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Inflation and Its Impacts on Economic Growth of Bangladesh

Shapan Chandra Majumder[1, 2, *]

[1]School of Economics, Shandong University, Jinan, P.R.China
[2]Department of Economics, Comilla University, Comilla, Bangladesh

Abstract

One of the most important targets for any developing country like Bangladesh is to achieve high economic growth. Even though there are many factors that affect economic growth, the concern of this paper is only on inflation. The relationship between economic growth and inflation is debatable. The main objective of this study is to investigate the relationship between inflation and economic growth in Bangladesh. To test unit root or stationary, Augmented Dickey Fuller Test is used. This study uses Granger causality and then error correction model to investigate the relationship between economic growth and inflation in Bangladesh during the period of 1975 –2013. To analyse the data the model is formed by taking economic growth of gross domestic product as dependent variable and three variables (i.e. inflation, money supply and remittance) as independent variables. Results of the unit root test indicate that only inflation rate has stationary and other three variables have unit root problem or non- stationary at level. But when these three variables are tested at first difference then the problem of unit root has disappeared and hence they have become stationary at first difference. The VECM presents that there exists a statistically significant long run positive relationship between inflation rate and economic growth of gross domestic product. Bangladesh has indicated a statistically significant long run positive relationship between the rate of inflation and economic growth of GDP.

Keywords

Inflation, Economic Growth, Cointegration, Vector Error Correction Model (VECM)

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1. Introduction

Achieving sustainable rapid economic growth is the objective of most countries. It has been a problem to achieve such objective due to many factors that affects economic growth. Economic growth and the rate of inflation is central subject of macroeconomics policy. Among many variables that can be stated as the determinant of economic growth is inflation (Barro, 1995). However there is no a clear cut or straight forward decision about the relationship between economic growth and inflation. Researchers investigate about inflation and economic growth and have arrived come up with different views. It has been a controversial in both theory and empirical findings.

There are two main types of inflation, which is demand pull inflation and cost push inflation. Demand pull inflation is inflation where the basic cause comes from the demand side. The constant increase in demand is due to factors such as increase in money supply, increase in government purchase, increases in exports and so on. When demand is increased and cannot be met by an equivalent increase in supply, the general price level will increase and inflation will happen. Cost push inflation, which is also called supply push inflation, occurs because of rising cost of production, for

* Corresponding author
E-mail address: scmajumder_71@yahoo.com

example an increase of price of raw materials, an increase of wage rate, and so on. The general price level of goods and services will rise when there is an increase of production costs in the industries (Raza *et al*. 2013).

The first controversial issue about economic growth and inflation is the relationship between them. Theories and previous studies about the relationship between inflation and economic growth have shown that there might be no relationship (Sidrauski, 1967), negative relationship (Fisher, 1993 and Barro, 1995) or positive relationship (Mallik and Chowdhury, 2001) between these two variables. Today the question is not only the simple relationship but also the level of inflation that can affect economic growth. The structuralists view that inflation has a positive effect on economic growth, whereas monetarists see inflation as detrimental to economic growth. Both views have their own explanation for why inflation has a positive or a negative impact on economic growth. For instance in neo classical views, inflation increases economic growth by shifting the income distribution in favour of higher saving capitalists. This increases saving and thus economic growth. Moreover, Keynesians also said that inflation may increase growth by raising the rate of profit, thus increasing private investment. On other hand, theories or empirical studies shows why inflation is negatively related to economic growth. For example, Barro (1995) said that high inflation reduces the level of investment and a reduction in investment adversely affects economic growth. Gultekin (1983) also explained why inflation and economic growth have a negative relationship as growth rate is depended on rate of return but rate of return is decreased by inflation and hence economic growth is negatively related to inflation.

The second controversial issue is the causality relationship between inflation and economic growth. The question about the forecasting power of inflation for economic growth and vice versa has been debatable. Granger causality assesses whether there is any potential predictability power of one indicator for the other. For instance, inflation Granger causes economic growth means inflation contains information about the future economic growth. Empirical studies has been indicated a bi–directional causality, a unidirectional causality (either from inflation to economic growth or from economic growth to inflation) and no causality between inflation and economic growth. A study by Paul, Kearney and Chowdhury (1997) indicated three different possibilities about the causality relationship between inflation and economic growth. They found no causality relationship between inflation and economic growth in 40% of the countries; bidirectional causality in about 20% of countries and a unidirectional (either inflation to economic growth or vice versa) relationship in the rest of the countries.

There is no debate in literature on the relationship between inflation and economic growth but there is a serious debate when we discuss sign of relationship between inflation and economic growth. Negative and positive both evidence available in literature between inflation and economic growth. Malik and Chowdhury (2001) estimated that inflation and economic growth are positively related with each other in India, Pakistan, Bangladesh and Sri Lanka. However there are so many other studies which pointed out negative relation between inflation and economic growth. Levine and Zervos (1993) concluded that the moderate inflation would not affect the growth rate negatively. They argued that if the inflation rate is above 80 percent, the growth rate is affected negatively.

Due to the controversial issues about economic growth and inflation, the researcher is highly interested to examine the relationship between inflation and its impacts on economic growth in Bangladesh. The main objective of this paper is to empirically examine the relationship between inflation and its impact on economic growth in Bangladesh using the time series analysis. In the present study, co-integration and error correction models are used to find the long-run and short-run relationship between the inflation and economic growth for Bangladesh. The long run relationship of the variables is evaluated using Johansen Co- integration analysis and vector error correction model. The rest of the study is organized as follows. Section 2 presents the review of related literature. Section 3 discloses the methods of the study. Section 4 presents the model specification. Section 5 discusses the empirical results while Section 6 concludes the study.

2. Literature Review

There is a lot of survey of literature, which investigated theoretical and empirical aspects of relationship between rate of inflation and economic growth of GDP. This section presents literature on the impact of inflation on economic growth in Table 1.

Table 1. Literature Review of Empirical Evidence of Inflation and Economic Growth.

Country	Study Period	Major Findings	Author(s)
Thailand	1995-2003	The seasonally adjusted, monthly percent changes in Thailand's consumer price index after removing its raw food and energy components is used as the dependent variable.	Sun (2004)
93 industrialised & developing economies		Non-linear relationship where low inflation rates have a positive impact on growth which turns negative as inflation rates increase.	Fisher (1993)
26 countries	1961-1992	They found the threshold level of inflation that is 40%. They found they negative	Bruno & Easterly

Country	Study Period	Major Findings	Author(s)
		relation between inflation and economic growth after this threshold level.	(1995)
Pakistan	1973- 2000	Low and stable inflation promotes economic growth, while a high level of inflation retards growth.	Mubarik (2005)
Nigeria	1970 - 2010	The positive correlation between inflation and economic growth arises through the effects of inflation on productivity which impacts positively on output, and hence, improved economic performance.	Umaru & Zubairu (2012)
Ghana	1960-2008	Threshold effect of inflation on economic growth	Frimpong & Oteng-Abayie, (2010)
Pakistan	1972-2010	A negative and significant inflation growth relationship has been found to be existed in the economy of Pakistan. Prevailing inflation is harmful to the GDP growth of the economy after a certain threshold level.	Ayyoub *et al.* (2011)
More than 100countries	1960-1990	A significant negative relationship between inflation and economic growth	Barro (1995)
87 countries	1970-1990	His results show that below that structural break, inflation has slightly positive effect on growth but after 8 percent inflation rate, it has powerful negative effect on growth.	Sarel (1996)
Pakistan	1971-1995	They disaggregate inflation into food and non-food inflation and suggest a strong role of money supply in accelerating inflation in Pakistan.	Khan and Qasim (1996)
IMF member countries	1960–96.	A rapid disinflation is associated with fall in GDP growth.	Ghosh & Phillips (1998)
22 Central & Eastern Europe	1990-1997	The authors found that threshold level is 13%.	Christoffersen & Doyle (1998)
140 developing & industrialized countries	1960-1998	The threshold estimates are 1-3 percent and 7-11 percent for industrial and developing countries, respectively.	Khan & Senhadji (2001)
Malaysia	1970-2005	The relationship between inflation rate and economic growth is nonlinear. In addition, below the threshold level, there is a statistically significant positive relationship between inflation rate and growth.	Munir & Mansur (2009)
165 countries	1960–2007	For all country groups threshold level of inflation for GDP growth is about 10 percent (except for advanced countries where threshold is much lower).	Espinoza *et al.* (2010)
Bangladesh	1980- 2005	They found the long the negative relation between inflation and economic growth. They also estimated threshold level of inflation which is 6% above this level inflation show negative effect on growth.	Ahmed & Mortaza (2005)
100 countries	1960-1990	He found the negative relation between economics growth and inflation and found the significant effect of inflation on economic growth.	Barro (1995)
Brazil	1980- 1995	They found the negative relation between economic growth and inflation in short run but there is no relation between in long run.	Faria & Carneiro (2001)
Pakistan, Sri Lanka India, Bangladesh		They find the positive relation between inflation and economic growth in all countries and also significant effect of inflation on economic growth	Mallik & Chowdhury (2001)
140 countries	1970-2005	A bilateral causal relationship between growth and inflation. It also showed that inflation is harmful to growth whereas the effect from growth to inflation is beneficial	Chuan Yeh (2009)
Nigeria	1970-2011	The results show that there exists a statistically significant positive relationship between inflation and economic growth in Nigeria.	Osuala *et al*.(2013)
Six South Asian Countries	1980-2012	The study finds that there is high positive correlation exist between inflation and economic growth for all the countries. The cointegration result suggest that there is long run relationship exist for Malaysia.	Behera (2014)
South African Economy	1993 - 2011	The results being analysed suggest the existence of a negative relationship between these two macroeconomic variables in the South Africa economy.	Munyeka (2014)
Mauritania	1990 - 2013	The study shows that a positive and significant relationship between the GDP and CPI in Mauritania.	Mahmoud (2015)
ASEAN-5 countries	1980 –2011	The study finds that there exists a statistically significant negative relationship between inflation and growth for the inflation rates above the threshold level of 7.84%, above which inflation starts impeding economic growth in the ASEAN-5 countries.	Thanh (2015)

Source: Various Sources

3. Methods of the Study

The empirical method of this study employs a restricted Vector Autoregressive model (VAR), which is commonly called Vector Error Correction Model-VECM. The study uses annual time series data from Bangladesh during 1975–2013. The data are collected from the Bangladesh Bureau of Statistics, Ministry of Finance of Bangladesh, Economic Trends, Bangladesh Bank and World Bank. All these sources of data are recognized and accepted and the provided information has been used widely in the country. So data and information of the sources incorporated in this analysis are reliable. The Augmented Dickey Fuller (ADF) unit root test is used to verify whether the variables are difference stationary. We used the Johansen (1988) cointegration approach to determine the number of cointegration equations among the variables and then the granger causality test. Also error correction model (ECM) is used to verify short run dynamics with long-run equilibrium. There are several

techniques for ECM in econometric evaluation, such as the VECM which is more appropriate for multivariate framework.

4. Model specification

In order to examine the impact of inflation on GDP growth, we have specified following econometric model. The independent variables are inflation rate, money supply, remittance, while the dependent variable is economic growth. The model is stated as follows:

$$GDPGRT = f(\text{Inflation Rate}, \text{Money Supply}, \text{Rem})$$

$$\text{Or } GDPGRT_t = \alpha + \beta InflR_t + \delta M2_t + \sigma Rem_t + U_t \quad (1)$$

Where, GDPGRT = Growth Rate of Gross Domestic Product (annual %), InflR = Inflation Rate (annual %), M2 = Money Supply (% of GDP), Rem = Remittance (Million $US), $\alpha, \beta, \delta,\ \sigma =$ parameters to be estimat, U = stochastic term, and t = 1, 2, 3… 39 (time period is from 1975– 2013).

4.1. Testing for Unit Root

Stationarity is defined as a quality of a process in which the statistical parameters (mean and standard deviation) of the process do not change with time (Challis and Kitney, 1991). We have to test the stationary property of all variables before making estimation in order to avoid spurious regressions. If the series is not stationary, then inference procedures are invalid. Results derived from the regression models would produce spurious results if non stationary data is used. Therefore, the first task is to check for the existence of stationarity property in the series of all variables. To check the stationarity of the data the Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981) test is applied. The Augmented Dickey-Fuller (ADF) test for autoregressive unit root tests the null hypothesis $H_0 = 0$ and against the alternative hypothesis $H_1 \neq 0$ in the regression.

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \gamma Y_{t-1} + \sum_{j=1}^{\rho} \delta_j \Delta Y_{t-j} + \varepsilon_t \quad (2)$$

From equation (2), α_0 is a constant, α_1 the coefficient on a time trend series, γ the coefficient of Y_{t-1} which measures the unit root, ρ is the lag order of the autoregressive process, δ_j is a measure of lag length, $\Delta Y_t = Y_t - Y_{t-1}$ are first differences of Y_t, Y_{t-1} are lagged values of order one of Y_t, ΔY_{t-j} are changes in lagged values, and ε_t is the white noise (Ssekuma, 2011).

4.2. Johansen Cointegration Test

Test of cointegration is performed to know if there is long run relationship between inflation and economic growth in Bangladesh. Cointegration analysis helps to identify long-run relationship or association among the variables. When two series has the same stochastic trend, they are said to be cointegrated. Johansen Cointegration (1988) test depends on his Maximum Likelihood (ML) estimator of the parameters of the following VEC model of two cointegrating variables. Cointegration analysis helps to identify long-run economic relationships between the variables. We then use the FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion and the HQ: Hannan-Quinn information criterion criteria to determine the number of lags in the cointegration test (order of VAR) and then use the trace and maximal eigenvalue tests to determine the number of cointegrating vectors present. We then estimate the Vector Error Correction Model (VECM) for all the endogenous variables in the model and use it to carry out tests such as Granger causality tests over the short and long run. Furthermore, we carry out variance decomposition tests to further understand the interactions of the variables.

Johansen-Juselius (1990) Multivariate Co-integration Model under vector autoregressive environment

$$\Delta X_t = \sum_{i=1}^{p-1} \mu_i \Delta X_{t-i} + \omega X_{t-1} + \varepsilon_t \quad (3)$$

Where, X_t is the (2×1) vector respectively, Δ is a symbol of difference operator, ε_t is a (2×1) vector of residuals. The VECM model has information about the short and long-run adjustment to changes inX_t, via the estimated parameters μ_i and, respectively. Here, ωX_{t-1} is the error correction term and ω can be factored into two separate matrices α and β, such as $\omega = \alpha\beta$ where β denotes the vector of cointegrating parameters while α is the vector of error-correction coefficients measuring the speed of convergence to the long-run steady state.

4.3. Vector Error Correction Model (VECM)

There can be a long run relationship between two series in a bivariate relationship if each series is integrated of the same order or have the same stochastic trend. If cointegration has been detected between series we know that there exists a long-term equilibrium relationship between them so we apply VECM in order to evaluate the short run properties of the cointegrated series. In case of no cointegration VECM is no longer required and we directly precede to Granger causality tests to establish causal links between variables. The regression equation form for VECM is as follows:

$$\Delta Y_t = \alpha_1 + p_1 e_1 + \sum_{i=0}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{m} \delta_i \Delta X_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta Z_{t-i} \quad (4)$$

$$\Delta X_t = \alpha_2 + p_2 e_{i-1} + \sum_{i=0}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{m} \delta_i \Delta X_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta Z_{t-i} \quad (5)$$

5. Empirical Results and Discussion

5.1. Unit Root Test

Unit root problem is tested in each variable by using Augmented Dickey Fuller (1981) test and its results are given in Table 2. These results have shown that all variables are not integrated in the same order and fail to reject the null hypothesis of non- stationary of all variables used except inflation rate at levels in the study. Thus, only inflation rate has stationary at level and other three variables have unit root problem when they are tested at level. But when these variables are tested at first difference then the null hypothesis is accepted and the alternative hypothesis is rejected that means all variables are stationary and the problem of unit root has disappeared from them. Also, all the variables are now integrated of order one $\{I(1)\}$ and the variables have become stationary at first difference. The results of ADF show that t-values for all variables are greater than critical values; therefore, the series are non-stationary.

Table 2. ADF test for unit root.

Variables	Constant and No Trend		Constant and Trend		No Constant & No Trend	
	At Level	At 1st Differenced	At Level	At 1st Differenced	At Level	At 1st Differenced
GDPGRT	-2.248594	-6.281999	-10.65406	-6.175484	0.022271	-6.335957
IflR	-16.72056	-15.76080	-16.91926	-15.50886	-9.946398	-16.01242
M2	0.402284	-7.136437	-1.560454	-7.332195	2.929546	-5.694321
Rem	-0.905162	-6.344524	-5.342115	-6.010659	1.600261	-5.699389

Source: Author's Envies output

5.2. Optimal Lag Length Selection

After the unit root test, the maximum lag length of the model is found by using Vector Autoregressive (VAR) lag order selection criteria. The results are presented into Table 3 and it has confirmed that the maximum lag length of the model is '3' and it is selected on the basis of the minimum value of each criterion and based on that the maximum number of 'lag 3' should be chosen. All criteria are asking to take 3 lag. So optimum lag would be 3 and we shall use this 3 lag in Johansen test of cointegration and vector error correction model. The estimated results for lag length criteria are given in the below Table 3.

Table 3. Results of lag length criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-638.8673	NA	3.81e+10	35.71485	35.89080	35.77626
1	-562.4198	131.6596	1.34e+09	32.35666	33.23639*	32.66371
2	-536.5001	38.87961	7.98e+08	31.80556	33.38908	32.35825
3	-515.7263	26.54424*	6.72e+08*	31.54035*	33.82766	32.33868*

* indicates lag order selected by the criterion

5.3. Johansen Test of Cointegration Analysis

To test the Johansen tests for cointegration, the variables must be non- stationary at level. But after converted all variables into first differenced, then they will become a stationary at first difference. This is the necessary condition for the Johansen tests. As it has found that all variables have become free from unit root problem at first difference and thus, it is more suitable to apply Johansen Maximum Likelihood Approach. The estimated results of the Johansen cointegration test are illustrated in Table 4. However, Table 4 illustrates the presence of cointegration for the variables adopted in this study, where it is statistically valid. This implies that there is a long-run relationship amongst GDP growth, inflation rate, money supply, and remittances. Accordingly, the variables involved in the regression equation will move together (Engle & Granger, 1987). Meaning that, the data series are drifting at the same trend. Trace Test indicates 2 cointegrating eqn(s) at the 0.05 level. Max Eigenvalue test indicates 2 cointegrating eqns at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. The results the Trace Tests indicate the presence that the two variables are cointegrating vectors. Thus, the null hypothesis of no cointegration amongst the variables is rejected. This infers the existence of a long run relationship

amongst the variables. Moreover, the result of the Maximum Eigenvalue Test also confirms the result at the 0.05 level. Consequently, we resort to the application of the Vector Error Correction Model (VECM). The application of the VECM will identify the long run relationship amongst these variables.

Table 4. Results of Johansen test for co-integration.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.739422	81.92491	47.85613	0.0000
At most 1 *	0.543799	34.85500	29.79707	0.0120
At most 2	0.141957	7.386221	15.49471	0.5332
At most 3	0.056287	2.027675	3.841466	0.1545
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.739422	47.06991	27.58434	0.0001
At most 1 *	0.543799	27.46878	21.13162	0.0056
At most 2	0.141957	5.358546	14.26460	0.6961
At most 3	0.056287	2.027675	3.841466	0.1545

The normalized cointegration equation is depicted in table 5 which reveals that the inflation rate has a positive effect on growth of GDP. In this sense, inflation rate plays a significant role in promoting economic growth in Bangladesh. On the other hand, money supply and remittance have a negative. The rate of inflation coefficient is 0.101034, implying that in Bangladesh; a one percent increase in rate of inflation while others keep constant contributes 0.101034% increase in growth of gross domestic product. Money supply and remittance carries negative and insignificant coefficient.

Table 5. Normalized cointegrating coefficients.

Cointegrating Equation(s):		**Log likelihood**	**-483.9719**
Normalized cointegrating coefficients (standard error in parentheses)			
GDPGRT	INFLR	M2	REM
1.000000	0.101034	-0.001302	-0.000444
	(0.04428)	(0.02745)	(8.6E-05)

Source: Author's Envies output

5.4. Vector Error Correction Estimates

If the variables are cointegrated or have long-run association, we can run restricted VAR that is VECM model. But if the variables are not cointegrated, we cannot run VECM model rather we shall run unrestricted VAR model. We have seen that the variables are cointegrated. So the VECM model can be run. While most of the studies have used bivariate and trivariate frameworks to test for causality between inflation and economic growth, in this paper we use multivariate procedure by the mean of a VECM which is specified as follows:

$$\Delta GDPGRT_t = \alpha_{10} + \alpha_{GDPGRT}\hat{e}_{t-1} + \sum_{i=1}^{m}\alpha_{11}(i)\Delta GDPGRT_{t-i} + \sum_{i=1}^{m}\alpha_{12}(i)\Delta InflR_{t-i} + \sum_{i=1}^{m}\alpha_{13}(i)\Delta M2_{t-i} + \sum_{i=1}^{m}\alpha_{14}(i)\Delta Rem_{t-i} + \varepsilon_{(gdpgrt)t} \quad (6)$$

The other three equations in the ECM model system are:

$$\Delta InflR_t = \alpha_{20} + \alpha_{InflR}\hat{e}_{t-1} + \sum_{i=1}^{m}\alpha_{21}(i)\Delta GDPGRT_{t-i} + \sum_{i=1}^{m}\alpha_{22}(i)\Delta InflR_{t-i} + \sum_{i=1}^{m}\alpha_{23}(i)\Delta M2_{t-i} + \sum_{i=1}^{m}\alpha_{24}(i)\Delta Rem_{t-i} + \varepsilon_{(InflR)t} \quad (7)$$

$$\Delta M2_t = \alpha_{30} + \alpha_{M2}\hat{e}_{t-1} + \sum_{i=1}^{m}\alpha_{31}(i)\Delta GDPGRT_{t-i} + \sum_{i=1}^{m}\alpha_{32}(i)\Delta InflR_{t-i} + \sum_{i=1}^{m}\alpha_{33}(i)\Delta M2_{t-i} + \sum_{i=1}^{m}\alpha_{34}(i)\Delta Rem_{t-i} + \varepsilon_{(M2)t} \quad (8)$$

$$\Delta Rem_t = \alpha_{40} + \alpha_{Rem}\hat{e}_{t-1} + \sum_{i=1}^{m}\alpha_{41}(i)\Delta GDPGRT_{t-i} + \sum_{i=1}^{m}\alpha_{42}(i)\Delta InflR_{t-i} + \sum_{i=1}^{m}\alpha_{43}(i)\Delta M2_{t-i} + \sum_{i=1}^{m}\alpha_{44}(i)\Delta Rem_{t-i} + \varepsilon_{(Rem)t} \quad (9)$$

Where, $\hat{e}_{t-1}$ is the error-correction term, which is the cointegrating vectors and α_i is the adjustment coefficient indicating the weight of adjusted disequilibrium in the past. To get a long-run relationship among the variables the coefficient of α_i should be statistically significant. α_{10}, α_{GDPGRT}, and $\alpha_{11}(i)$ are the parameters, and ε_{it} is the white-noise disturbance terms that may be uncorrelated with each other.

C (1) is the residual of the one period lag of the cointegrating vector/equation between inflation and growth rate of gross domestic product. It's sign negative and also statistically significant. The p-value is 0.03% which is less than 5%. When the probability of a variable is less than 5% that particular variable becomes significant. So, here the error correction term becomes significant. When the ECT is significant and its sign is negative it means that inflation has a long-run causality on GDP growth rate. That means inflation causes GDP growth rate in the long-run or there

exists a long-run causality, which is presented in Appendix 1. To check the short-run causality we shall be using the Chi-square value of Wald statistics from inflation to GDP growth rate. Here the coefficients C (7) to C (9) are inflation. If all the coefficients of inflation C (7) to C (9) jointly influence the GDP growth rate then we can say that there is a short-run causality from inflation to GDP growth rate. The corresponding Chi-square probability is 17.92% which is more than 5%. So null hypothesis cannot rejected rather can accept the null hypothesis. It means that the all coefficients of rate of inflation jointly they are zero. So all the rate of inflation having three lags jointly cannot cause GDP growth rate in the short-run, which is presented in Appendix Table 2.

Table 6. Vector Error Correction Estimates.

Error Correction:	D(GDPGRT)	D(INFLR)	D(M2)	D(REM)
CointEq1	-1.674853	-0.792549	1.701991	667.2860
	(0.38387)	(1.18353)	(1.21210)	(796.773)
	[-4.36311]	[-0.66965]	[1.40417]	[0.83749]
CointEq2	-0.160703	-0.051926	0.056893	115.5329
	(0.03404)	(0.10495)	(0.10748)	(70.6543)
	[-4.72107]	[-0.49477]	[0.52931]	[1.63519]
CointEq3	0.096325	0.034548	0.070988	107.5052
	(0.02628)	(0.08104)	(0.08300)	(54.5570)
	[3.66473]	[0.42632]	[0.85532]	[1.97051]
R-squared	0.829423	0.708346	0.667468	0.715631

Standard errors in ( ) & t-statistics in [ ]

Three conditions are necessary to check the model efficiency or model specification. Firstly the model should not have any serial correlation, secondly it should not have any ARCH effects and finally it should be normally distributed. The model of GDP growth rate fulfills the required three conditions which are shown in Appendix Table 3 & Table 4 and Appendix Figure 1. So we can say that our model is efficient. Because there is no serial correlation, no ARCH effects and the residuals are normally distributed.

6. Conclusion

The main objective of this study is to examine the impact of inflation on economic growth in Bangladesh. Annual time-series data for the period of 1975-2013 are employed in the study. In the present study, co-integration and error correction models are used to find the long-run and short-run relationship between the inflation and economic growth for Bangladesh. The diagnostic tests carried out for all variables are all satisfied, that is, no serial correlation and no heteroskedasticity and the residuals are normally distributed, implying that the estimates are reliable and therefore can be relied upon. The methodology is employed in this study included the regression analysis to examine the impact, stationary test is carried out using the Augmented Dickey-Fuller technique (ADP) test. The empirical results show that there exists a statistically significant long-run positive relationship between inflation and economic growth for Bangladesh by a statistically significant long-run positive relationship between rate of inflation and economic growth of GDP. The results are same with the findings of those Mallik and Chowdhury (2001), Hussain (2011), Behera (2014), and Mahmoud (2015) who said that there is positive relationship between inflation and economic growth in long run.

Appendix

Table A1. Dependent Variables: D (DGPGRT).

Method: Least Squares
Date: 01/30/15 Time: 19:38
Sample (adjusted): 1979 2013
Included observations: 35 after adjustments
D(GDPGRT) = C(1)*(GDPGRT(-1) + 0.000382518840841*REM(-1) - 6.05823462066) + C(2)*(INFLR(-1) - 0.00827800190939*REM(-1) + 19.0918639477) + C(3)*(M2(-1) - 0.0078359433446*REM(-1) - 10.207728961) + C(4)*D(GDPGRT(-1)) + C(5)*D(GDPGRT(-2)) + C(6) *D(GDPGRT(-3)) + C(7)*D(INFLR(-1)) + C(8)*D(INFLR(-2)) + C(9) *D(INFLR(-3)) + C(10)*D(M2(-1)) + C(11)*D(M2(-2)) + C(12)*D(M2(-3)) + C(13)*D(REM(-1)) + C(14)*D(REM(-2)) + C(15)*D(REM(-3)) + C(16)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-1.674853	0.383867	-4.363107	0.0003
C(2)	-0.160703	0.034040	-4.721071	0.0001

C(3)	0.096325	0.026284	3.664727	0.0016
C(4)	0.559992	0.321801	1.740183	0.0980
C(5)	0.326862	0.229453	1.424527	0.1705
C(6)	0.378023	0.142311	2.656312	0.0156
C(7)	0.160626	0.080974	1.983679	0.0619
C(8)	0.039464	0.051590	0.764950	0.4537
C(9)	0.039925	0.028573	1.397290	0.1784
C(10)	-0.095514	0.068287	-1.398718	0.1780
C(11)	-0.130266	0.071404	-1.824351	0.0839
C(12)	-0.044513	0.062586	-0.711231	0.4856
C(13)	-1.58E-05	0.000661	-0.023858	0.9812
C(14)	-0.000119	0.000749	-0.159242	0.8752
C(15)	0.000402	0.000677	0.593781	0.5597
C(16)	0.152203	0.462694	0.328949	0.7458
R-squared	0.829423	Mean dependent var		-0.029817
Adjusted R-squared	0.694758	S.D. dependent var		1.457674
S.E. of regression	0.805346	Akaike info criterion		2.708288
Sum squared resid	12.32308	Schwarz criterion		3.419305
Log likelihood	-31.39505	Hannan-Quinn criter.		2.953731
F-statistic	6.159123	Durbin-Watson stat		2.083072
Prob(F-statistic)	0.000169			

Table A2. Results of Wald Test.

Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	1.405271	(9, 19)	0.2537
Chi-square	12.64744	9	0.1792
Null Hypothesis: C(7)=C(8)=C(9)=C(10)=C(11)=C(12)=C(13)=C(14)=C(15)=0			

Table A3. Results of Breusch-Godfrey Serial Correlation LM Test.

F-statistic	0.118775	Prob. F(3,16)	0.9477
Obs*R-squared	0.762481	Prob. Chi-Square(3)	0.8584

Table A4. Results of Heteroskedasticity Test (ARCH).

F-statistic	2.813882	Prob. F(3,28)	0.0574
Obs*R-squared	7.412746	Prob. Chi-Square(3)	0.0598

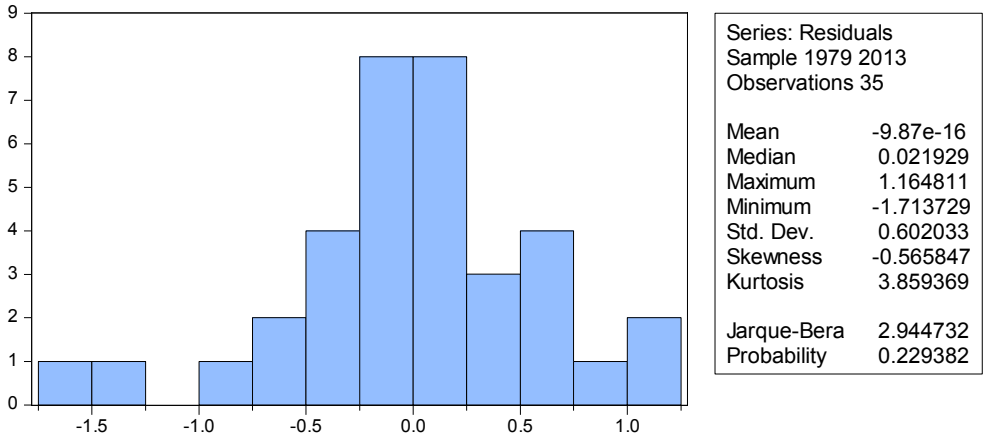

Figure A1. Figure of Normality Test.

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