

Bangladesh Economic Update
Growth and Inflation Trajectory
August 2012



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For orders and request, please contact:

Unnayan Onneshan - The Innovators

16/2, Indira Road, Farmgate

Dhaka-1215, Bangladesh

Tell: + (880-2) 8158274, 9110636

Fax: + (880-2) 8159135

E-mail: info@unnayan.org

Web: www.unnayan.org

1. INTRODUCTION

This Monthly Economic Update attempts to examine the dynamic relationship between the rate of growth in GDP and the rate of inflation in Bangladesh economy. Empirical tests have been conducted in this regard to understand the growth and inflation trajectory.

The ruling orthodoxy argues that the job of the central bank is to rein in inflation for sustaining the growth of an economy.

The anti-monetarists argue that the central bank should go for fiscal targeting rather than targeting inflation.

The Post Keynesians urges that the central bank is the inflation creator as it targets to control inflationary pressure by using the nominal rate of interest.

The ruling orthodoxy argues that the job of the central bank is to rein in inflation for sustaining the growth of an economy. However, the anti-monetarists argue that the central bank should go for fiscal targeting rather than targeting inflation. The Post Keynesians urges that the central bank is the inflation creator as it targets to control inflationary pressure by using the nominal rate of interest. Inflation targeting has been practised by most of the central banks since the last decade. The heterodox economists, however, emphasise that inflation targeting may slow down the rate of growth of a country in the long run, if fiscal targeting is not adopted simultaneously. Such perspectives suggest harmonization of monetary and fiscal policies by increasing aggregate demand and maintaining a modest rate of inflation.

Bangladesh has been experiencing a relatively moderate but sustained rate of growth in real GDP at around 5 percent to 6 percent and above for the last two decades. Though this rate of growth in real GDP is at a satisfactory level compared to the rate of growth of the world, one cause of concern is that the rate of inflation has also been increasing, particularly in recent years. The most crucial macroeconomic policy challenge, which Bangladesh is facing is that, it has to achieve the dual targets of sustained rate of growth in real GDP on the one hand, and of keeping rates of inflation within a modest level on the other part. While the economy has performed reasonably in maintaining a stable level in rate of growth in GDP in recent times, the challenge of maintaining the rates of inflation within a modest level has turned out to be a formidable one.

2. GROSS DOMESTIC PRODUCT (GDP)

2.1 GDP Growth

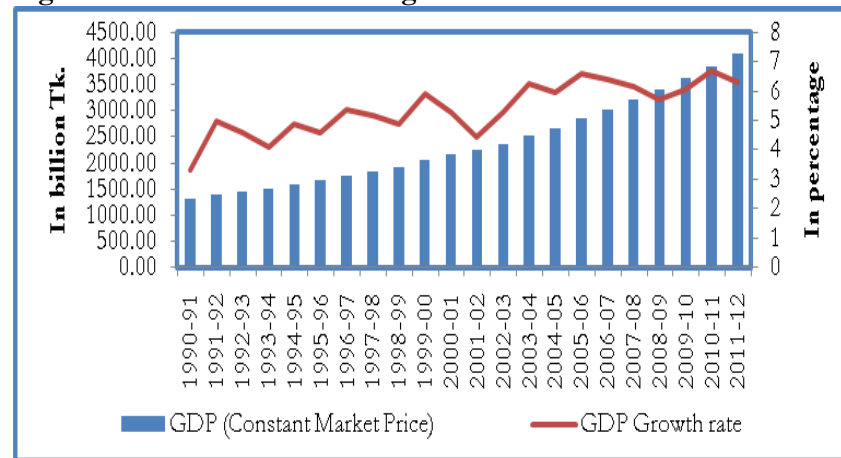
GDP is increasing in volume but the incremental rate of growth in GDP is erratic to some extent. In the current fiscal year, government has targeted to achieve GDP growth rate of 7.2 percent. This target may not be achieved due to the global crisis as well as insufficient inflow of FDI, foreign aid, restricted inflow of loan within the country etc.

GDP is increasing in volume but the incremental rate of growth in GDP is erratic to some extent.

In FY 2011-12, government had targeted to achieve the GDP growth rate of 7.5 percent. However, at the end of the last fiscal year, government actually achieved only 6.32 percent which was 39 percentage points less than that of the previous fiscal year. Though targeted GDP growth rate is not achieved, the growth rate of GDP in Bangladesh is satisfactory compared to the world growth rate. In FY 2010-11, the world rate was 3.53 percent whereas it was 6.32 percent in Bangladesh.

In FY 2010-11, the world growth rate was 3.53 percent whereas it was 6.32 percent in Bangladesh.

Figure 1: Real GDP and erratic growth rate



Source: Bangladesh Bank, Ministry of Finance, 2012

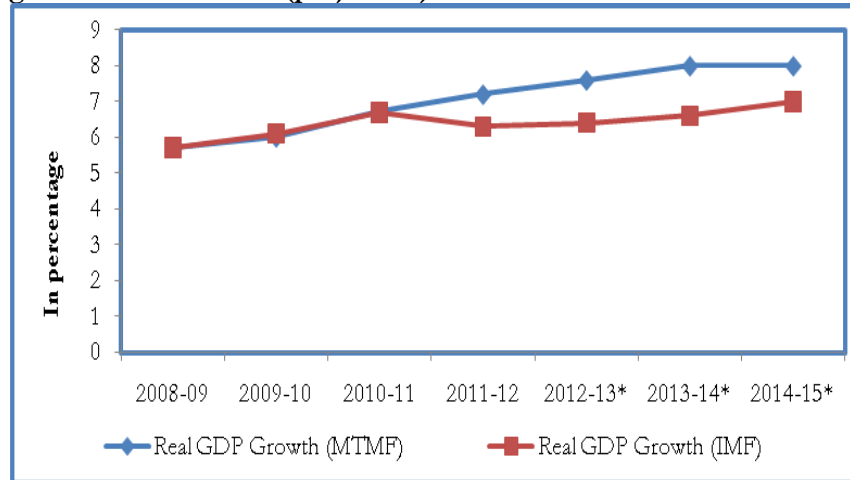
It is to be noted that the average growth rate of GDP in Bangladesh was above 6 percent during FY 2003-04 to FY 2011-12; the average GDP growth rate was 6.35 percent and standard deviation was 0.42 percent. That means, the fluctuation of the growth rate of GDP is reasonable and Bangladesh economy is in a stable situation considering the growth. The biggest obstacles to sustainable development in Bangladesh are overpopulation, poor infrastructure, corruption, political instability and a slow implementation of economic reforms.

2.2 MTMF and IMF-MEFP target on Growth Rate of Real GDP

The gap between the target of MTMF and IMF-MEFP on Growth Rate of Real GDP might be 1.2 percent in FY 2012-13, 1.4 percent in FY 2013-14 and 1 percent in FY 2014-15.

The target of IMF-MEFP on real growth of GDP is ambitious than the target of MTMF. In FY 2010-11, the target of IMF-MEFP and MTMF on growth rate of real GDP was 6.7 percent. In FY 2011-12, the target of growth rate of real GDP by IMF-MEFP was 7.2 percent against the target of MTMF at 6.3 percent. The gap between the target of MTMF and IMF-MEFP might be 1.2 percent in FY 2012-13, 1.4 percent in FY 2013-14 and 1 percent in FY 2014-15.

Figure 2: Gap between real GDP growth rate IMF and government's MTMF (projection)



Source: Bangladesh Bank, Ministry of Finance and International Monetary Fund (IMF-MEFP), 2012

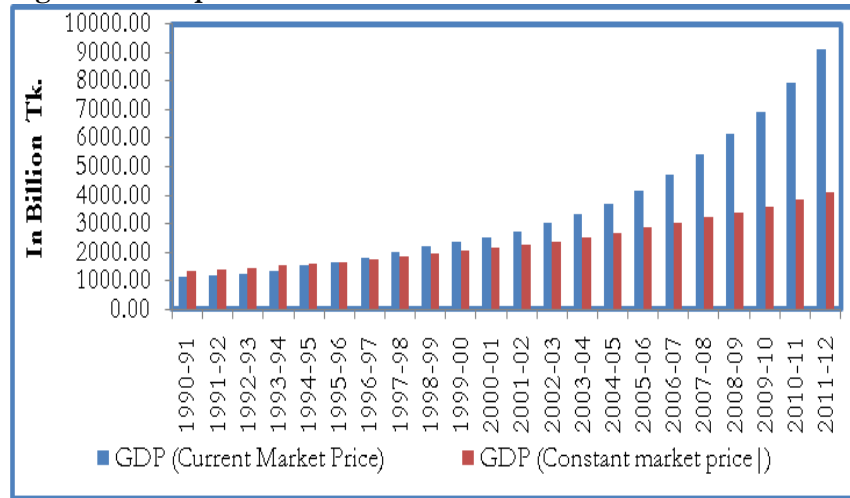
2.3 Real and Nominal GDP

In the recent fiscal years, nominal GDP is increasing more than that of the real GDP.

In FY 2011-12, nominal GDP was Tk. 9147.80 billion whereas real GDP was Tk. 4093.80 billion and GDP deflator at 223.45 percent.

In the recent fiscal years, nominal GDP is increasing more than that of the real GDP. In FY 2011-12, nominal GDP was Tk. 9147.80 billion whereas real GDP was Tk. 4093.80 billion and GDP deflator at 223.45 percent. In FY 2011-12, nominal GDP and real GDP increased by 14.82 and 6.36 percent which is respectively 7 percentage points more and 3 percentage points less than FY 2010-11. At the same time, the percentage change of GDP deflator was 16.45 percent which is 1.8 percent more than that of the previous fiscal year. However, in FY 2002-03, nominal GDP was Tk. 3005.80 billion whereas real GDP was Tk. 2371.01 billion and GDP deflator was only 126.77 percent. After FY 2002-03, the gap between nominal and real GDP has been increasing due to the increasing rate of inflation. As a consequence, GDP deflator is also increasing.

Figure 3: Comparison between real GDP vs. nominal GDP



Source: Bangladesh Bureau of Statistics, Ministry of Finance (2012)

3. INFLATION

In FY 2012-13, the government has targeted the rate of inflation at 7.2 percent while the business as usual scenario suggests that it might be a hard task to rein in inflation at single digit in FY 2012-13.

The inflationary pressure has been increased due to the contractionary monetary policy, orthodox exchange rate management which induces depreciation of BDT, the rise in imports bills, internationally price hikes in food etc.

The government has taken an initiative of calculating inflation with new base year (FY 2005-06) for which the overall rate of inflation has slide down than that of the calculation based on the old base year (FY 1995-96).

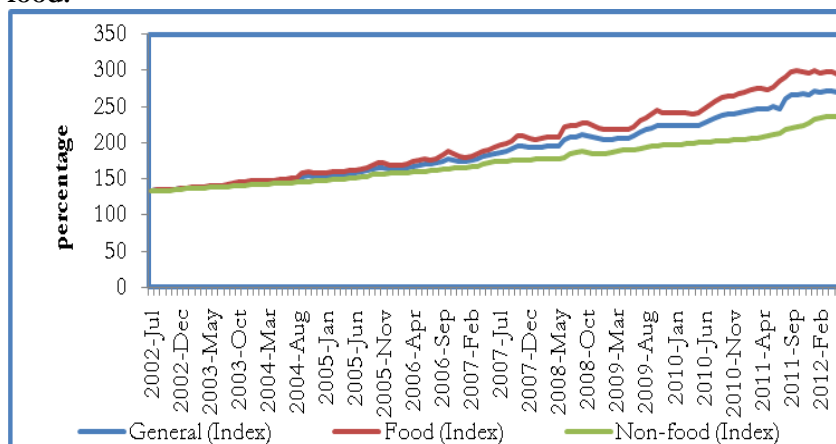
In FY 2012-13, the government has targeted the rate of inflation at 7.2 percent while the business as usual scenario suggests that it might be a hard task to rein in inflation at single digit in FY 2012-13. The government has already taken the restrained monetary policy to harness the rate of inflation which might increase further in the upcoming months due to such contraction. To achieve the targeted rate of growth in GDP, it is necessary to maintain the rate of inflation at a tolerable limit. In Bangladesh, it is mainly obsessed by external supply side factors and internal demand for food and energy. The inflationary pressure has been increased due to the contractionary monetary policy, orthodox exchange rate management which induces depreciation of BDT, the rise in imports bills, internationally price hikes in food etc. In the national budget and monetary policy of FY 2011-12, the rate of inflation was targeted at 7.5 percent whereas; it stood at 10.6 percent (12-month average) and 8.56 percent (point to point inflation).

3.1 Consumer Price Index (CPI) of General, Food and Non-Food

The government has taken an initiative of calculating inflation with new base year (FY 2005-06) for which the overall rate of inflation has slide down than that of the calculation based on the old base year (FY 1995-96). In July of FY 2012-13, CPI of general, food and non-food according to the new base year were 173.20, 183.97 and 159.39 respectively. The statistics in accordance with the old base year indicates CPI of general, food and non-food at 275.18, 303.29 and 238.27 in July of FY 2012-13. In June of FY 2011-12, CPI of

food and non-food inflation were 296.74 and 236.74 which were 19.63 and 24.77 higher than that of the same time of the previous fiscal year; and 50.45 and 36.22 higher than that of FY 2009-10.

Figure 4: Consumer Price Index (CPI) of general, food and non-food.



Source: Bangladesh bank, Bangladesh Bureau of Statistics, Ministry of Finance, 2012

3.2 Rate of Inflation

In recent fiscal years, the government borrowing due to meet up soaring import bills has contributed much to higher inflationary pressure though the grant from IMF-MEFP as well as the bumper harvest of Boro rice have helped to decline the rate of inflation to some extent which might take a vertical drift in the upcoming months under the business as usual scenario. The rate of general inflation (point-to-point) in July of FY 2012-13 was 8.03 percent which was 8.56 percent in June, 2012. However, general inflation (twelve month average) in July, 2012 was 10.36 percent against 10.62 percent in the previous month of FY 2011-12.

The rate of general inflation (point-to-point) in July of FY 2012-13 was 8.03 percent which was 8.56 percent in June, 2012.

Table 1: Rate of inflation (point to point) in July of FY 2012-13 considering two base years

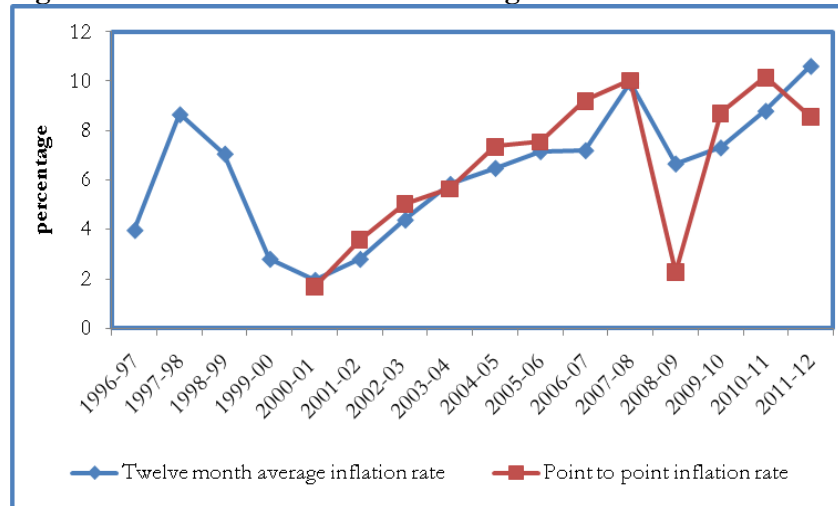
	Old Inflation (Base year 1995-96)	New Inflation (Base year 2005-06)
National Inflation	8.03	5.21
Food Inflation	6.3	2.23
Non-food Inflation	11.54	9.94
General (Rural)	7.71	4.84
Food (Rural)	5.84	2.07
Non-food (Rural)	11.76	10.19
General (Urban)	8.85	5.92
Food (Urban)	7.36	2.62
Non-food (Urban)	10.97	9.59

Source: Bangladesh Bureau of Statistics, 2012

The rate of inflation (twelve months average) was the highest during the world recession in FY 2007-08 at 9.94 percent because of the price hike of food-grains, fertilisers and fuel.

In FY 2010-11, annual average rate of inflation and point to point rate of inflation were 8.8 percent and 10.17 percent respectively which were 7.31 percent and 8.7 percent respectively in the previous fiscal year. The rate of inflation (twelve months average) was the highest during the world recession in FY 2007-08 at 9.94 percent because of the price hike of food-grains, fertilisers and fuel. Moreover, two consecutive cyclones hitting in November 2007 and 2009 respectively, had badly affected the economy. Twelve month average inflation had first faced double digit in October, 2011 and point to point inflation had faced double digit in March, 2011.

Figure 5: Total inflation scenario in Bangladesh



Source: Bangladesh Bureau of Statistics, Bangladesh Bank 2012

According to IMF-MEFP, MTBF and MTMF forecast, inflation might increase at 8.6 percent, 7 percent and 7.5 percent respectively at the end of the FY 2012-13.

An inconsistency is observed between the businesses as usual scenario of inflation and the target by MTMF, MTBF and IMF-MEFP. According to IMF-MEFP, MTBF and MTMF forecast, inflation might increase at 8.6 percent, 7 percent and 7.5 percent respectively at the end of the FY 2012-13. The annual average rate of food inflation is increasing over the successive three years.

Table 2: Current scenario and future projection of inflation rate

	Inflation rate (MTMF)	IMF	MTBF
2008-09	4.5	6.7	
2009-10	6.5	7.3	7.3
2010-11	6.5	8.8	8
2011-12*	6.3	10.7	7.5
2012-13*	6.1	8.6	7
2013-14*	6	8.2	6.5
2014-15*	6		6
2015-16*			5.5

Source: Bangladesh Bank, Ministry of Finance and International Monetary Fund 2012

Point-to-point food inflation is declining from October 2011 as well as twelve month average from December 2012 mainly, due to the bumper harvest of food grain. On the contrary, non-food twelve month average inflation items have maintained an upward trend from the very beginning (July 2011) of the FY 2011-12 due to electricity and fuel price hikes.

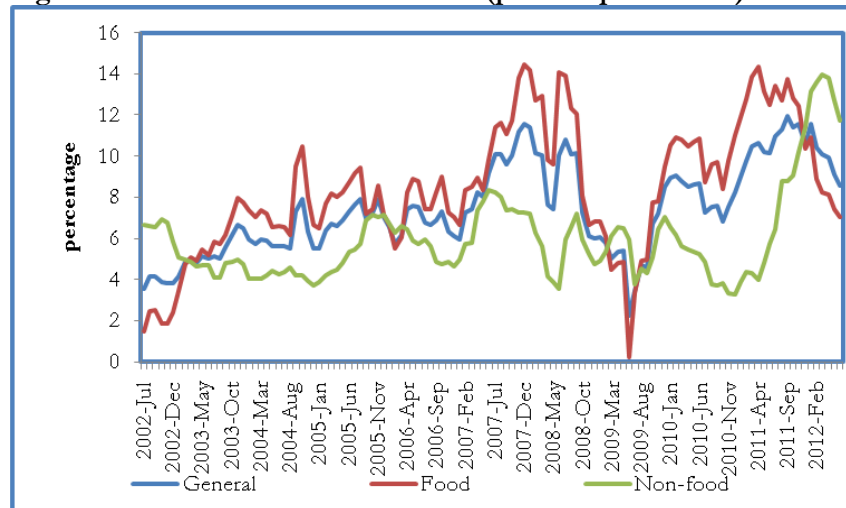
3.3 Food and Non-Food Inflation

Mostly food inflation has pulled the non-food inflation to soar in both case of point to point and twelve month average basis.

Mostly food inflation has pulled the non-food inflation to soar in both case of point to point and twelve month average basis. Food and non-food inflation (point-to-point) considering new base year in July 2012 were 2.23 and 9.94 percent respectively, while considering the old base year the rates were 6.30 and 11.54 correspondingly. The rate of food inflation (point-to-point) was declining from October 2011. On the contrary, non-food items maintained an upward trend in prices from the very beginning (July 2011) of FY 2011-12 due to electricity and fuel price hikes. In recent months, food inflation trends to be lower than that of non-food inflation because of the bumper harvest of food grain.

Non-food items maintained an upward trend in prices from the very beginning (July 2011) of FY 2011-12 due to electricity and fuel price hikes.

Figure 6: Food and non-food inflation (point to point basis)

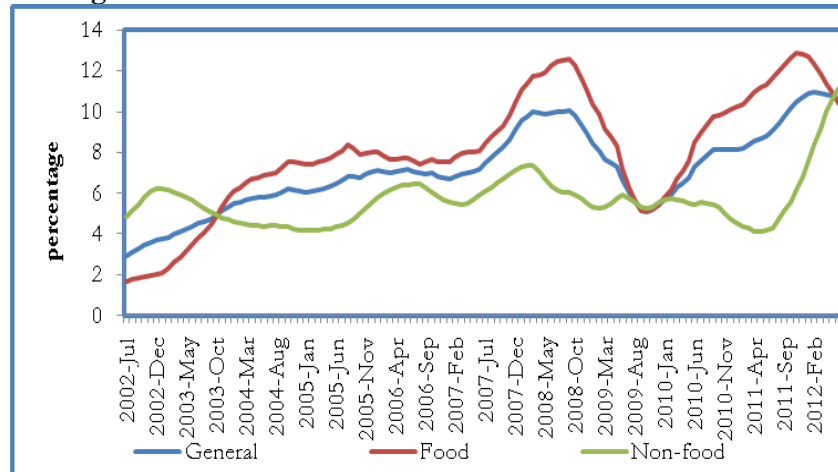


Source: Bangladesh Bureau of Statistics and Bangladesh Bank, 2012

Food inflation based on twelve month average is increasing over the successive three years.

Food inflation based on twelve month average is increasing over the successive three years. However, food and non-food inflation (twelve month average) in July 2012 was 9.79 and 11.57 percent respectively against 11.73 and 4.29 percent respectively in the same period of the previous fiscal year. Twelve month average food inflation is declining from January 2012 mainly due to the bumper harvest of food grain.

Figure 7: Twelve month average basis food and non-food inflation in Bangladesh



Source: Authors' calculation based on Bangladesh Bank, 2012

Food inflation was the highest in the history of Bangladesh in December, 2011 which was 12.83 percent.

Food inflation was the highest in the history of Bangladesh in December, 2011 which was 12.83 percent. This happened mainly because of the increase in global food and oil prices that often leads to higher domestic retail prices due to increase in the cost of production and overall prices. Moreover, fuel price hike in December 2011 in its fourth times boosted the food inflation to rise further. The Energy Regulatory Commission of Bangladesh raised power tariff for bulk users and retail consumers which increase fuel prices and may lead to soar in non-food inflation. Non-food inflation maintained a declining trend from FY 2007-08 to FY 2010-11. In FY 2010-11, it was 4.15 percent which was 5.45 percent in the previous fiscal year. However, it is observed that non-food inflation have continued to increase sharply from August in FY 2011-12.

3.4 Inflationary Situation in Urban and Rural Areas

It is clearly noticeable that food inflation is higher in urban areas whereas non-food inflation is higher in rural areas than that of the urban areas.

It is clearly noticeable that food inflation is higher in urban areas whereas non-food inflation is higher in rural areas than that of the urban areas. In FY 2011-12, general inflation was 11.68 percent in the urban and 10.20 percent in the rural areas which were found 9.40 percent in rural and 7.30 percent in urban areas in the previous fiscal year. In urban areas, food inflation was 12.20 percent and non-food inflation was 10.98 percent in FY 2011-12 while in the rural areas it were 9.73 percent and 11.22 percent respectively. Business as usual scenario suggests that inflation might increase in the urban area than that of rural area in FY 2012-13.

Table 3: Inflation status of rural and urban in Bangladesh

	Rural			Urban		
	General	Food	Non-food	General	Food	Non-food
2006-07	7.30	7.96	6.10	7.03	8.54	5.34
2007-08	9.99	11.94	6.41	9.80	13.05	6.06
2008-09	6.83	7.09	6.33	6.24	7.43	4.8
2009-10	7.16	7.96	5.62	7.69	9.85	4.99
2010-11	9.40	12.03	4.18	7.30	9.76	4.07
2011-12	10.20	9.73	11.22	11.68	12.20	10.98

Source: Bangladesh Bureau of Statistics, 2012

In the rural areas, food and non-food inflation in July, 2012 were 5.84 percent and 11.76 percent (base year 1995-96). However, considering the new base year, food and non-food inflation were 2.07 percent and 10.19 percent. General inflation in the rural areas was 7.17 percent (in base year 1995-96) and 4.84 percent (in the base year 2005-06). However, considering the new base year 2005-06, general, food and non-food inflation in urban areas in July 2012 were 5.92, 2.62 and 9.59 percent respectively, while those were 8.85, 7.36 and 10.97 percent respectively according to the old base year.

4. COMPARISON BETWEEN GDP GROWTH RATE AND INFLATION RATE

A matter of concern is that while GDP growth and inflation rate move in the same direction, on an average for every one percent change in the rate of growth in GDP, the rate of inflation changes by 3.86 percent.

Considering the movement of growth and inflation rate of GDP, no specific relation is shown between the rate of growth in GDP and the rate of inflation over the years. During FY 2008-09 to FY 2010-11, it shows a positive relationship. This is a matter of concern that while they move in the same direction, on an average for every one percent change in the rate of growth in GDP, the rate of inflation changes by 3.86 percent. On the other hand, while they move in opposite direction, for every one percent change in the rate of growth in GDP, the rate of inflation changes by only 1.25 percent. Out of twenty one years of data, ten years have experienced movement in the same direction while the remaining eleven years have experienced in the opposite direction.

While GDP growth and inflation rate move in opposite direction, for every one percent change in the rate of growth in GDP, the rate of inflation changes by only 1.25 percent.

In FY 2011-12, the rate of growth in GDP and the rate of inflation were 6.32 percent and 10.62 percent respectively which were 1.83 percent higher and 0.34 percent less than that of the previous fiscal year. Simultaneously, change in the rate of inflation stands at 5.38 percent (negative) for one percent change in the rate of growth in GDP. During FY 1996-97 to FY1999-00, a negative relationship between the rate of growth in GDP and inflation has been found in these consecutive four year. However, a positive relationship is shown during the FY 2008-09 to FY 2010-11.

Table 4: Relationship between the growth rate of GDP and inflation

Year	Inflation Rate	GDP Growth rate	Δ Inflation Rate	Δ GDP Growth Rate	Change in Inflation Rate for 1 percent Change in Growth Rate		
1990-91	8.30	3.30				same dir.	opposite dir.
1991-92	4.60	5.00	-3.70	1.70	-2.18	Opposite	-2.18
1992-93	2.70	4.60	-1.90	-0.40	4.75	Same	4.75
1993-94	3.30	4.10	0.60	-0.50	-1.20	Opposite	-1.2
1994-95	8.90	4.90	5.60	0.80	7.00	Same	7
1995-96	6.70	4.60	-2.20	-0.30	7.33	Same	7.33
1996-97	2.50	5.40	-4.20	0.80	-5.25	Opposite	-5.25
1997-98	7.00	5.20	4.50	-0.20	-22.50	Opposite	outlier
1998-99	8.90	4.90	1.90	-0.30	-6.33	Opposite	-6.33
1999-00	3.90	5.94	-5.00	1.04	-4.81	Opposite	-4.81
2000-01	1.60	5.27	-2.30	-0.67	3.43	Same	3.43
2001-02	2.79	4.42	1.19	-0.85	-1.40	Opposite	-1.4
2002-03	4.38	5.26	1.59	0.84	1.89	Same	1.89
2003-04	5.83	6.27	1.45	1.01	1.44	Same	1.44
2004-05	6.48	5.96	0.65	-0.31	-2.10	Opposite	-2.1
2005-06	7.17	6.63	0.69	0.67	1.03	Same	1.03 1.03
2006-07	7.22	6.43	0.05	-0.20	-0.25	Opposite	
2007-08	9.93	6.19	2.71	-0.24	-11.29	Opposite	
2008-09	6.66	5.74	-3.27	-0.45	7.27	Same	7.27
2009-10	7.31	6.07	0.65	0.33	1.97	Same	1.97
2010-11	8.79	6.66	1.48	0.59	2.51	Same	2.51
2011-12	10.62	6.32	1.83	-0.34	-5.38	Opposite	-5.38
						Avg.	3.86 -3.07
						St. dev.	2.53 2.46

5. GDP AND INFLATION: AN ECONOMETRIC ANALYSIS

Although the relationship between inflation and economic growth remains controversial or somewhat inconclusive, several empirical studies confirms the existence of either a positive or negative relationship between these two major macroeconomic variables. The purpose of this paper is to empirically explore the present relationship between inflation and economic growth in Bangladesh based on data FY 1990-91 to FY 2012-13*. To test the dynamic relationship between these two variables, the following procedures are followed.

The unit root test results of Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Test that are based on with drift and drift with a stochastic trend are shown (Table 5 and 6).

Table 5: Unit Root Test with drift

Variable	DF Test		ADF Test	
	Level	First Difference	Level	First Difference
lnGDPGr	-3.066***	-7.372***	-1.126	-6.229***
lnInf	-2.908***	-4.491***	-3.399***	-6.891***

Note: *, ** and *** denote rejection of the null hypothesis of unit root test at the 10 percent, 5 percent and 1 percent respectively.

Table 6: Unit Root Test with Drift around a Stochastic Trend

Variable	DF Test		ADF Test		PP Test	
	Level	First Difference	Level	First Difference	Level	First Difference
lnGDPGr	-5.924***	-7.008***	-3.910**	-6.025***	-5.824***	-7.454***
lnInf	-3.584*	-4.320**	-4.342**	-6.619***	-3.628**	-4.313**

Note: *, ** and *** denote rejection of the null hypothesis of unit root test at the 10, 5 and 1 percent respectively.

All the variables are stationary (lnGDPGr - log of GDP growth and lnInf – log of inflation rate) in the first difference series i.e., I (I) in all the cases (Table 5 and 6). The results provide the basis for the test of long run relationship between rate of growth and rate of inflation.

Table 7: Johansen and Juselius Cointegration Result

Hypothesis	γ_{trace}			γ_{max}		
Null	$r = 0$	$r \leq 1$	$r \leq 2$	$r = 0$	$r \leq 1$	$r \leq 2$
Alternative	$r = 1$	$r = 2$	$r = 3$	$r = 1$	$r = 2$	$r = 3$
Results	19.4983**	1.7809**	17.7174**	1.7809

Note: * and ** denote rejection of hypothesis at the 1 and 5 percent significance level significantly.

The Johansen-Juselious Cointegration results show that the null hypothesis of no Cointegration, i.e., $r = 0$, is rejected for both inflation and growth of GDP of Bangladesh. This is because either γ_{trace} and γ_{max} is larger than the critical values at least, at the 5 percent significant level. These results provide the evidence that there is at least, one co-integrating factor in each case and have given conclusion that the rate of growth in GDP and rate of inflation have a long run relationship.

The results of multiple linear regression analysis are shown here, (Table 8 and 9). Growth of GDP is used as a dependent variable and model fits the data quite well (R- square and Adjusted R-square both are high), but coefficient of inflation is highly insignificant that means rate of inflation cannot explain growth of GDP in the short run (Table 8).

Table 8: Multiple variable linear regression; dependent variable: GDPGr

Variable	Coefficient	Standard Error	t-statistics	Probability
Constant	6.1726	.9341	6.61	0.000
Inf	-.0359	.0531	-0.68	0.508
Inv	.0145	.0055	2.64	0.018
Con	-.0041	.0022	-1.88	0.079
GovEx	-.0021	.0034	-0.62	0.543
NEx	-.0026	.0029	-0.90	0.381
R-squared			0.75	
Adjusted R-squared			0.67	
F-statistic			9.61	
Probability (F-statistic)			0.002	

On the other hand, the rate of inflation is used as the dependent variable; the explanatory variables are failed to explain the dependency and all the coefficients including growth of GDP are highly insignificant statistically (Table 9). The R-square and adjusted R-square are very low indicating the low variation of dependency of inflation on selected explanatory variables.

Table 9: Multiple Variable Linear Regression; Dependent variable: Inf

Variable	Coefficient	Standard Error	t-statistics	Probability
Constant	11.0126	7.9075	1.39	0.183
GDPGr	-.7744	1.1441	-0.68	0.508
Inv	.0191	.0302	0.63	-.0450
Con	-0.0091	.0112	-0.81	0.427
GovEx	.01364	.0156	0.87	0.396
NEx	-.0111	.0136	-0.81	-0.427
R-squared			0.3658	
Adjusted R-squared			0.1676	
F-statistic			1.85	
Probability (F-statistic)			0.1607	

The Granger Causality Test shows that there is independent relationship between growth of GDP and rate of inflation.

Table 10: Pair wise result of Granger Causality Tests

Null Hypothesis:	F-Statistic	Probability	Decision
lnGDPGr does not Granger Cause lnInf	2.37527	0.1249	Do not reject
lnInf does not Granger Cause lnGDPGr	2.21826	0.1412	Do not reject

Independence is suggested when the sets of *lnGDPGr* and *lnInf* coefficients are not statistically significant in both regressions. No cause and effects exist there between rate of growth and rate of inflation in Bangladesh in the short run.

6. CONCLUSION

Based on the data for the period of 1990-91 - 2012-13, quantitative analysis shows that in the short run, there is no relationship between these two variables as well as any kind of causality does not exist but in the long run there is a relationship between rate of inflation and growth of GDP. Moreover, a matter of concern is that while inflation and growth of GDP moves in the same direction, on an average for every one percent change in the rate of growth in GDP, the rate of inflation changes more than that when they move in the opposite direction. This empirical exercise vindicates that the government and the central bank need to move towards a policy of harmonisation of monetary and fiscal policies as opposed to the current inflation-targeting framework which reduces aggregate demand through contractionary measures and yet to make its mark in reigning in inflationary pressures.

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Appendix: The Details of the Econometric Exercise

Unit Autoregressive Root Tests

In order to test for short run dynamics and long run relationship among time series variables, the time series properties of each variable are estimated by the unit autoregressive tests i.e., whether a time series variable is stationary: here three procedures are employed for detecting a unit autoregressive root: (i) The Dickey-Fuller (DF) Test (Dickey and Fuller 1979), (ii) The Augmented Dickey-Fuller (ADF) Test (Dickey and Fuller 1981) and (iii) The Phillips-Perron (PP) Test (Phillips and Perron 1988).

This unit root tests are based on both Unit Root Test with Drift and Unit Root Test with Drift around a Stochastic Trend to get robust outcomes.

The Dickey-Fuller (DF) Test

In the DF test, the regression models take the following form:

Random Walk with drift:

$$\Delta \ln GDPGr_t = \beta + \ln GDPGr_{t-1} + u_t$$

$$\Delta \ln Inf_t = \alpha + \ln Inf_{t-1} + \varepsilon_t$$

Random Walk with drift around a Stochastic Trend:

$$\Delta \ln GDPGr_t = \beta_1 + \beta_2 t + \beta \ln GDPGr_{t-1} + u_t$$

$$\Delta \ln Inf_t = \alpha_1 + \alpha_2 t + \alpha \ln Inf_{t-1} + \varepsilon_t$$

Here 't' is the time or trend variable. In each case, the null hypothesis that is $\beta = 0$; $\alpha = 0$, there is a unit root where the time series is non-stationary. The alternative hypotheses are $\beta < 0$; $\alpha < 0$ where the time series is stationary.

The Augmented Dickey-Fuller (ADF) Test

The ADF test for a unit autoregressive tests will have to occur for the following regressions with a view to testing the null hypothesis $H_0: \delta = 0$; $H_0: \gamma = 0$ against the alternative hypothesis $H_1: \delta < 0$; $H_1: \gamma < 0$

$$\Delta \ln GDPGr_t = \beta_1 + \beta_2 t + \delta \sum_{i=1}^n \Delta \ln GDPGr_{t-i} + u_t$$

$$\Delta \ln Inf_t = \alpha_1 + \alpha_2 t + \gamma \sum_{i=1}^n \Delta \ln Inf_{t-i} + \varepsilon_t$$

Where u_t and ε_t are pure white noise error terms and where $\Delta \ln GDPGr_{t-1} = (\ln GDPGr_{t-1} - \ln GDPGr_{t-2})$ and so on; in case of inflation $\Delta \ln Inf_{t-1} = (\ln Inf_{t-1} - \ln Inf_{t-2})$ and so on.

The number of lagged difference terms to include is often determined empirically, the idea of the error terms of the described models is serially uncorrelated.

The Phillips-Perron (PP) Test

The results are also verified by Phillips and Perron test. The test regressions are following like this:

$$\ln GDPGr_t = \beta_0 + \delta_t + \gamma_1 \ln GDPGr_{t-1} + \sum_{j=1}^p \gamma_j \Delta \ln GDPGr_{t-j} + u_t$$

$$\ln Inf_t = \alpha_0 + \theta_t + \sigma_1 \ln Inf_{t-1} + \sum_{j=1}^p \sigma_j \Delta \ln Inf_{t-j} + \varepsilon_t$$

The PP tests are correct for any serial correlation and heterosecdasticity in the error terms u_t and ε_t by directly modifying the test statistics $t_\pi = 0$ and $T\hat{\pi}$. The hypothesis testing procedure is the same as asymptotic distributions as the ADF test.

Cointegration Test

Johansen (1988) has introduced maximum likelihood approach to identify whether a long run equilibrium relationship among time series variables is there.

Economically, two variables will be cointegrated if they have a long term or equilibrium relationship between them. In this case, the regression models take the following form:

$$\ln GDPGr_t = \beta_1 + \beta_2 \ln Inf_t + u_t$$

$$\ln Inf_t = \alpha_1 + \alpha_2 \ln GDPGr_t + \varepsilon_t$$

Johansen recommends two different likelihood ratio tests of the significance of the canonical correlations; the trace test and maximum Eigen value test. Through this test, the time series variables of growth rate of GDP and inflation rate of Bangladesh are tested to investigate the long run relationship among the variables.

Multiple Variables Linear Regressions

In case of multiple variables, both GDP growth and Inflation rate are used as dependent variables while investment, consumption, government expenditure, net export and the opposite variable are used as the explanatory variables and the models are taking as following form:

$$GDPGr_t = \beta_1 + \beta_2 \ln Inf_t + \beta_3 Inv_t + \beta_4 Con_t + \beta_5 GovEx_t + \beta_6 NEx_t + u_t$$

$$\ln Inf_t = \beta_1 + \beta_2 GDPGr_t + \beta_3 Inv_t + \beta_4 Con_t + \beta_5 GovEx_t + \beta_6 NEx_t + \varepsilon_t$$

Pair wise Granger Causality Tests

The Granger Causality Test assumes that the information relevant to the prediction of the respective variables, $\ln GDPGr$ and $\ln Inf$, is contained solely in the time series data on these variables. The test involves estimating the following pair of regressions:

$$\ln GDPGr_t = \sum_{i=1}^n \alpha_i \ln Inf_{t-i} + \sum_{j=1}^n \beta_j \ln GDPGr_{t-j} + u_t$$

$$\ln Inf_t = \sum_{i=1}^n \gamma_i \ln GDPGr_{t-i} + \sum_{j=1}^n \delta_j \ln Inf_{t-j} + \varepsilon_t$$

Where it is assumed that the disturbances u_t and ε_t are uncorrelated. Since there are two variables, we are dealing with bilateral causality.



Unnayan Onneshan - The Innovators

16/2, Indira Road, Farmgate
Dhaka-1215, Bangladesh
Tell: + (880-2) 8158274, 9110636
Fax: + (880-2) 8159135
E-mail: info@unnayan.org
Web: www.unnayan.org