AN EMPIRICAL STUDY ON INFLATION AND ECONOMIC GROWTH IN BANGLADESH

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Abstract: In this study, the relationship between the inflation and the economic growth in Bangladesh has been examined in the framework of data covering 1988:2008 periods. The existence of the long term relationship between these two variables has been examined using Bound Test developed by Pesaran et al. (2001), and the existence of a cointegration relationship between the two series has been detected following the test result. Whereas no statistically significant long term relationship has been found with the formed ARDL models, a negative and statistically significant short term relationship has been found. The Causality relationship between the two series has been examined in the framework of the causality test developed by Toda Yamamoto (1995) but no Causality relationship has been found from economic growth to inflation, a Causality relationship has been found from inflation to economic growth.

Keywords: Economic Growth, Cointegration, ARDL Model, Causality Relationship, Bound Test.

I. INTRODUCTION

The relationship between the economic growth and the inflation is one of the most important macroeconomic problems. This relationship has been argued in economics literature and these arguments have shown differences in relation with the condition of world economy. In accordance with these policies, increases in the total demand have caused increases products and inflation too. However, inflation was not regarded as a problem in that period rather considered that it has a positive effect on the economic growth and it was accepted widely. Amid these views, Phillips first introduced hypothesizes that high inflation positively affects the economic growth by creating of a lower unemployment rate. When it came to 1970s, the growth rates begun to decrease in countries with high inflation and especially high inflations and hyperinflations took place in Latin American countries in 1980s. It caused the emergence of the views stating that inflation has negative effects on the economic growth instead of the positive effect on the economic growth and build up these views.

Although the relationship between inflation and economic growth remains controversial or somewhat inconclusive, several empirical studies confirm the existence of either a positive or negative relationship between these two major macroeconomic variables. Moreover, with time a common consensus evolved that low and stable inflation promotes economic growth and vice versa (Mubarik, 2005). This further raise the question that what is rate of low inflation should be. And the answer clearly depends on the nature and structure of the economy and differs across countries. In this regard, recently macroeconomists have adopted an econometric technique simply by looking at a nonlinear or structural break effect which states that the impact of inflation on economic growth could be positive up to a certain threshold level and beyond this level the effect turns to be negative (Sweidan, 2004). This supports both the view of the structuralists and the monetarists up to a certain extent, that is, low inflation is helpful for economic growth but once the economy attained faster growth then inflation is unfavourable for the sustainability of such growth.

The objective of the study is to examine the relationship between inflation and economic growth in Bangladesh. Bounds Test approach developed by Pesaran et al. (2001) has been used to examine the cointegration relationship between the data series from 1980-2008. Modified WALD method developed by Toda and Yamamoto (1995) has been used to determine the direction of the causality relationship between the data series.

II. LITERATURE REVIEW

The studies that examine this relationship have been increased especially in the 1990s. These studies starting with Kormandi and Meguire (1985) and than with Grimes (1991), Fischer (1993), DeGregorio (1993), Gylfason and Herbertsson (2001), Valdovinoz (2003), and Guerrero (2004) have revealed that inflation has negative effects on the economic growth. In a study conducted by Kormandi and Meguire using data of 47 sample countries covering 1950-1977, it has been observed that an

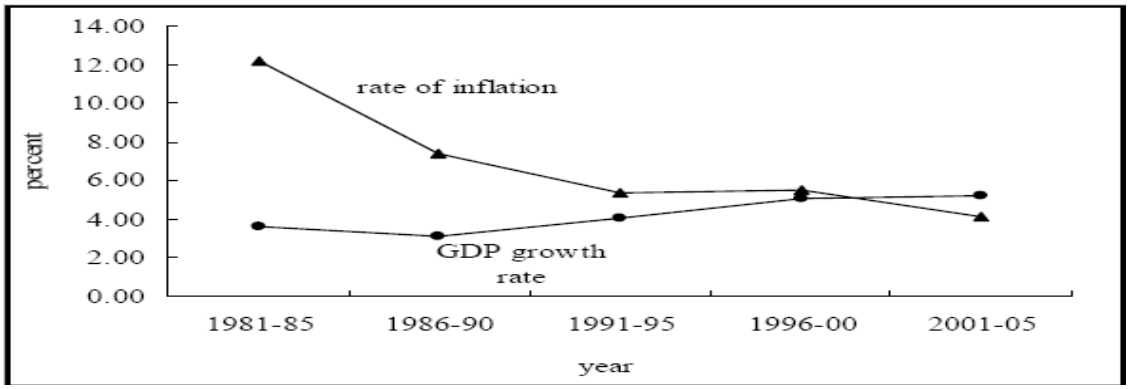
increase in inflation by 1% reduces the economic growth by 0.57%. Fischer (1991) has stated that macroeconomic policy preferences like budget deficits and foreign exchange systems are important for the economic growth. In a study conducted by Fischer (1993), it has been shown that a negative relationship exists between the economic growth and inflation and budget deficits. He found the direction of causality as from macroeconomic policies (such as inflation and budget deficits) to the economic growth. According to the Fischer's study (1993), inflation reduces the growth, investments and productivity; public deficits reduce both capital accumulation and productivity increase.

Using data of 21 countries covering 1961-1987, Grimes (1991) has found a positive relationship between inflation and the economic growth for a short term, and a negative relationship between them for a long term. In his study covering 12 Latin American countries between 1950 and 1985, DeGregorio (1993) has found a negative relationship between the inflation and the economic growth. Gomme (1993) has conducted a research which found a negative relationship between the inflation and the economic growth. In his study covering 100 countries between 1960 and 1990, Barro (1995) has detected a similar relationship. Motley (1998) has been included in the literature by finding that an increase in inflation by 5% reduces the economic growth by 0.1-0.5%, which is a fitting result for that period using data between 1960 and 1990. In their articles reviewed 170 countries between 1960 and 1992, Gylfason and Herbertsson (2001) have found both economically and statistically significant and strong relationship between these two variables. In his study covering 8 Latin American countries, Valdovinoz (2003) has found a negative relationship using the data between 1970 and 2000. In his study conducted in 2004, Guerrero has examined the countries which experienced hyperinflation in the previous periods and he set forth that inflation is in a significant and strong negative relationship with the economic growth even before reaching a certain threshold value.

Bruno and Easterly (1998) has stated in their study that this relationship only arise in the crisis periods resulted with high inflation. Mallik and Chowdhury (2001), who examined the relationship between the inflation and the growth in short and long term for four Asian countries using time series analysis, has stated the positive effect of inflation on the growth and emphasized the importance of inflation in the economic growth. Generally, the views stating that the effect of the inflation on the economic growth is a positive one are based on the idea that inflation increases the compulsory savings (Bruno and Easterly, 1995). However, this result is based on the empirical analyses conducted using the data from periods in which the growth rate is high and the inflation rate is relatively low (Erçel, 1999).

III. DATA AND METHODOLOGY

The study uses the quarterly time series data of Gross Domestic Production (Y hereafter) and Consumer Price Index (INF hereafter), for Bangladesh from 1988 to 2008. Real GDP series has been formed by deflating nominal GDP series which are measured as million TL with price index based on 1988=100. These data are shown in Figure 1.



Source: Ahmed S. & Mortaza G. (2005)

Figure 1: Average GDP Growth and Inflation Rates (1998 – 2008)

Empirical studies show that most of the time series are not stationary. Since facing a unauthentic regression problem among these series which include a unit root, some methods are suggested to solve this problem. One of them is taking the differences of the series and then putting them into regressions. However, in this case the author is confronted with a new problem. This method leads to the loss of information that is important for the long-run equilibrium. As long as the first differences of the variables are used, determining a potential long run relationship between these variables becomes impossible. This is the point of origin of co-integration analysis.

The co-integration approach developed by Engle and Granger (1987) has overcome this problem. According to this approach, time series which are not stationary at levels but stationary in the first difference can be modelled with their level states. In this way, losing of information in the long run can be prevented. However, this approach becomes invalid if there are more than one co-integration vectors. Moving from this point, with the help of the approach developed by Johansen (1988), it is possible to test how many co-integration vectors there are among the variables by using the VAR model in which all the variables are accepted as endogenous.

Therefore, unlike the Engle Granger method, a more realistic examination is provided without limiting the test in one co-integration vector expectation. However, in order to perform these tests developed by Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990), the condition must be met that all series should not be stationary at the levels and they should become stationary when the same differences are taken. If one or more of the series are stationary at levels, that is to say I(0), the co-integration relationship cannot be examined with these tests. Bounds test approach developed by Pesaran et al. (2001) removes this problem. According to their approach, the existence of a co-integration relationship can be examined between the series regardless of whether they are I(0) or I(1) (under the circumstance that dependent variable is I(1) and the independent variables are either I(0) or I(1)). This point is the greatest advantage of the bounds test among all the co-integration tests.

When examining the methodology used in causality aspect, we see that causality test developed by Granger (1969) is performed if the series are stationary in their level conditions. Vector error correction (VEC) model developed by Engle and Granger (1987) used widely if cointegration occurs between series which become stationary when the same difference is taken. In the vector error correction model which is a limited VAR model, F test is used for testing the causality. However; if the series are cointegrated, traditional F test statistics used for testing the Granger causality may not be valid because it does not fit into the standard distribution (Toda and Yamamoto, 1995; Giles and Mizra, 1998; Giles Williams, 1999). In the causality testing performed with modified WALD method developed by Toda and Yamamoto (1995), cointegration relationship between the series is not important and it is enough to determine the right model and to know the maximum cointegration level of the variables in the model.

IV. EMPIRICAL EVIDENCE

4.1. Stationary Test

Before testing for cointegration and causality first the author tested for unit roots to find the stationarity properties of the data. Augmented Dickey-Fuller (ADF) t-tests (Dickey and Fuller 1979) and Phillips and Perron (PP) (1988) tests were used on each of the two time series for Bangladesh. Akaike information criterion is used to determine the duration of delays in both tests.

Table 1: Stationary Test Results

Variables	**ADF Test**		**PP Test**	
	Without Trend	With Trend	Without Trend	With Trend
LY	0.391	-2.761	-0.116	-3.579
ΔLY	-4.135*	-4.185*	-8.133*	-8.303*
LINF	-1.124	0.210	-1.722	2.181
ΔLINF	0.170	-1.780	-6.270*	-5.567*

According to ADF and PP test results, both tests are found to be first difference stationary This situation satisfies the Pesaran et al.'s (2001) precondition that the dependent variable must be I(1) and independent variables I(0) or I(1).

4.2. The bounds test approach to cointegration

Firstly an unrestricted error correction model (UECM) is formed. The form of this model adapted into our study is as follows.

$$\Delta LY_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} \Delta LY_{t-i} + \sum_{i=0}^{m} \alpha_{2i} \Delta LINF_{t-i} + \alpha_3 LY_{t-1} + \alpha_4 LINF_{t-1} + \mu_t \qquad (1)$$

Where LY_t is log of real GDP and $LINF_t$ is log consumer price index. F test is applied on first period lags of dependent and independent variables to test the existence of cointegration relationship. Basic hypothesis for this test is established as ($H_0 : \alpha_3 = \alpha_4 = 0$) and calculated F statistic is compared with table bottom and top critical levels in Pesaran et al. (2001). If the calculated F statistics is lower than Pesaran bottom critical value, there is no cointegration relationship between the series. If the calculated F statistics is between the bottom and top critical values, no exact opinion can be made and there is a need to apply other cointegration test approaches. Lastly; if the calculated F statistics is higher than the top critical value, there is a cointegration relationship between the series. After the cointegration relationship is observed between the series, Autoregressive Distribution Lag (ARDL) models are established to long term and short term relationships. In UECM models, "m" represents number of lags.

After the number of lags was determined, F test statistics calculated with UECM model has been compared with the table bottom and top critical levels in Pesaran et al. (2001). Bounds Test results are given in Table 2.

Table 2: Bound Test Results

k	**F statistics**	**Critical Values (5% Significance)**	
		Top Critical Values	Bottom Critical Values
1	10.567	6.30	5.65

K: number of independent variables in equation (1). Critical values were obtained from table CI(iii) Pesaran at al (2001:300)

As it is seen from Table 2, a cointegration relationship has been detected between the series, because F statistics exceeds the top critical value of Pesaran. Owing to the fact a cointegration relationship has been detected between the series, Autoregressive Distribution Lag (ARDL) model can be established to determine long term and short term relationships.

4.3. Model of ARDL

Autoregressive Distribution Lag (ARDL) model are established as follows to examine the long term relationship between the variables. Akaike information criterion has been used to determine the number of lags.

$$LY_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} LY_{t-i} + \sum_{i=0}^{n} \alpha_{2i} LINF_{t-i} + \mu_t \qquad (2)$$

4.3.1. Long Run Coefficients

Table 3: ARDL (5, 1) Long Run Coefficients

Variables	**Coefficients**	**T-Statistic**
LE	0.011	1.014
C	09.371	14.435*

* Significance at 1%

According to the results in Table 3, there is no long term statistically significant relationship between the economic growth and the inflation.

4.3.2. Short Run Coefficients

$$\Delta LY_t = \alpha_0 + \alpha_1 EC_{t-1} + \sum_{i=1}^{m} \alpha_{2i} \Delta LY_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta LINF_{t-i} + \mu_t \qquad (3)$$

In equation (3), EC_{t-1} is lag value of error term that obtained from long-run relationship. The coefficient of EC_{t-1} is expected to be negative and it shows the eliminating speed of disequilibrium.

Table 4: Short Run Coefficients

Variables	Coefficients	T-statistic
DLY (-1)	-0.025	-0.205
DLY (-2)	0.033	0.468
DLY (-3)	0.021	0.164
DLY (-4)	-0.201	-2.454*
DLE	-0.169	-2.045*
C	0.725	1.045
ECT (-1)	-0.703	-2.897*

* Significance at 1%

According to the results in Table 4, a short term negative and statistically significant relationship has been detected between the economic growth and the inflation. Furthermore, EC_{t-1} variable has been found negative and statistically significant as expected.

4.4. The Toda–Yamamoto approach to Granger causality test

Toda and Yamamoto (1995) has stated that WALD hypothesis test which is to be performed with adding extra lag to VAR model in accordance with the maximum cointegration relationship of the series will have chi-square (χ^2) distribution. Toda and Yamamoto (1995) approach fits into a standard VAR model in variable levels (instead of first differences as in Granger causality tests) and accordingly minimizes the risks resulted from the possibility of wrong detection of cointegration levels of the series (Mavrotas and Kelly, 2001). VAR model with two variables comprise of Gross Domestic Product (LY) and Consumer Price Index (LINF) series has been formed as follows.

$$LY_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} LY_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} LY_{t-j} + \sum_{i=1}^{k} \phi_{1i} LINF_{t-i} + \sum_{j=k+1}^{d\max} \phi_{2j} LINF_{t-j} + \mu_{1t} \qquad (4)$$

$$LINF_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} LINF_{t-1} + \sum_{j=k+1}^{d\max} \beta_{2j} LINF_{t-j} + \sum_{i=1}^{k} \delta_{1i} LY_{t-1} + \sum_{j=k+1}^{d\max} \delta_{2j} LY_{t-j} + \mu_{2t} \qquad (5)$$

In VAR model, "k" represents the number of lags, and "$d\max$" represents the maximum cointegration level of the variables entered into the model. Basic idea of this approach is to increase the number of lags in the VAR model up to the maximum cointegration level of the variables entered into the model. Hypothesis for the equation (4) if $\phi_{1i} \neq 0$ inflation is the reason for the economic growth. Similarly, hypothesis for the equation (5) if $\delta_{1i} \neq 0$ economic growth is the reason for the inflation.

According to ADF and PP test results, both tests are found to be first difference stationary. In this case, the maximum cointegration levels of the variables take place in the model has been found as ($d\max = 1$). Secondly, the number of delays to be used in the VAR model should be determined. For that reason, maximum duration of lag has been taken as 8 and duration of lag which minimizes the critical values like LR (Likelihood Ratio), FPE (Final Prediction Error), Akaike (AIC), Schwarz (SC) and Hannan Quinn (HQ) has been tried to be determined.

Table 5: Determination of Lag Length at VAR Model

Number of lags	LR	FPE	AIC	SC	HQ
1	264.0784	1.80e-08	-6.600086	-6.340089	**-6.398073***
2	4.214556	1.86e-08	-6.467340	-6.081884	-6.314322
3	10.09087	1.96e-08	-6.532341	-6.017504	-6.327302
4	6.456322	1.90e-08	-6.685432	-6.896254	-6.283493
5	**15.13765***	**1.59e-08***	**-6.609087***	**-6.914404***	-6.252250
6	2.178962	1.72e-08	-6.512340	-6.710104	-6.379162
7	0.746366	1.92e-08	-6.465342	-6.564323	-6.102756
8	1.787657	2.11e-08	-6.417899	-6261530	-6.874522

* Shows the lag length which obtains minimum information criterion

Table 6: Result of Causality

Direction of Causality			χ^2	P Value
LINF	$\Rightarrow$	LY	12.495	0.012**
LY	$\Rightarrow$	LINF	4.789	0.327

* * Significance at the level of 5%

It is shown in the table 5 that LR, FPE and AIC information criteria indicate 5 lags. Moreover; when the graphics of model's error terms are examined, it has been observed that 5 lags indicated by LR, FPE and AIC information criteria has not caused an autocorrelation problem. Accordingly, it has been approved that duration of delay is taken as 5. In this way; after having determined the number of lags of VAR model, a causality analysis has been performed in the context of VAR model "$k + d_{\max} = (5+1) = 6$" level by adding the maximum cointegration level of 1 to this number of lags. The model is estimated using SUR (Seemingly Unrelated Regression). According to the result in Table 6, whereas there is no causality relationship from economic growth to inflation, unidirectional causality running from inflation to economic growth.

V. CONCLUSION

In this study, the relationship between the inflation and economic growth in Bangladesh has been examined with the data covering 1988: 2008 periods in the framework of Pesaran et al. (2001) Bounds Test approach and Toda Yamamoto (1995) causality analysis approach. The existence of a cointegration relationship between the two series has been detected following the Bounds Test results. Later, ARDL models have been established to determine long term and short term relationships. Whereas no statistically significant long term relationship has been found, a negative and statistically significant short term relationship has been found. A unidirectional causality running from inflation to economic growth Toda Yamamoto (1995) approach performed to determine the causality aspect of the relationship. In conclusion; the importance of the macroeconomic policies which provide cost stability are obvious for a steady and sustainable growth.

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