INFLATION AND ECONOMIC GROWTH IN BANGLADESH

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ABSTRACT

The main purpose of this study is to find out the longrun of relationship between inflation and economic growth in Bangladesh over the period 1978 to 2010. A stationarity test was carried out using the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP)tests and stationarity found at first difference at 1% and 5% level of significance. The result of the Co-integration test showed that for the periods, 1978-2010, there was no co-integrating relationship between inflation and economic growth for Bangladeshi data. Further effort was made to check the causality relationship that exists between the two variables by employing the VAR-Granger causality at two different lag periods. The results showed the same at different lags. The first test was conducted using lag two (2) and in the result unidirectional causality was seen running from Inflation to economic growth. Further test at lag four (4) was carried out and it supported the first by also indicating a unidirectional causality running from inflation to economic growth. Thus, the study through the empirical findings maintain the fact that the causality that run from inflation to economic growth is an indication of relationship showing that inflation indeed has an impact on growth.

Keywords: Inflation, Economic Growth, Bangladesh, Cointegration, Granger causality

INTRODUCTION:

Inflation is defined as a sustained rise in the general level of prices i.e., a persistent rise in the price levels of commodities and services, leading to a fall in the currency's purchasing power. High inflation is bad for the economy and it adversely affects economic performance. Even moderate levels of inflation can distort investment and consumption decisions. Reducing inflation also has costs associated with including lost output and higher rates of unemployment. The problem of inflation used to be confined to national boundaries, and was caused by domestic money supply and price rises. In this era of globalization, the effect of economic inflation crosses borders and percolates to both developing and developed nations. Too much money in circulation, increases production costs, declines in exchange rates, decreases in the availability of limited resources such as food or oil etc are the basic causes of inflation. Inflation is a sign that an economy is growing, but excessive economic growth can be detrimental as it can lead to hyperinflation as experienced, at the other extreme, an economy with no inflation has essentially stagnated. The right level of economic growth, and thus the right level of inflation, is somewhere in the middle. Creeping or mild inflation can be viewed as having favorable impacts on the economy. On the other hand zero inflation is harmful to other sectors in the economy with falling prices, profits, and employment. In general, unpredicted running and galloping inflation are regarded has unprecedented effects on an economy because it distort and disrupt the price mechanism, discourage investment and saving, adversely effects fixed income group, creditors and ultimately leads to the breakdown of morals.

However, much less agreement exists about the precise relationship between inflation and economic performance, and the mechanism by which inflation affects economic activity at the macroeconomic level. This has generated a significant debate both theoretically and empirically. A series of studies found no conclusive empirical evidence for either a positive or a negative association between inflation and economic growth. Notable among these studies are Wai (1959); Bhatia (1960); Dorrance (1963, 1966); Johansen (1967). The second strand of the literature found a negative correlation between inflation and economic growth. Among these studies are Fisher (1993); De Gregorio (1993); Barro (1995, 1996); Brunno and Easterly (1995); Malla (1997); Faria and Carneiro (2001); Dewan & Hussein (2001). While the third strand of the literature found a positive relationship between inflation and economic growth.

Despite these plethora of studies both for developing and developed countries, the literature on inflation and economic growth in Bangladesh is scanty. The purpose of this paper is to empirically examine the relationship between inflation and economic growth in Bangladesh. This paper is organized as follows; section one is the introduction while section two reviews the empirical literature on inflation and economic growth; section three discusses the model and methodology while section four provides data and empirical evidence and the final section which is section five provides the summary and conclusion of the study.

LITERATURE REVIEW:

There have been extensive theoretical and empirical research examine the relationship between inflation and economic growth both in the context of developed and developing countries. This section presents a brief review.

Erbaykal and Okuyan (2008) examined the relationship between the inflation and the economic growth in Turkey has been in the framework of data covering 1987:1-2006:2 periods. The existence of the long term relationship between these two variables was examined using Bound Test developed by Pesaran et al. (2001), and the existence of a cointegration relationship between the two series was detected following the test result. Whereas no statistically significant long term relationship was found with the formed ARDL models, a negative and statistically significant short term relationship has been found. The causality relationship between the two series was examined in the framework of the causality test developed by Toda Yamamoto (1995). Whereas no causality relationship was found from economic growth to inflation, a causality relationship was found from inflation to economic growth.

Saaed (2007) explored the relationship between inflation and economic growth in the context of Kuwait, using annual data set on real GDP and CPI for the period of 1985 to 2005. The estimated result of the relationship shows a long-run and strong inverse relationship between CPI and real GDP in Kuwait.

Mubarik (2005) estimated the threshold level of inflation for Pakistan using an annual data set from the period between 1973 and 2000. He employed the Granger Causality test as an application of the threshold model and finally, the relevant sensitivity analysis of the model. His estimation of the threshold model

suggests that an inflation rate beyond 9-percent is detrimental for the economic growth of Pakistan. This in turn, suggests that inflation rate below the estimated level of 9-percent is favorable for the economic growth. Moreover, the sensitivity analysis performed for the robustness of the threshold model also confirms the same level of threshold inflation rate.

Sweidan (2004) examined whether the relationship between inflation and economic growth has a structural breakpoint effect or not for the Jordanian economy from the period between 1970 and 2003. He finds that this relation tends to be positive and significant below an inflation rate of 2-percent and the structural breakpoint effect occurs at an inflation rate equal to 2-percent. Beyond this threshold level inflation affects economic growth negatively.

Mallik and Chowdhury (2001) examined the short-run and long-run dynamics of the relationship between inflation and economic growth for four South Asian economies: Bangladesh, India, Pakistan, and Sri Lanka. Applying co-integration and error correction models to the annual data retrieved from the International Monetary Fund (IMF) International Financial Statistics (IFS), they found two motivating results. First, the relationship between inflation and economic growth is positive and statistically significant for all four countries. Second, the sensitivity of growth to changes in inflation rates is smaller than that of inflation to changes in growth rates. These results have important policy implications, that is, although moderate inflation promotes economic growth, faster economic growth absorbs into inflation by overheating the economy. Therefore, these four countries are on the turning point of inflation-economic growth relationship.

Faria and Carneiro (2001) investigated the relationship between inflation and economic growth in the context of Brazil which has been experiencing persistent high inflation until recently. Analyzing a bivariate time series model (i.e., vector autoregression) with annual data for the period between 1980 and 1995, they found that although there exist a negative relationship between inflation and economic growth in the short-run, inflation does not affect economic growth in the long-run. Their empirical results also support the superneutrality concept of money in the long run. This in turn provides empirical evidence against the view that inflation affects economic growth in the long run.

Shitundu and Luvanda (2000) used the Least Trimmed Squares (LTS) method, as introduced by Rousseeuw and Leroy (1987), which detects regression outliers and produces robust regression, to examine the impact of inflation on economic growth in Tanzania. The empirical results obtained suggest that inflation has been harmful to economic growth in Tanzania.

Malla (1997) conducted an empirical analysis using a small sample of Asian countries and countries belonging to the Organization for Economic Cooperation and Development (OECD) separately. After controlling for labor and capital inputs, the estimated results suggest that for the OECD countries there exists a statistically significant negative relationship between economic growth and inflation including its first difference. However, the relationship is not statistically significant for the developing countries of Asia. The crucial finding of this empirical analysis suggests that the cross-country relationship between inflation and long-term economic growth experiences some fundamental problems like adjustment in country sample and the time period. Therefore, inconclusive relationship between inflation and economic growth can be drawn from comparing cross country time-series regressions with different regions and time periods.

Barro (1995) explored the inflation–economic growth relationship using a large sample covering more than 100 countries from 1960 to 1990. His empirical findings indicate that there exists a statistically significant negative relationship between inflation and economic growth if a certain number of the country characteristics (e.g., fertility rate, education, etc.) are held constant. More specifically, an increase the average inflation by 10 percentage points per year reduces the growth rate of real per capita GDP by 0.2 to 0.3 percentage points per year. In other words, his empirical analysis suggests that the estimated relationship between inflation and economic growth is negative when some reasonable instruments are considered in the statistical process. Finally, he added that there is at least some reason to consider that higher long-term inflation reduces economic growth.

Bruno and Easterly (1995) examined the determinants of economic growth using annual CPI inflation of 26 countries which experienced inflation crises during the period between 1961and 1992. In their empirical analysis, inflation rate of 40 percent and over is considered as the threshold level for an inflation crisis. They find inconsistent or somewhat inconclusive relationship between inflation and economic growth below this threshold level when countries with high inflation crises are excluded from the sample. In addition, the empirical analysis suggests that there exists a temporal negative relationship between inflation and economic growth beyond this threshold level. The robustness of the empirical results is examined by controlling for

other factors such as shocks (e.g., terms of trade shocks, political crises, and wars). Finally, they found that countries recover their pre-crisis economic growth rates following successful reduction of high inflation and there is no permanent damage to economic growth due to discrete high inflation crises.
Sarel (1995) mentioned that inflation rates were somewhat modest in most countries before the 1970s and after then rates started to be high. Therefore, most empirical studies conducted before the 1970s show the evidence of a positive relationship between inflation and economic growth and a negative relationship between the two beyond that time period due to the severe inflation hike.

ECONOMETRIC METHODOLOGY:

Following the lead of Alfred (2007), the study employs two econometric models to achieve the empirical results. The first econometric model examines the short-run and long-run relationship between real GDP and GDPD by applying the Johansen (1988) co-integration test and the associated Error Correction Model (ECM) and the second is the application of the Granger causality test to determine the direction of causality between the two variables.

MODEL SPECIFICATION:

The primary model showing the relationship between Money and Inflation is specified thus:
GDP = f (GDPD)…….. (1)

$$GDP_t = \propto_0 + \propto_1 GDPD_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,
GDP is Gross Domestic products as a proxy for growth
GDPD is the Gross Domestic Product Deflator used as a proxy for inflation
$\propto_0$ is the constant term, 't' is the time trend, and 'ε' is the random error term

DATA DESCRIPTION AND SOURCES:

To capture the relationship between growth and Inflation, Economic growth was proxied by the GDP and the GDP deflator (GDPD) is used as a proxy for Inflation. The data covers the period from 1978 to 2010. All the variables are taken on annual basis from World Development Indicators (World Data Bank Online Version). All the variables are transformed in their natural logarithms in order to avoid the problems of heteroscedasticity and denoted as LGDP and LGDPD.

ESTIMATION TECHNIQUE:

Unit Root Test:

The first step involves testing the order of integration of the individual series under consideration. Researchers have developed several procedures for the test of order of integration. The most popular ones are Augmented Dickey-Fuller (ADF) test due to Dickey and Fuller (1979, 1981), and the Phillip-Perron (PP) due to Phillips (1987) and Phillips and Perron (1988). Augmented Dickey-Fuller test relies on rejecting a null hypothesis of unit root (the series are non-stationary) in favor of the alternative hypotheses of stationarity. The tests are conducted with and without a deterministic trend (t) for each of the series. The general form of ADF test is estimated by the following regression

$$\Delta y_t = \propto_0 + \propto_1 y_{t-1} + \sum_{i=1}^{n} \propto \Delta y_i + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$\Delta y_t = \propto_0 + \propto_1 y_{t-1} + \sum_{n=1} \propto_1 \Delta y_i + \delta_t + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:
Y is a time series, t is a linear time trend, Δ is the first difference operator, α_0 is a constant, n is the optimum number of lags in the dependent variable and e is the random error term; the difference between equation (1) and (2) is that the first equation includes just drift. However, the second equation includes both drift and linear time trend pp.

$$y_t = \propto_0 + \propto y_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The Cointegration Test:

Once a unit root has been confirmed for a data series, the next step is to examine whether there exists a long-run equilibrium relationship among variables. The existence of long-run equilibrium (stationary) relationships among economic variables is referred to in the literature as cointegration which is very significant to avoid the risk of spurious regression. The Johansen procedure will be employed to examine the question of cointegration and provide not only an estimation methodology but also explicit procedures for testing for the number of cointegrating vectors as well as for restrictions suggested by economic theory in a multivariate setting. Engel and Granger (1987) pointed out that a linear combination of two or more non-stationary variables may be stationary. If such a stationary combination exists, then the non-stationary time series are said to be co-integrated. The VAR is based on co-integration test using the methodology developed in Johansen (1991, 1995).

Johansen's methodology takes its starting point in the vector autoregression (VAR) of order P given by

$$y_t = \mu + \Delta_1 y_{t-1} + - - - + \Delta P y_{t-p} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where,

Y_t is an nx1 vector of variables that are integrated of order commonly denoted (1) and ε is an nx1 vector of innovations.

This VAR can be rewritten as

$$\Delta y_t = \mu + \delta_{yt-1} + \sum_{i-1}^{p-1} \tau_i \Delta y_{t-1} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where

$$\Pi = \sum_{i-1}^{p} A_{i-1} \quad and \quad \tau_i = \sum_{j=i+1}^{p} A_j$$

To determine the number of co-integration vectors, Johansen (1988, 1989) and Johansen and Juselius (1990) suggested two statistic tests, viz., the trace test statistic, and the maximum eigenvalue test statistic.

TRACE TEST STATISTIC:

The trace test statistic can be specified as:

$$\tau_{trace} = -T \sum_{i-r+1}^{k} log\,(1 - \lambda_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where, λ_i is the i th largest eigenvalue of matrix Π and T is the number of observations. In the trace test, the null hypothesis assumes that the number of distinct cointegrating vector(s) be less than or equal to the number of cointegration relations (r).

MAXIMUM EIGENVALUE TEST:

The maximum eigenvalue test examines the null hypothesis of exactly r cointegrating relations against the alternative of r+1 cointegrating relations with the test statistic: $\tau_{max} - -T log(1 - \lambda_{r+1})$, where λ_{r+1} is the (r +1)th largest squared eigenvalue. In the trace test, the null hypothesis of r = 0 is tested against the alternative of r + 1 cointegrating vectors.

It is well known that Johansen's cointegration test is very sensitive to the choice of lag length. So first a VAR model is fitted to the time series data in order to find an appropriate lag structure. The Akaie Information Criterion (AIC), Schwarz Criterion (SC) and the Likelihood Ratio (LR) test are used to select the number of lags required in the cointegration test.

3.3.3 Granger-causality Test

After the testing of the Cointegration relationship, we test for causality between Growth and Inflation in

Bangladesh. If the two variables are co-integrated, an Error Correction term (ECT) is required to be included (Granger, 1988) in the following bivariate autoregression:

$$GDP_t = \beta_0 + \sum_{i=1}^{n} \beta_{1t}\, GDP_{t-1} + \sum_{i=1}^{m} \beta_{2t}\, GDPD_{t-1} + \delta_1 ECT_{t-1} + \epsilon_{1t} \ldots\ldots\ldots\ldots (9)$$

$$GDPD_t = \gamma_0 + \sum_{i}^{m} \gamma_{1t}\, GDP_{t-1} + \sum_{i=1}^{n} \gamma_{2t}\, GDPD_{t-1} + \delta_1 ECT_{t-1} + \varepsilon_{1t} \ldots\ldots\ldots\ldots (10)$$

The term ECT_{t-1} is the error correction term derived from the long-run cointegrating relationship in equation 3. We note that the estimate δ_1 and δ_2 can be interpreted as the speed of adjustment. According to Johansen and Juselius (1987), the existence of cointegration implies the existence of the causality relation between the variables (Growth and Inflation) under the constraint $|\delta_1| + |\delta_2| > 0$. If cointegration relationship between the variables GDP_t and $GDPD_t$ does not exist, the term ECT will be removed and the bivariate autoregression equation 9 and 10 becomes:

$$GDP_t = \beta_0 + \sum_{i=1}^{n}{}' \beta_{1t}\, GDP_{t-1} + \sum_{i=1}^{m}{}' \beta_{2t}\, GDPD_{t-1} + \epsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

$$GDPD_t = \gamma_0 + \sum_{i=1}^{m}{}' \gamma_{1t}\, GDP_{t-1} + \sum_{i=1}^{n}{}' \gamma_{2t}\, GDPD_{t-1} + \epsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Rejecting (accepting) H_0; $\beta_{21} = \beta_{22}$---------- $= \beta_{2m}$ in equation (9 and 10) or equation (11 and 12) suggests that Growth do (do not) Granger cause Inflation. On the other hand, rejecting (accepting) H_0; $\beta_{11} = \beta_{12} =$ ---------- $= \gamma_m$ suggest that Inflation do (do not) Granger Cause
(have an effect) on Growth. These tests enable us to reveal the relationship of no causality, unidirectional causality of feedback causality between money supply and inflation.

DATA AND EMPIRICAL RESULTS:

Unit Root Test:

This involves testing for the stationarity of the individual variables using both the Augmented Dickey Fuller (ADF) and Phillips – Perron (PP) tests to find the existence of unit root in each of the time series. The results of both the ADF and PP tests are reported in Tables 1(Levels & Frist Difference).

Table 1: Unit Root Result

Series	LEVELS			1st DIFFERENCE		
	ADF	PP	REMARK	ADF	PP	REMARK
LGDP	2.331224	2.497473	NS	2.682675	-4.854303	I(1)
LGDPD	-1.105508	-1.668032	NS	-5.241794	-7.463293	I(1)
Critical Values at 1% level of Significance						
	-2.664853	-2.636901		-2.669359	-2.639210	
Critical Values at 5% level of Significance						
	-1.955681	-1.951332		-1.956406	-1.951687	

All the variables were not found stationary in levels. This can be seen by comparing the observed values (in absolute terms) of both the ADF and PP test statistics with the critical values (also in absolute terms) of the test statistics at the 1%, 5% and 10% level of significance. Result from table 1 provides strong evidence of non stationarity. Therefore, the null hypothesis is accepted and it is sufficient to conclude that there is a presence of unit root in the variables at levels. As a result of the above result, all the variables were differenced once and both the ADF and PP test were conducted on them a shown in table 1. The coefficients compared with the critical values (1%, 5% and 10%) reveals that all the variables were stationary at first difference and on the basis of this, the null hypothesis of non-stationary is rejected and it is safe to conclude that the variables are stationary. This implies that the variables are integrated of order one, i.e. 1(1).

COINTEGRATION TEST RESULT AND ANALYSIS:

The result of the cointegration condition (that is the existence of a long term linear relation) is presented in Table 2 (Trace Statistics & Maximum Eigenvalue) using methodology proposed by Johansen and Juselius (1990):

Table 2: Cointegration Test among Series

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
None	0.341045	15.09015	15.41	11.26170	14.07
At most 1	0.132200	3.828441	3.828441	0.799988	3.76

Trace test and Max-Eigen test indicate no cointegrating equation; both at 0.05 level
*denotes rejection of the hypothesis at the 0.05 level

In the Cointegration tables, both trace statistic and maximum Eigenvalue statistic indicated no cointegration at the 5 percent level of significance, suggesting that there is no cointegrating (or long run) relationship between growth and inflation. Since the null hypothesis was accepted, there is no need to further subject the variables to error correction test which has lead us to examine the causality between growth and inflation.

GRANGER CAUSALITY TEST ANALYSIS:

Causality does not necessarily suggest exogeneity in the sense that the result gotten may not explain whether the relationship is positive or negative. However, growth and inflation, as widely suggested by many economist scholars in the literature reviewed are known to relate inversely, in other words, the economy does not grow well in the midst of high inflation. In any case the following result shown in the tables below reveals the direction of causality between growth and inflation at lag two (2) and lag four (4).

Table 3: Results of Granger Causality Test

Null Hypothesis	F-Statistic	Probability	Decision
LGDPD does not Granger Cause LGDP	3.72769	0.03719	Rejected
LGDP does not Granger Cause LGDPD	2.52739	0.98160	Accepted

(Number of lags = 2)

Following the result in table 3, the null hypothesis that LCPI does not Granger Cause LGDP is rejected and it is safe to conclude that Uni-directional causality run from Inflation to GDP at lag two (2).

Table 4: Results of Granger Causality Test

Null Hypothesis	F-Statistic	Probability	Decision
LGDPD does not Granger Cause LGDP	5.23572	0.00437	Rejected
LGDP does not Granger Cause LGDPD	1.36400	0.28005	Accepted

(Number of lags = 4)

In the result shown in table 3, the null hypothesis that LGDPD does not Granger cause LGDP is also rejected, further confirming a unidirectional causality from Inflation to GDP at lag 4.

CONCLUSION:

The objective of this study is to find out the existence of longrun relationship between inflation and economic growth in Bangladesh. The methodology employed in this study is the cointegration and Granger causality test. We used the GDP deflator (GDPD) as a proxy for inflation and the GDP as a perfect proxy for economic growth to examine the relationship for the period 1978-2010. The stationarity tests out using the Augmented Dickey-Fuller test (ADF) and Phillip-Perron test (PP) indicate that there is presence of a unit root at levels but at first difference the variables are found stationary at 1% and 5% level of significance.

The Johansen-Juselius co-integration technique test showed that for the periods, 1978-2010, there was no co-integrating relationship between inflation and economic growth for Bangladesh data. Thus, we could not find any long-run relationship between inflation and economic growth for Bangladesh.

Besides the non-existence of cointegration existing between economic growth and openness, further effort was made to check the causality relationship that exist between the two variables by employing the VAR-Granger causality aproach at two lag periods as could be seen in table 3 to 4. The first test was conducted using lag two (2) and in the result unidirectional causality was seen running from inflation to economic growth. Further test at lag four (4) was carried out

and it supported the first by indicating a unidirectional causality running from inflation to economic growth. It should be borne in mind that the study did not consider if the relationship between inflation and growth was negative or positive; however, various studies as reviewed in the literature has come out with the result that high inflation is and has never been favourable to economic growth. Hence it will be good to maintain the fact that the causality that run from inflation to economic growth is an indication of relationship showing that inflation indeed has an impact on growth.

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