.22, which implies that 1 per cent increase in government revenue causes 0.22 per cent CPI inflation holding other variables constant. The positive coefficient of government revenue indicates that government revenue affects CPI through the supply side as revenue collected by the government through taxes increases the cost of production. According to World Bank data, corporate tax rate (% of commercial profit) in Bangladesh stood at 34.4 per cent in 2016, while it was 21 per cent in Cambodia, 29.5 per cent in Nepal and 30.6 per cent in Indonesia. This high corporate tax rate ultimately transmitted to the prices of final goods and services because of the profit motives of the firms. Among the revenue sources, Value added tax (VAT) accounts for 36.1 per cent, income tax accounts for 35.2 per cent, and custom duty accounts for 28.8 percent of the total revenue in the last five fiscal years\(^2\) (National Board of Revenue (NBR), 2017). The main source of revenue is VAT, which is imposed on different stages of production process. Imposition of tax at different stages of production process increases the overall cost of production that eventually pushes up the price of final goods and services. Another significant source of revenue is custom duty, which is levied on imports, increases the price of imported goods. Therefore, an increase in government revenue through higher corporate tax or VAT or custom duty at import stage increases the cost of production and thereby pushes the price level up.

Money supply has positive impacts on CPI inflation in the long run. The price elasticity with respect to broad money is 0.19, which implies that 1 per cent increase in money supply will increase the CPI by 0.19 per cent holding other variables constant in the long run. This effect of broad money on CPI supports monetary phenomenon of inflation, which says price level increases due to excess money supply. The positive coefficient of money supply indicates that growth in money supply increases the demand for goods and services more than the available supply in the market, thereby price level increases to clear the market. Thus, money supply affects CPI through the demand side of the economy. This finding is consistent with previous studies, such as Akhtaruzzaman (2005); Mortaza (2006); Arif and Ali (2012) that were conducted earlier in Bangladesh.

The impact of exports on CPI inflation is negative (the coefficient is -0.46) which implies that 1 per cent increase in exports reduces CPI by 0.46 per cent holding other variables constant in the long run. The negative impact of exports on CPI indicates that Bangladesh’s exports growth reduces the overall price index in the long run. For instance, Bangladesh experienced 11.72 percent export growth, on average, during the period of 1980-2016. This higher export growth might help the firms to improve their productivity and to reach their economies of scale. While a firm runs at economies of scales, its cost of production decreases and it can supply goods and services at cheaper prices and thus contributes to reduce the price level.

The estimate shows that government expenditure has negative impacts on CPI inflation in the long run, which means that government expenditure eases CPI inflation in the long run. The coefficient of government expenditure is -0.35, which implies that 1 per cent increase in government expenditure decreases CPI by 0.35 per cent holding other variables constant. The reasonable explanation for the negative impacts of government expenditure on price level is that government expenditure contributes in a productive way to remove long-term supply side bottlenecks of the economy, which smoothen the supply of goods and services. In the short term, government intervenes through Trading Corporation of Bangladesh (TCB), which supplies necessary commodities in case of any artificial shortage in the market. In the long run, government’s initiatives, such as institutional reforms through Bangladesh Investment Development Authority (BIDA), skill enhancing projects, infrastructure projects have helped to increase productivity of the firms. Higher productivity enables a firm to provide goods and services at lower cost. Reduced cost of production has contributed to reduce the price level of goods and services.

\(^2\) Fiscal year in Bangladesh starts from 1st July and ends on 30th June of the following year.
The long run estimate shows that the effect of exchange rate on CPI inflation is negative, i.e. exchange rate (BDT/US$) depreciation does not cause CPI inflation rather it decreases CPI. The coefficient is -0.70, which means that 1 per cent depreciation of local currency reduces CPI by 0.70 per cent. This can be explained by the fact that depreciation of local currency discourses imports and encourages exports as it makes Bangladeshi goods and services competitive to the rest of the world. Higher exports help the firms to achieve economies of scale and to reduce the cost of production. Therefore, depreciation of local currency does not cause CPI inflation in Bangladesh.

### 7. POST-ESTIMATION DIAGNOSTIC AND STABILITY TESTS

The validity and robustness of the estimated model are checked through standard econometric tests, such as residual diagnostics tests (Jarque–Bera (JB) normality test, Breusch–Godfrey serial correlation test and ARCH test for heteroskedasticity) and stability diagnostics tests (CUSUM and CUSUMSQ test).

#### Residual diagnostic tests

i) Jarque–Bera (JB) normality test:

![Figure 1. Plot of Jarque–Bera (JB) normality test](image)

**Source:** generated by the author by using Jarque–Bera (JB) normality test with Eviews 9 software

Null hypothesis: Residual of the model is normally distributed

From the above figure, Jarque-Bera test statistic is 0.314996, corresponding probability is 0.854279, which is not significant at 5% level. Since the null hypothesis cannot be rejected at 5 % level, meaning that the residual of the model is normally distributed.

ii) Breusch–Godfrey serial correlation test:

Null hypothesis: Residual of the model is not serially correlated

Observations*R-squared= 2.115263, corresponding probability of Chi-Square =0.1458, which is not significant at 5% level. Since the null hypothesis cannot be rejected at 5 % level, meaning that the residual of the model is not serially correlated.

iii) ARCH test for heteroskedasticity:

Null hypothesis: Residual of the model has no ARCH effect.

Observations*R-squared= 0.818753, corresponding probability of Chi-Square =0.3655, which is not significant at 5% level. Since the null hypothesis cannot be rejected at 5% level, meaning that the residual of the model has no heteroskedasticity.

iv) Stability diagnostics tests (CUSUM and CUSUMSQ test):

The structural stability of the model is examined by employing CUSUM and CUSUM square (CUSUMSQ) tests, which detects systematic change in the regression coefficients (Brown et al., 1975).
The above figure presents the plot of CUSUM and CUSUM SQ test statistics. Test statistics in both cases fall within the critical bound lines (red dashed line) at 5% level of significance. It means that estimated coefficients of the model are stable over the sample period of 1980-2016. Therefore, results from the estimated model can be used for practical policy-making purposes.

8. CONCLUSION AND POLICY IMPLICATIONS

This study investigates the relative importance of key determinants of CPI inflation in Bangladesh for the period 1980-2016. The long run estimate shows that GDP and imports are the two major determinants of CPI inflation in Bangladesh, where GDP affects CPI inflation through the demand side and imports affect CPI inflation through the supply side. Government revenue and money supply have a moderate positive impact on CPI inflation in the long run, which means that government revenue affects CPI through the supply side and money supply affects CPI through the demand side of economy. The long run results also demonstrate that exports, exchange rate and government expenditure do not cause CPI inflation rather negatively affects CPI inflation. In the short run, the previous year’s inflation has a strong influence and the previous year’s imports has a moderate influence on the current year’s inflation, which indicates that the price level is sticky and rigid to the adjustment by any policy.

Bangladesh needs faster, long-term sustainable economic growth to eradicate poverty as one quarter of the total population still living below the poverty line. For the last three consecutive fiscal years, the real economic growth exceeded the potential economic growth, which means the economy is running on overcapacity and beyond full employment level, and there is risk of rising inflation. To stabilize the economic growth government should remove supply side bottlenecks of the economy by pursuing rigorous structural reforms, such as improvement of infrastructure, strengthening of institutions, ensure the rule of law to improve the business environment and reduce the cost of production.

Import cost must be reduced to contain CPI inflation as the study finds imports as the second major source of CPI inflation in Bangladesh. Import cost increases due to both higher tariff rate and longer lead-time. The average applied tariff rate, which stands at 13 percent until 2016, should be reduced further as it is still highest in south Asia and much higher than those of South East Asian countries. Reducing tariffs might allow more businesses to grow, as more firms will be able to import raw materials at affordable cost. The port management authority must raise its efficiency level to shorten lead-time for importing raw materials for local industries. If the Chittagong port, the premier port in Bangladesh, performs at the same level as the Colombo Port in Sri Lanka, the maritime cost will reduce significantly due to shorter lead-time for importing raw materials and Bangladeshi exporters would be able to send goods to the outside world at a much cheaper rate (TDS, 2017).
As government revenue has a moderate effect on CPI inflation, government should pursue necessary legal and structural reforms to increase the efficiency of revenue administration so that government does not need to increase tax rate to increase revenue. Revenue-GDP ratio, which is the lowest in south Asian region, was only 10.4 percent on average in the last five fiscal years (FY 2012-13 to 2016-17) (NBR, 2017). Since revenue-GDP is one of the lowest in the world despite high corporate tax, there remains scope to reduce corporate tax rate to an efficient level by reducing it. This might bring more businesses in the country and hence improve the revenue collection (Laffer, 2004). If the revenue collection improves, government can reduce the rate of VAT (Value added tax), which is regressive in nature and imposed on various stages of production, and tariffs while importing raw materials, thus, the cost of production of goods and services will be reduced and hence the price.

Since broad money also has a moderate positive effect on CPI inflation, central bank should pursue a cautious monetary policy by containing the growth of money supply for stable moderate inflation, which has been reflected in the recent published monetary policy statement for the first half (July-December) of the fiscal year 2018-19. Bangladesh Bank has kept the commercial bank’s lending limit to 83.5 percent of the deposit, which was 85.0 percent of the deposit a year ago, and the private sector credit growth target to 16.8 per cent for the first half of the fiscal year despite the actual credit growth of 17.0 percent in June 2018.

Although the study did not find that exports, government expenditure, and exchange rate cause CPI inflation rather negatively affect the CPI inflation in Bangladesh, excessive government spending to boost aggregate demand or excessive depreciation of the local currency due to wider mismatch between imports and exports remains a challenging issue for the government in the future. Therefore, prudent macroeconomic policy through effective fiscal monetary coordination is essential so that CPI inflation does not arise through high budget deficit or output gap.

While this paper is limited by using annual data from the period 1980 to 2016 due to non-availability of the quarterly GDP data, the use of quarterly data could have produced more accurate results. Future study can be conducted with quarterly data subject to its availability.

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**REFERENCES**


APPENDICES

Appendix-1. Lag Selection

VAR Lag Order Selection Criteria
Endogenous variables: LCPI LBM LGDP LXP LIM LGE LGR LEX
Exogenous variables: C
Date: 01/28/18   Time: 23:53
Sample: 1980 2016
Included observations: 35

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<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>967.7774</td>
<td>407.9999*</td>
<td>8.93e-33</td>
<td>-51.18728</td>
<td>-47.98771*</td>
<td>-50.08279*</td>
</tr>
<tr>
<td>2</td>
<td>1043.607</td>
<td>77.99623</td>
<td>8.45e-33*</td>
<td>-51.86536*</td>
<td>-45.81962</td>
<td>-49.77700</td>
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</table>

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix-2. Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 01/20/18   Time: 10:55
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments
Standard errors in ( ) & t-statistics in [ ]

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<tr>
<td>LBM(-1)</td>
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<tr>
<td></td>
<td>-1.86928*</td>
</tr>
<tr>
<td>LGDP(-1)</td>
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<tr>
<td></td>
<td>-6.83944*</td>
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<tr>
<td>LXP(-1)</td>
<td>0.462700 (0.04612)</td>
</tr>
<tr>
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<td>10.0315*</td>
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<tr>
<td>LIM(-1)</td>
<td>-0.572135 (0.10282)</td>
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<tr>
<td></td>
<td>-5.56448*</td>
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<tr>
<td>LGE(-1)</td>
<td>0.353334 (0.14265)</td>
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<td></td>
<td>2.47694*</td>
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<td>LGR(-1)</td>
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### Table: Panel Cointegration Results

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