Sources of Inflation in Bangladesh: An Empirical Analysis

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Abstract- Inflation is one of the major problems of the economy of Bangladesh. The study analyzed the key determinants of inflation in Bangladesh using data for the period from 1987 to 2012. To explain the relationships a model is constructed with lagged independent variables and Ordinary Least Square (OLS) method has been used. Empirical results show that money supply and unemployment positively and significantly affect inflation. Results also indicate that exchange rate significantly and negatively influences over inflation rate. The explanatory variables accounted for 77 percent of the variation of inflation during the study period. This study suggests that money supply should be controlled to decrease inflation. Exchange rate is also an important tool to control inflation. A depreciation in the exchange rate raises inflation.

Index Terms- Inflation, Money supply, Exchange rate, Unemployment.

I. INTRODUCTION

In economics, inflation is a sustained raise in the general price level of goods and services in an economy over a period of time. When the general price level increases, each unit of currency buys less good and services. Consequently, inflation reflects reduction in the purchasing power per unit of money- a loss of real value in the medium of exchange and unit of account within the economy. That is why a fundamental macroeconomic purpose for a country to achieve price stability and the monetary authority to set policies accordingly to prevent any persistent rise in the general price level. By the Consumer Price Index (CPI) Inflation is measured. Policy makers always try to control price within the limit. The CPI dealings the prices of a fixed market basket of several thousand goods and services purchased by household.

During the last decade the rate of inflation in Bangladesh was restrained. Inflation rate in Bangladesh was 8.80 and food item inflation is 11.34 in FY 2010- FY2011. At present, the rate of inflation in Bangladesh is 9.73 percent (Bangladesh Economic Review, 2011 [1]. It is a matter of serious concern for the consumer of Bangladesh. Because it reduces the purchasing power of them. Since Bangladesh is not a high income country people have to adjust with purchasing power a lot. It is also a matter of worry for the policy makers because it tipples down the government of a country. This is why they have to keep in check some variables which have greater impacts on the inflation.

Inflation means a rising trend in the general price level of a country. Inflation is sustained increase in the price level at least consecutive three years (Gills et al, 1996[2]. This is one reason for the reliance on monetary policy as a means of controlling inflation. The growth in money supply and its economic implications is therefore an issue to be thoroughly investigated. This subject has bordered the minds of Bangladeshi policy makers for decades. Despite the lacks of consensus among different schools of thought on its effectiveness as an instrument of monetary policy, the Central Bank of Bangladesh (Bangladesh Bank) relies on it as its major barometer for shaping economic activities. The design and shift of the monetary measures taken by the central bank in recent times have been either expansionary or contractionary. Expansionary policy tools have been used to increase money supply with the intent of increasing output. Contractionary policy tools have been used on the other hand to decrease money supply in the economy in order to discourage consumption thereby curtailing inflation.

Moreover, if there is depreciation in the exchange rate, this depreciation causes inflation to increase. Depreciation means the currency buys less foreign exchange, therefore imports are more expensive and exports are cheaper. Therefore we get – (1) imported inflation- The price of imported goods goes up because they are more expensive to buy from abroad. That is why policy maker must keep their eyes on exchange rate to control inflation. (2) Higher domestic demand. Cheaper exports increases demand for import of foreign country. Therefore there is an increase in domestic aggregate demand and we may get demand pull inflation. (3) Less incentives to cut cost. Manufacturer who export see an improvement in competitiveness without making any effort. Some argue this may reduce their incentive to cut costs, and therefore we get higher inflation in the long. For all these above reasons Policy makers of any country must keep their eyes on exchange rate to control inflation of an economy.
This study is an attempt to analyze the impact of money supply, exchange rate and unemployment on inflation in Bangladesh. The specific purposes of the study are as follows:

- To explain the relationship between inflation and money supply in Bangladesh.
- To examine the relationship between inflation and unemployment in Bangladesh.
- To discuss the relationship between inflation and nominal exchange rate in Bangladesh.

II. LITERATURE REVIEW

There have been ample literatures to examine the relationship between inflation and its determinants. But a few studies are found on empirical analysis of inflation and its

determinants in Bangladesh. This section provides a summary of the findings from the previous literature. And also some related findings of other countries will be included here.

Bangladesh Bank, IMF and CPD 2007 [3] explored that both demand and supply side factors constitute the relevant sources of inflation in Bangladesh. Among these are M2 growth, private sector credit growth, market capitalization growth, growth of government borrowing, remittance growth, exchange rate change, market syndicate.

Shamim and Mortoza 2005 [4] used the data from 1981 to 2005. They use time series analysis such as unit root and error correction mechanism. The result shows that there is a negative long run relationship between inflation and economic growth in Bangladesh.

Taslim, 1980 [5] used regression models for explaining the inflationary process of Bangladesh. He explored that one year lagged money supply had significant positive effect on inflation. However, the introduction of wage variable as an additional independent variable resulted in dramatic fall of statistical significance of coefficients of other variables in the regression model.

Khanam and Rahman, 1995 [6**]** examined the causative factors of inflation in Bangladesh during the period from 1972-73 to 1991-92 using Ordinary Least Square (OLS) method. Their results showed that growth rate of import prices and money wages, both considered as supply side variables, affect the inflation positively. They also found that all demand side variables have insignificant influence on the rate of growth of prices. In an analytical writing Ahmed and Das, 2007 [7] found that world food price and fuel price triggered inflationary pressure in Bangladesh. They also detected inflation inertia is another reason to sustain higher inflation.

Kibria,2010 [8] also traced there is a upward trend in inflation as international commodity prices are showing signs of increase, excess liquidity prevailing in the domestic market, increased flow of remittance and its impact on Foreign Reserve and stagnancy in investment in Bangladesh.

Hossain and Islam, 2013 [9] on their economic analysis of the determinants of inflation in Bangladesh analyzed the relationship between inflation, money supply, interest rate, nominal exchange rate and fiscal deficit for the period 1990 to 2010 using the ordinary least square (OLS) method. Their findings showed that inflation is positively and significantly affected by money supply and a year lagged of interest rate. But when the same money supply was lagged by a year together with fiscal deficit, they significantly and negatively influenced inflation. Their study revealed that interest rate, fiscal deficit and nominal exchange rate have no significant relationship with inflation. They cautioned in their recommendation that wages and import of goods and services from abroad to be controlled, as well as the supply of money.

Yen Chee Lim and Siok Kun Sek, 2014 [10] in their publication which focused on two categories of countries – (High inflation group and Low inflation group) the use of the error correction model based on the auto regressive distributed lag (ARDL) to explain the short run and the long run relationship between inflation and other variables revealed that in low inflation countries, GDP growth and imports of goods and services in the long run have significant impact on inflation. Whilst none of the variables were found to be significant determinants in the short run in high inflation countries.

Ashwani, 2014 [11] used a cointegration approach to identify the key determinants of inflation in India for the period 1981 to 2011. The study found the existence of a long run relationship among inflation, money supply, private and social spending and exchange rate. It was concluded that money supply, exchange rate and private final consumption expenditure contributed significantly to Indian's inflation at that time. It was recommended that there should be a balance between fiscal spending, money supply and exchange rate management for the maintenance of economic growth.

Cheng & Tan, 2002 [12] agreed that inflation in Malaysia was controlled well during recent financial crisis compared to other neighboring countries. In research done by Baghestani & Abu Al-Foul, 2010 [13] had analyzed that Federal Reserve gave the accurate information about inflation once the government forecast.

Agha and Khan, 2006 [14] have looked at the fiscal deficit and total bank borrowing by the government sector to explain inflation. Whereas Khan et al., 2007 [15] identified inflation expectations, private sector credit and imported inflation as the most significant explanatory factors. L. H. Cheng and P. Laura, 1997 [16] shows that high inflation is appeared in the Turkish economy since the1970s. They found that monetary variables especially money supply and exchange rate play main role to the Turkish inflation process. Public sector deficit and depreciation also contribute to inflation in Turkey.

Methodology and Empirical model:

Here we used linear model to explain the impact of money supply, exchange rate and unemployment on inflation. The sample period for investigation is 1987 to 2012.The empirical study will employ annual, time series secondary data collected from different sources.

Reliability of data is a serious issue for any kinds of study. Since Bangladesh is a developing country the statistical data base system is not enough strong here. Despite this problem, Data is taken with intensive attention from different government institutions, concerned ministries, concerned corporate offices, research journals, statistics and various websites. All these sources of data are well recognized and widely accepted.

As the primary focus of this paper is to analyze the sources of inflation, the econometric model is specified to facilitate the test of hypothesis that whether explanatory variables cause inflation. In this model, the explanatory variables are money supply (M2), Exchange rate (Er) and unemployment (Un). The dependent variable is inflation. The model can be shown as follows:

$$Inf_t = \beta_1 + \beta_2\, M2_{t-1} + \beta_3\, Er_{t-1} + \beta_4\, Un_{t-1} + \mu_t$$

Where, μ_i is an error term and it is indicating time, β_1 is the scalar parameter and β_3 and β_4 are the slope coefficient of the respective variable.

Variable definition and data sources:

1. Inf= represented by Consumer price index (CPI) in Bangladesh.

Source: Bangladesh Economic Review.

2. M2= Money supply= M1+ time deposits= (Currency outside bank+ deposit of financial institutions with Bangladesh Bank+ demand deposits)

Source: www.databank.worldbank.org

3. Er= Exchange rate

Source: Statistical yearbook of Bangladesh.

4. Un= Unemployment

Source: www.globaleconomy.com

Expected Sign of the estimated coefficient

- $\beta_2 > 0$: As Bangladesh is a developing country, if money supply increases
  money supply is also increases.
- $\beta_3 < 0$: Exchange rate is negatively related with inflation.
- $\beta_4 < 0$: Inflation is negatively related with unemployment.

Empirical Analysis:

We took all variables by using an econometric program name Eviews7, and then we ran OLS (ordinary least square) method.

We use Augmented Dickey- Fuler (ADF) to know whether data is stationary or not. On the basis of ADF test, the impact of result shows that all variable's data non stationary at level. All the given variables are stationary at first difference.

Using Eviews7, We obtain the following multiple regressions:

$Inf_t = 191.4992 + 0.581725\ M2_{t-1} - 3.790343\ Er_{t-1} + 17.18616\ Un_{t-1} + \mu_t$

Estimated results with ordinary least squares method as shown in appendix 1A is summarized in the following table:

Table 1:

Variables	Coefficients	Standard error	t-statistic	probability
M2(-1)	0.581725	0.116058	5.012382	0.0001
Er (-1)	-3.790343	0.999729	-3.791370	0.0011
Un(-1)	17.18616	6.210343	2.767344	0.0115

Dependent variable: Inf

R^2 = 0.772010 S.E. = 17.7338

Durbin- Watson stat = 0.927288 F- statistic = 23.70303

Prob (F-statistic) = 0.000001

Here, the table shows the result of the estimated equation. From the table we can say that estimated coefficients β_2 and β_3 have expected signs. But the sign for unemployment coefficient is not expected. But it is not impossible at all. Bangladesh economy experienced a lot of adverse supply shocks over the past few decades. In case of adverse supply shock inflation and unemployment move in the same direction.

Again, the results show that explanatory variable can explain about 77% change in the dependent variable as adjudged with the coefficient of multiple determinants. Here t-value of the coefficient of the money supply is 5.012382 which is statistically significant and clearly suggest that as money supply increases inflation also increases in the next period. Similarly t-value of the coefficient of the exchange rate is -3.791370 which clearly indicates that as exchange rate increases inflation decreases in the next period. The t-value of unemployment is 2.7673 which in statistically significant and clearly indicates that as unemployment rises inflation also rises.

Test for Multi co-linearity:

Muliticolinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated, meaning that one can be linearly predicted from the others with a non-trivial degree of accuracy.

It is essentially a sample phenomenon, arising out of largely non-experimental data collected in the most social sciences. Although BLUE the OLS estimators have large variances and covariance's making precise estimation difficult in the presence of multicolineariy, We do not have one unique model to detect it or measuring its strength.

In this model, using Eviews7 and considering some rule of thumbs, results as shown in appendix (1.B) is summarized in table 2:

Table 2:

	M2	ER	UN
M2	1.000000	0.961269	0.788629
ER	0.961269	1.000000	0.843416
UN	0.788629	0.843416	1.000000

The table (2) indicates that there is 78% Multicolinearity between money supply and unemployment. It also indicates that there is 96% multicolinearity between money supply and exchange rate. And there is 84% multicolinearity between exchange rate and unemployment. So there is high multicolinearity. The remedial measure is shown below.

Remedial measure:

When we face with severe multicolinearity problem, one of the simple thing is to do is to drop one of the collinear variables. There is another remedy that sometimes simply increasing the size of the sample may attenuate the colinearity problem. Now, in our model we found multicolinearity problem. Therefore remedial measure may be called for.

Dropping collinear Variable:

Regression results from the appendix (1.C) are displayed in table 3:

Table 03

Variable	coefficient	Standard error	t-statistic	prob
M2(-1)	0.196686	0.071232	2.761203	0.0114
UN(-1)	4.861596	6.710015	0.724528	0.4764

R^2= 61%

From the table 3, we obtain following regression model:

Inf (-1) = 101.1348 + 0.196686 m2 (-1) + 4.861596 un (-1) +u_i

From this we see that, estimated t-values for the entire variable are not significant. The t value of the coefficient of unemployment is 0.724528 which is statistically insignificant. Again in this model, R^2= 61% where R^2= 77% in the original model. So we can conclude that despite multicolinearity problem we can not drop exchange rate variable from the model because exchange rate is statistically significant variable.

It has been said that if the sole purpose of regression analysis is prediction or forecasting then multicolinearity is not a serious problem because the higher theR^2, the better the prediction.

Again, the multicolinearity problem may be solved as we increase sample size of the model. This model is estimated by using data of 26 years. Though data processing is not much easy in Bangladesh and it is rare to found for large sample size we are unable to show that as sample size increases multicolinearity attenuates.

Test for Heteroscedasticity:

In Statistics, a collection of random variables is heteroscedastic if there are populations that have different variability's from others. The possible existence of Heteroscedasticity is a major concern in the application of regression analysis. We can detect the heteroscedasticity of error variance by using Eviews7. Here, White's Heteroscedasticity test is suitable in this model.

Table 4:

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. error	t-statistic	Prob.
M2(-1)	0.588736	0.058597	10.04714	0.0000
ER(-1)	-3.551574	0.570922	-6.220768	0.0000
UN(-1)	10.93636	4.66006	3.205226	0.0041
C	186.5536	17.82796	10.46410	0.0000

R-squared	0.763318	Mean dependent var	151.4296
Adjusted R-squared	0.731043	S.D. dependent var	34.93030
S.E. of regression	18.11523	Akaike info criterion	8.772022
Sum squared resid	7219.556	Schwarz criterion	8.965575
Log likelihood	-110.0363	Hannan-Quinn criter.	8.827758
F-statistic	23.65052	Durbin-Watson stat	1.238362
Prob(F-statistic)	0.000000		

Here calculated R^2(n.R^2) value is =19.76

At 5% level of significance with 3 df the chi-square value is 7.81 and 1% level of significance with 3 df the chi-square value is 11.34. Since calculated chi-square value > critical chi-square value, on the basis of the white test we conclude that there is heteroscedasticity.

Remedial Measures:

Since heteroscedasticity does not destroy the unbiasedness and consistency properties of the OLS, but they are no longer efficient. This lack of efficiency makes the usual hypothesis testing procedure dubious value. Therefore, remedial measure may be taken. There are two approaches of taking remedy- when $\sigma_i^2$is known and when $\sigma_i^2$is unknown.

When $\sigma_i^2$is known:

The Weighted least square method is the simplest straightforward method of correcting heteroscedasticity. Estimators obtained by this method are BLUE.

When $\sigma_i^2$is unknown:

Since the true $\sigma_i^2$is rarely known there is way of obtaining consistent estimates of the variances and covariance of OLS estimators even if there is heteroscedasticity. Then we use HAC standard error and covariance test.

By comparing OLS and HAC estimation we can illustrate following result from appendix (1.A) and (1.E)-

Inf (-1) = 186.5531+ 0.588736 m2 (-1) -3.551574 er (-1) + 14.93636 un (-1)

t= (7.12) (5.01) (-3.79) (2.76)

se= (26.86) (0.11) (0.99) (6.2)

HAC t= (8.90) (8.58) (-4.61) (2.54)

Se= (20.95) (0.06) (0.76) (5.87)

Proceeding results shows that HAC's heteroscedasticity standard errors are smaller than the OLS than the OLS standard error and estimated t-value are much smaller than OLS t-value. HAC standard error is not robust error. To be robust they need to fulfill both conditions. But they fulfill only t-value condition. It may be happened due to some specification error. Some other relevant variables need to be included in the model. Since inflation depends on many other variables expect money supply, exchange rate and unemployment, it is not possible to add all other variables due to time shortage and availability of data.

III. Conclusion and Policy implication

Inflation is a serious issue for any economy. Policy maker needs to control inflation in order to achieve sustainable growth. There are several variables that affect inflation. Policy maker needs to control these variables to control inflation.

In this paper, we examined the effects of money supply, exchange rate and unemployment on inflation by OLS method using yearly data for a period 26 years. The explanatory variable can explain 77% of the dependent variable. The analysis reveals that there is a positive significant relationship between money supply at crrent period and inflation in the next period. And there is also negative significant relationship between exchange rate and inflation. Both the results are expected. But the analysis shows that there is positive relation between inflation and unemployment which is not much expected. But it's not impossible at all. This may be due to some adverse supply shocks that occured Bangladesh economy over the last few decades. The single equation model we developed in this study may suffer from a number of shortcomings. Therefore, some venues for future research may be considered. They are as follows:

(1) This study uses yearly time series data, which may mask some important dynamic aspects of the short run behavior of inflation. An analysis based on quarterly or monthly data should certainly be more enriching.

(2) Foreign currency reserve may be included in order to determine the inflationary effects of such reserve.

APPENDIX (1):

Appendix (1A)

Dependent Variable: INF(-1)
Method: Least Squares
Date: 10/28/14 Time: 20:49
Sample (adjusted): 1988 2012
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	191.4992	26.86715	7.127635	0.0000
M2(-1)	0.581725	0.116058	5.012382	0.0001
ER(-1)	-3.790343	0.999729	-3.791370	0.0011
UN(-1)	17.18616	6.210343	2.767344	0.0115

R-squared	0.772010	Mean dependent var	152.9668
Adjusted R-squared	0.739440	S.D. dependent var	34.74145
S.E. of regression	17.73381	Akaike info criterion	8.734469
Sum squared resid	6604.247	Schwarz criterion	8.929490
Log likelihood	-105.1809	Hannan-Quinn criter.	8.788560
F-statistic	23.70307	Durbin-Watson stat	1.289867
Prob(F-statistic)	0.000001		

Appendix (1B)

	M2	ER	UN
M2	1.000000	0.961269	0.788629
ER	0.961269	1.000000	0.843416
UN	0.788629	0.843416	1.000000

Appendix (1C)

Dependent Variable: INF(-1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	101.1348	15.72434	6.431734	0.0000
M2(-1)	0.196686	0.071232	2.761203	0.0114
UN(-1)	4.861596	6.710015	0.724528	0.4764
R-squared	0.615951	Mean dependent var		152.9668
Adjusted R-squared	0.581037	S.D. dependent var		34.74145
S.E. of regression	22.48722	Akaike info criterion		9.175938
Sum squared resid	11124.85	Schwarz criterion		9.322203
Log likelihood	-111.6992	Hannan-Quinn criter.		9.216506
F-statistic	17.64215	Durbin-Watson stat		0.643292
Prob(F-statistic)	0.000027			

Appendix (1D)

Dependent Variable: INF

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2	0.588736	0.058597	10.04714	0.0000
ER	-3.551574	0.570922	-6.220768	0.0000
UN	14.93636	4.660006	3.205223	0.0041
C	186.5536	17.82796	10.46410	0.0000

R-squared	0.763318	Mean dependent var	151.4296
Adjusted R-squared	0.731043	S.D. dependent var	34.93030
S.E. of regression	18.11523	Akaike info criterion	8.772022
Sum squared resid	7219.556	Schwarz criterion	8.965575
Log likelihood	-110.0363	Hannan-Quinn criter.	8.827758
F-statistic	23.65052	Durbin-Watson stat	1.238362
Prob(F-statistic)	0.000000		

Appendix (1E)

Dependent Variable: INF

HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2	0.588736	0.069032	8.528455	0.0000
ER	-3.551574	0.768819	-4.619521	0.0001
UN	14.93636	5.873870	2.542848	0.0185
C	186.5536	20.95044	8.904521	0.0000

R-squared	0.763318	Mean dependent var	151.4296
Adjusted R-squared	0.731043	S.D. dependent var	34.93030
S.E. of regression	18.11523	Akaike info criterion	8.772022
Sum squared resid	7219.556	Schwarz criterion	8.965575
Log likelihood	-110.0363	Hannan-Quinn criter.	8.827758
F-statistic	23.65052	Durbin-Watson stat	1.238362
Prob(F-statistic)	0.000000		

APPENDIX (2):

YEAR	M2	ER	UN	INF(CPI)
1987	56.45571	30.94983	1.2	113
1988	58.08339	31.73325	1	121
1989	61.90577	32.27	0.9	131
1990	62.7118	34.56881	3.1	136.4
1991	65.34484	36.59618	3.6	147.7
1992	69.51465	38.95076	3.3	154.4
1993	74.95924	39.56726	3.2	158.7
1994	84.38503	40.21174	3	163.9
1995	86.32229	40.27832	2.8	178.4
1996	89.80858	41.79417	2.5	100
1997	93.65727	43.89212	2.9	103.96
1998	97.14974	46.90565	2.5	112.96
1999	105.1374	49.0854	3.1	120.94

2000	120.939	52.14167	3.3	124.31
2001	166.8571	55.80667	3.4	126.72
2002	182.0961	57.888	3.4	130.26
2003	195.6199	58.15004	4.3	135.97
2004	211.1136	59.51266	4.5	143.9
2005	229.632	64.32748	4.3	153.26
2006	259.392	68.93323	4.2	164.21
2007	272.8316	68.87488	4.3	176.04
2008	289.0103	68.59828	4.4	193.54
2009	322.9526	69.03907	5	206.43
2010	363.3406	69.64929	4.5	210.65
2011	390.5483	74.1524	4.5	213.87
2012	392.657	81.86266	4.5	215.65

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