

Due Diligence in Bangladesh Monetary and Credit Program Path Derivation

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Abstract

In general it is widely expected that bankers need to maintain plain, fair and true principle in communicating financial aspects to the stakeholders. Bankers possess specialized knowledge in formulating banking policies related to economics, finance and accounting. Bankers need to put the interest of stakeholders ahead of their own. Bankers require to keep continuous learning efforts regarding the continuously shifting paradigm of economics. Bearing in mind this development in solicited and unsolicited communication bankers necessitates putting utmost personal endeavour and keeping themselves logical avoiding fallacy. In central banking bankers require to follow due diligence particularly in Bangladesh monetary and credit program path derivation. Due diligence issue relating to Bangladesh monetary and credit program path is demonstrated in this paper for better communicating to the stakeholders. Consequently, central banker can serve for the betterment of the stakeholders and country applying fiduciary responsibility.

Introduction

Among interest rate, exchange rate, asset price and monetary/credit channels, this paper concentrated on monetary and credit channels impacting inflation and GDP. Bangladesh monetary and credit program and balance of payment are technical and crucial issue. In order to address this concern, plain and fair approaches have followed with due diligence. Bangladesh monetary and credit program requires specialised knowledge related to economics, banking, finance and accounting. Econometric knowledge is also required to understand the dynamics of monetary policy. In Bangladesh, monetary and credit programming firstly, I have derived yearly program path taking into account related macroeconomic developments. Quarterly segregation of monetary and credit program is impacted by seasonality. In such case monthly seasonal factors

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are used for smoothing. According to the quantity theory of money, inflation is directly related with money supply. Real GDP is also vital factor of money supply. This paper, from quantitative and qualitative point of view, highlighted these factors as a part of plain and fair communication to the stakeholders. This study unfolds the vital macroeconomics dynamics to commune the stakeholders. This will contribute to take informed decision by the stakeholders about the monetary economics interactions.

Organization of the paper

Literature review is presented in section I. Section II deals with research methodology. Derivation of Bangladesh monetary and credit program applying due diligence is described in section III. Conclusion is made in section IV.

Section I

Literature review

Sayera and Akhtaruzzaman (2012) pointed out that the objective of their study is to explore the inflation-economic growth linkage, if any, in Bangladesh. With this view, various tables and charts, correlation matrices, pair-ranger Causality tests and quadratic regression equation estimated by OLS based time series annual data covering the sample period from 1976 to 2012 are used. The results of all data including regression analysis convincingly demonstrate that the relationship between inflation and growth is non-linear with an existence of a threshold level (relative to the threshold) would be hurtful for growth in terms of potential cost of forgone output and, at the same time, too high level of inflation would also impede economic growth. Thus, Government's inflation target of 7.5 percent set in FY 12/13 budget seems to be reasonable as it stands within the range threshold levels of inflation found in the study.

Taylor (2009) rule in equation form: $i_t = \pi_t + r_t^* + a_\pi(\pi_t - \pi_t^*) + a_y(y_t - \bar{y}_t)$. In this equation, i_t is the target short-term nominal interest rate (e.g. the federal funds rate in the USA, the Bank of England base rate in the UK), π_t is the rate of inflation as measured by the GDP deflator, π_t^* is the desired rate of inflation, r_t^* is the assumed equilibrium real interest rate, y_t is the logarithm of real GDP, and \bar{y}_t is the logarithm of potential output, as determined by a linear trend. In this equation, both a_π and a_y should be positive (as a rough rule of thumb, Taylor's

1993 paper proposed setting $a_\pi = a_y = 0.5$). That is, the rule "recommends" a relatively high interest rate (a "tight" monetary policy) when inflation is above its target or when output is above its full-employment level. By specifying $a_\pi > 0$, the Taylor rule says that an increase in inflation by one percentage point should prompt the central bank to raise the nominal interest rate by more than one percentage point (specifically, by $1 + a_\pi$, the sum of the two coefficients on π_t in the equation above). Since the real interest rate is (approximately) the nominal interest rate minus inflation, stipulating $a_\pi > 0$ implies that when inflation rises, the real interest rate should be increased. Taylor explained the rule in simple terms using three variables: inflation rate, GDP growth, and the interest rate. If inflation were to rise by 1 percent, the proper response would be to raise the interest rate by 1.5 percent (Taylor explains that it doesn't always need to be exactly 1.5 percent, but being larger than 1 percent is essential). If GDP falls by 1 percent relative to its growth path, then the proper response is to cut the interest rate by 0.5 percent. The central bank does not need to take fluctuations in the output gap into account when setting interest rates (that is, it may optimally set $a_y = 0$).

The money supply and MM related issues of developed and developing countries have been widely worked out. Johannes and Rasche (1979), Bomhoff (1997), Park (1980), Arby (2000), Ford and Morris (1996), Baghestani and Moot (1997) have pursued studies on money supply and MM of different countries. They highlighted the degree of controllability over money supply by the monetary authority, stability and predictability of money supply, determinants of money supply and policy implications for governing monetary policy. Accordingly, BB's MM is disaggregated to understand the impact on inflation and other rates of the economy.

Section II

Research methodology

Technical analysis, quantity theory of money and rational expectation with due diligence is considered in Bangladesh monetary and credit program path derivation of Bangladesh. Seasonality, past trends, domestic and global development and unconventional monetary policy emphasising thrust sector sectors is applied in this paper. The deviation of program and actual path of Bangladesh monetary and credit program and balance of payments variables are graphically shown to understand the future outcome.

Section III

Derivation of Bangladesh monetary and credit program applying due diligence

Before moving towards quantity theory of money and judgemental approach, I have tested fifteen hypotheses related to Bangladesh monetary and credit program.

1. The stability of GDP test result is BLUE following ARMA model. Equation: $bd_growth = c + a \cdot bd_growth(-1) + ma(1) + trend + u$. To test the GDP stability in Bangladesh we can use this model. Diagnostic tests on residual. a. Serial Correlation test b. Heteroskedasticity test and c. Non-normality test. Sayed (2014) deals with ARMA model.

OLS method

- Equation: $gdp = \alpha + \beta M_2 + \varepsilon$
- Hypothesis testing: $\beta_t \neq 0$. Reject the null $\beta_t = 0$ and accept the alternative hypothesis that is β is different from zero due to high t-value.
- $|t_{cal}| > |t_{tab}|$, Z test, F statistic and adjusted R^2
- Checking multicollinearity in the data. Testing the variance inflated function (VIF) = $1/(1-r^2_{23})$.
- Maximum log likelihood
- Checking structural break in the data and set dummy if necessary.
- Making the regression BLUE. OLS is described by Sayed et al. (2016).

2. The noteworthy hypothesis of Bangladesh monetary and credit programme is to amplify of share of time deposit (TD) in M2. The share of TD was 75.76% at the end of June 2010, which accomplished at 76.03% at the end of June 2013. Introduction of plastic card, online and mobile banking and financial engineering can provide impetus in this regard.

3. Optimization of DMBs excess reserves using OMOs. Sayed (2016) explained excess reserves.

4. Technical exercise implies foreign exchange reserves can be increased of higher level addressing BOP accounts.

5. Particular and complementary solution determines the government bonds price and coupon rates. Sayed (2016) elaborated this issue.

6. ARIMA model implies maintaining auto regressive (AR) process the exchange rate can be forecasted. Setting $ARIMA(p,d,q) = ARIMA(1,1,0)$ [for example]. Determine quarterly seasonality in Bangladesh's M2 for instance. ARIMA is described by Sayed (2015).

7. The exercise of ARDL model suggests there is long run relationship between M2 and nominal GDP. ARDL Bounds Test $\Delta gdp_t = \beta_0 + \sum_{i=0}^{i=1} \beta_{1i} \Delta gdp_{t-i} + \sum_{i=0}^{i=1} \beta_{2i} \Delta m2_{t-i} + \beta_3 gdp_{t-1} + \beta_4 m2_{t-1} + \varepsilon_t$

ARDL restricted ECM $gdp_t = \beta_0 + \sum_{i=0}^{i=1} \beta_{1i} \Delta gdp_{t-i} + \sum_{i=0}^{i=1} \beta_{2i} \Delta m2_{t-i} + yecm_{t-1} + \varepsilon_t$

- Unit Root Test for Stationarity . Combination of I(0) and I(1) is required for ARDL.
- Lag order selection: According to the AIC, among the top 20 model our best model is ARDL (3,2) for instance.
- Diagnostic checking
Breusch-Godfrey Serial Correlation LM test and unit root of the model residuals
Autoregressive Conditional Heteroskedasticity (ARCH) test
Ramsey RESET (regression specific error test)
Cumulative sum (CUSUM) to test the stability of long run coefficient. ARDL is presented by Sayed et al. (2016).

8. We failed to reject the null hypothesis as there is no unit root according to the test statistics.

9. Bidirectional causality found in VAR.

10. In VAR model the estimated coefficient of $\beta_i \neq 0$ is accepted due to high t-value. Exercised VAR model in the study is:

$$(X1) = a_0 + \sum_{j=1}^k a_1(X1)_{t-j} + \sum_{j=1}^k a_2(X2)_{t-j} + \sum_{j=1}^k a_3(X3)_{t-j} + \sum_{j=1}^k a_4(X4)_{t-j} + u_1t$$

- Orthogonalised residuals regressed each other
- Checking the bidirectional causality between X and Y
- Unit root
- Exogeneity test
- Variance decomposition. Shock explains the forecast error variance. For example checking the exchange rate pass-through on GDP.
- Analysis of IRF (positive and negative shock)
- Forecasting (with the estimated coefficients and checking lower average RAMSE).
VAR model is described in Sayed (2015) paper.

11. According to co integration test, there is long run relationship among the stipulated variables.

12. In VECM there is positive relationship between RM and inflation. Exercised VEC model is: $D\text{inflation}(X1) = \alpha_0 + \sum_{j=1}^k \alpha_1 DX1_{t-j} + \sum_{j=1}^k \alpha_2 DX2_{t-j} + \sum_{j=1}^k \alpha_3 DX3_{t-j} + \sum_{j=1}^k \alpha_4 DX4_{t-j} + \text{ECT}_{t-k} + u1_t$. VECM is addressed in Sayed (2013) article.

- Trace and Maximum Eigen Value Test for co-integration
- Test of cointegration rank
- Speed of adjustment
- Test for misspecification
- Test on weak exogeneity
- IRF

13. Determination of priors and potential priors using DSGE. Filtering of de-seasonalized logarithmic data with the Hodrick-Prescott (HP) filter or by de-trending. Comparing priors and posteriors mean for interest rate increase to curb inflation for example. Conditional variance decomposition of the interested variables. Younus (2017) Working Paper can be consulted regarding DSGE model.

14. Equilibrium exchange rate can be maintained following REER based exchange rate. REER is presented in Sayed (2015) paper.

15. Using monetary tools and economic findings the stability of MM need to be maintained in Bangladesh.

Brief on econometrics exercise related to monetary variables of Bangladesh are highlighted in **Annexure**.

Quantity theory of money in short

Following quantity theory of money safe limit of monetary expansion in a year has been derived in this paper. Money supply more than safe limit is considered as expansionary monetary policy. Money supply less than safe limit is considered as contractionary monetary policy. Accommodative monetary policy is the in between of expansionary and contractionary monetary policy. To achieve the potential level of GDP growth and low and stable inflation BB may prudently decide what type of monetary policy will be followed. Potential level of GDP growth is the average of previous few years recent real GDP growth. Average 6 percent-7 percent

inflation rate considering the business cycle is the indicator of optimum inflation level. Considering Bangladesh GDP growth model (ARMA) and correlation of GDP and inflation solving quantity theory of money ultimately participatory and judgemental approach are pursued in quantifying M2, RM and BOP growth numbers. In participatory monetary policy stakeholders' opinion are considered. Average of real GDP growth rate and inflation with future expectation are considered in this paper for formulating monetary expansion for next financial year. BB considers upcoming year government budget declared GDP and inflation rate rather average of this two variables in monetary expansion.

Finally, income velocity of money derives dividing nominal GDP by M2, which is declining trend region in the U shaped curve. Decline in income velocity of money indicates that still there is room for broad money growth in Bangladesh. Change in income velocity of money for FY 2012-13 is estimated on average at 1.90 percent. Quantity theory of money can be resolved plugging 5-year average annual GDP growth rate and future expectation (7.0 percent), 5-year annual inflation rate (6.0 percent) and past 5-year average annual percentage changes in income velocity of money combining future expectation (1.90 percent). Upcoming year GDP growth and inflation rate is found from the national budget for quantifying of safe limit of monetary growth in a year. Considering real economic developments these numbers may change.

We know $MV=PY$

Log function is required to work out the equation.

Thus, we get $\ln M + \ln V = \ln P + \ln Y$

Or, $(1+M) (1+V) = (1+P) (1+Y)$

Or, $(1+M) = (1+P) (1+Y) / (1+V)$

Or, $M = ((1+P) (1+Y) / (1+V)) - 1$

Or, $M = ((1+0.060) (1+0.070) / 1+(-)1.90) - 1$

Or, $M = (1.1342 / (1-0.019)) - 1$

Or, $(1.1342 / 0.981) - 1$

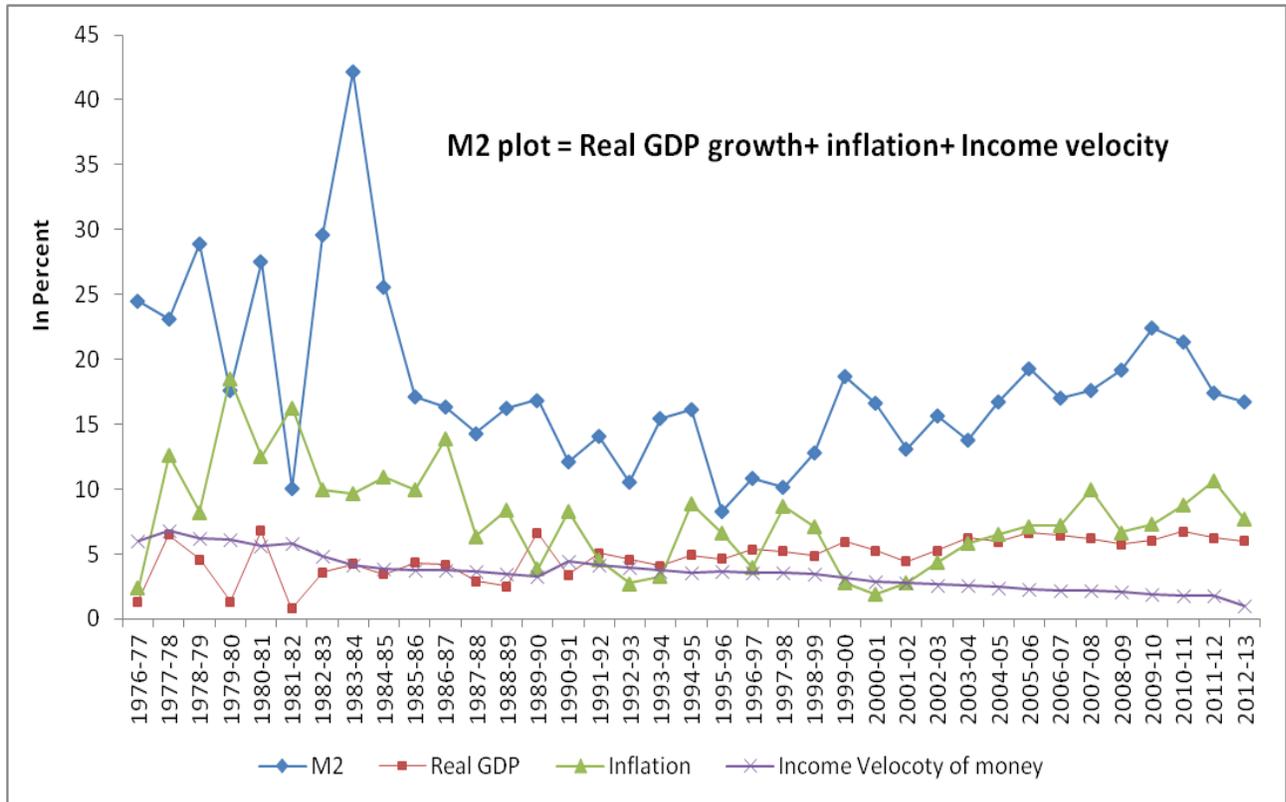
Or, $1.15617 - 1$

Or, 0.15617

Or, 15.6%

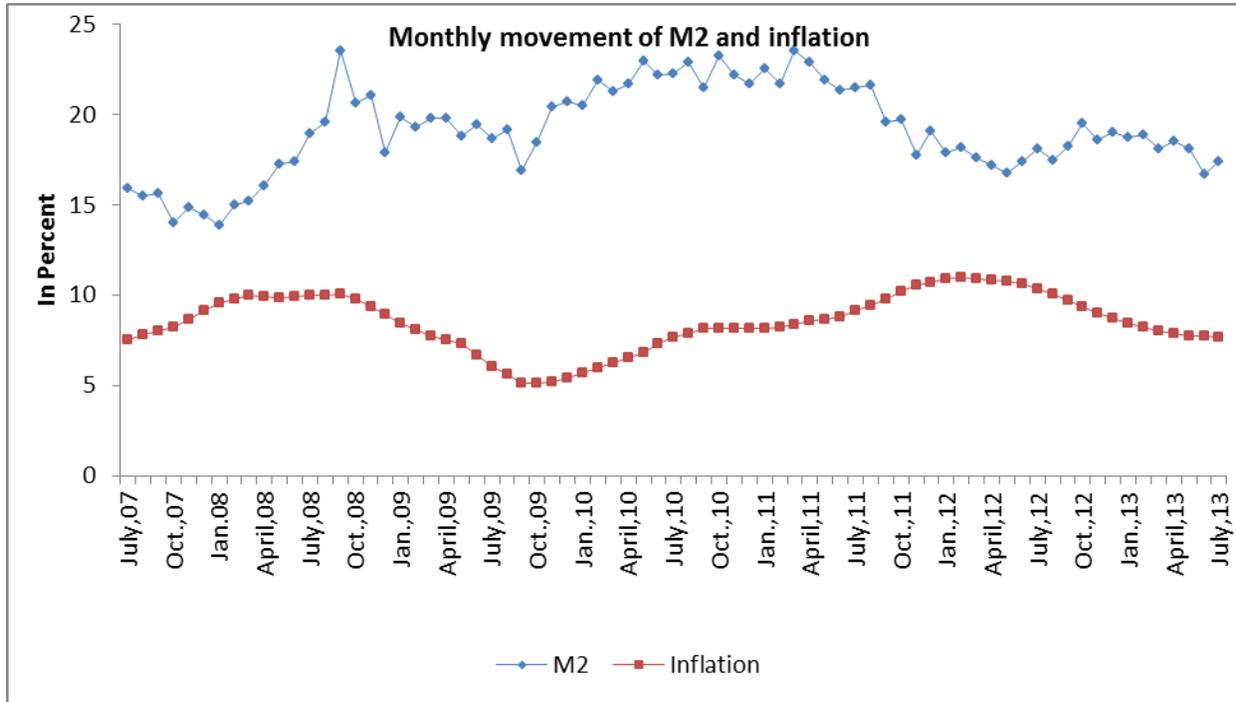
Here, M= yearly broad money growth, P= CPI inflation rate, Y= real GDP and V= percentage change in income velocity of money. Hence, real GDP growth, inflation and percentage change in income velocity of money provides us safe limit of monetary expansion in a financial year considering the money demand. M2 plot can be demonstrated summing real GDP growth, CPI inflation and income velocity of money (**Chart 1**).

Chart 1



In the quantity theory of money equation if we assume GDP and velocity as constant then the direct relationship between money (M2) and inflation (P) can be found (**Chart 2**). In **Chart 2** M2 affect inflation with few lags. At the beginning the augment in M2 also contributes to enhance in CPI inflation. In the plot the relation of money and inflation is clear. Seasonality, demand pull and cost push factors may create volatility in inflation apart from money supply.

Chart 2



Component wise Bangladesh monetary and credit programme with due diligence

Historical data and current demand observed from the quantity theory of money have been observed in deriving monetary programming numbers of Bangladesh. Maintenance of optimum inflation and GDP growth is central aspect of monetary policy. BOP end June 2012 overall surplus US\$ 89.4 crore (**Table-5**) is added with RM end June 2012 NFA to arrive June 2013 number, which is equivalent to Tk. 76123.70 crore (**Table-3**). In this conversion exchange rate used Tk. 80.0 against 1 US\$ at the end of June 2013. DMBs asset and liabilities of foreign exchange holdings is added with the NFA of RM in order to get relevant NFA of M2 (**Table-1**). The noteworthy hypothesis of Bangladesh monetary and credit programme is to amplify of share of time deposit (TD) in M2. The share of TD was 75.76 percent at the end of June 2010, which accomplished at 76.03 percent at the end of June 2013. Introduction of plastic card, online and mobile banking and financial engineering can provide impetus in this regard.

Table-1 Monetary and credit programme (In crore Taka)

Particulars	Outstanding stock (Actual)			Program 2012-13			
	June, 2010	June, 2011	June 2012	September 2012	December 2012	March 2013	June 2013
	1	2	3	4	5	6	7
A. Net Foreign Assets of banking system	67073.70	70620.00	78860.30	90112.10	81795.20	83697.10	86496.00
		(+5.29)	(+11.67)	(+14.27)	(+3.72)	(+6.13)	(+9.68)
B. Net Domestic Assets of banking system	295957.50	369899.90	438249.20	445991.00	476207.50	493707.10	516207.10
		(+24.98)	(+18.48)	(+1.77)	(+8.66)	(+12.65)	(+17.79)
a) Domestic credit	340213.70	433525.90	518214.30	529960.70	567201.00	584198.90	616209.30
		(+27.43)	(+19.53)	(+2.27)	(+9.45)	(+12.73)	(+18.91)
Public sector	69453.00	92813.20	110312.70	109923.30	120542.80	123142.30	132654.10
		(+33.63)	(+18.85)	(-0.35)	(+9.27)	(+11.63)	(+20.25)
Govt.(net)	54392.30	73436.10	91906.80	91901.20	103119.10	105919.10	115530.80
		(+35.01)	(+25.15)	(-0.01)	(+12.20)	(+15.25)	(+25.70)
Other Public	15060.70	19377.10	18405.90	18022.10	17423.70	17223.20	17123.30
		(+28.66)	(-5.01)	(-2.09)	(-5.34)	(-6.43)	(-6.97)
Private sector	270760.70	340712.70	407901.60	420037.40	446658.20	461056.60	483555.20
		(+25.84)	(+19.72)	(+2.98)	(+9.50)	(+13.03)	(+18.55)
b) Other items (net)	-44256.20	-63626.00	-79965.10	-83969.70	-90993.50	-90491.80	-100002.20
		(+43.77)	(+25.68)	(+5.01)	(+13.79)	(+13.16)	(+25.06)
C. Broad money (A+B)	363031.20	440519.90	517109.50	536103.10	558002.70	577404.20	602703.10
		(+21.34)	(+17.39)	(+3.67)	(+7.91)	(+11.66)	(+16.55)
i) Currency outside banks	46157.10	54795.10	58417.10	61214.50	63072.71	65361.80	67573.50
		(+18.71)	(+6.61)	(+4.79)	(+7.97)	(+11.89)	(+15.67)
ii) Deposits	316874.10	385724.80	458692.40	474888.60	494929.99	512042.40	535129.60
		(+21.73)	(+18.92)	(+3.53)	(+7.90)	(+11.63)	(+16.66)
a) Demand deposits	41831.30	48305.90	51304.30	49794.90	74729.79	72904.50	76892.50
		(+15.48)	(+6.21)	(-2.94)	(+45.66)	(+42.10)	(+49.88)
b) Time deposits	275042.80	337418.90	407388.10	425093.70	420200.20	439137.90	458237.10
		(+22.68)	(+20.74)	(+4.35)	(+3.14)	(+7.79)	(+12.48)

Note: Figures in brackets indicate percentage changes over end June.

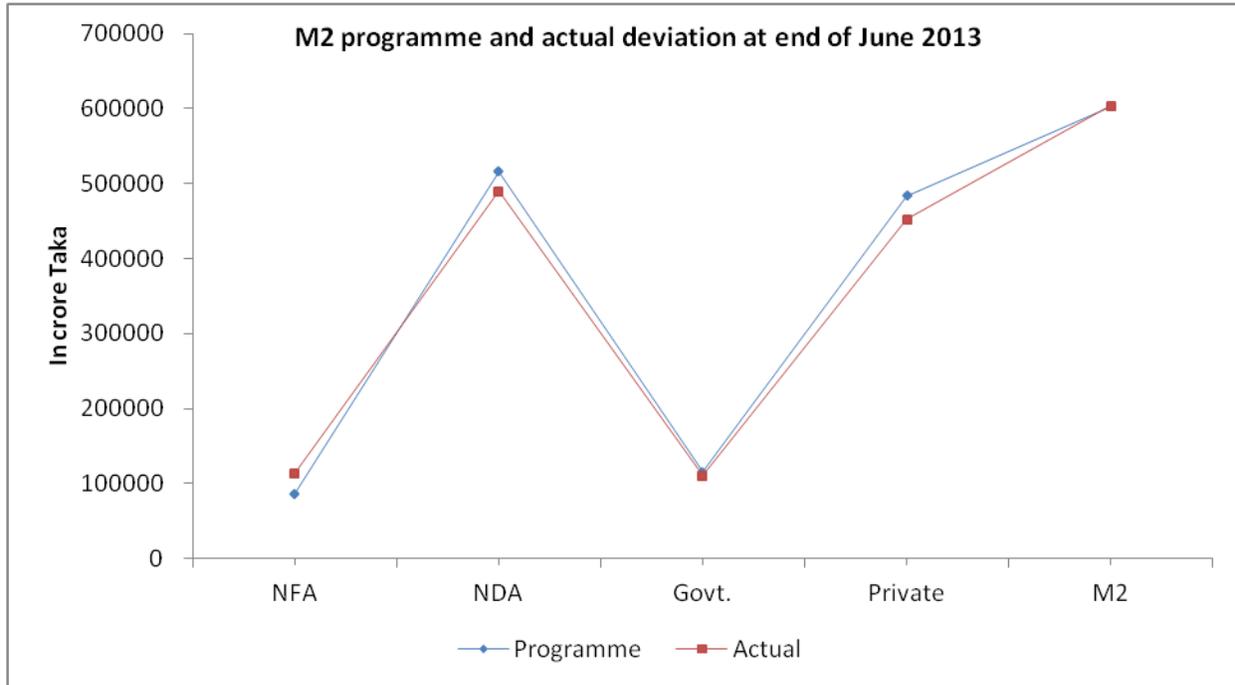
Government sector credit expansion from the banking system to implement the ADP is expected to Tk. 23624.00 crore for FY 2012-13. The borrowing amount declares in the national budget, which is subject to change according to revised ADP. Subsequently, additional amount can also be estimated bearing in mind declining trend of non-bank and foreign funds maintaining overall budget deficit at 5 percent level of GDP. Through treasury bills and bonds government obtain money from DMBs. This mode of financing will be elaborated later in section V. Other public sector credit is expected to decline due to privatization process of the state owned enterprises

(SOEs) during that time period. Negative growth rate 6.97 percent is assumed in this sector. Public sector credit programmed 20.25 percent expansion for FY 2012-13 (**Table-1**). Private sector credit component is elaborated in the SBS of BB. This is the thrust sector of the economy. Private sector credit is ranged from personal loan to manufacturing industry. Housing loan, auto loan, crop loan, credit card to the common people like developed country encouraging financial inclusion as well as monetization in Bangladesh. Following related economic standpoint private sector credit growth is expected to 18.55 percent in FY 2012-13 (**Table-1**). Private sector growth is estimated at 9.50 percent and 13.03 percent the end of December, 2012 and March 2013 respectively. The main component of other item (net) is inter-bank asset of unclassified asset inter-bank liabilities and contingent liability of unclassified liability. Other item (net) can be plus or minus nature in the balance sheet.

Table-2: Monetary and credit programme			(In crore Taka)
Particulars	Outstanding stock		
	June, 2013 (Programme)	June, 2013 (Actual)	Difference between Programme and Actual of June, 2013
1	2	3	4
A. Net Foreign Assets of banking system	86496.00	113384.80	-26888.8 (-31.09)
B. Net Domestic Assets of banking system	516207.10	490120.60	26086.50 (+5.05)
a) Domestic credit	616209.30	571737.10	44472.20 (+7.22)
Public sector	1326541.10	119579.90	1206961.20 (+90.99)
Govt.(net)	115530.80	110124.60	5406.2 (+4.68)
Other Public	17123.30	9455.30	7668.00 (+44.78)
Private sector	483555.20	452157.20	31398.00 (+6.49)
b) Other items (net)	-100002.20	-81616.50	-18385.70 (+18.39)
C. Broad money (A+B)	602703.10	603505.40	-802.30 (-0.13)
i) Currency outside banks	67573.50	67552.90	20.60 (+0.03)
ii) Deposits	535129.60	535952.50	-822.90 (-0.15)
a) Demand deposits	76892.50	56050.20	20842.30 (+27.11)
b) Time deposits	458237.10	479902.30	-21665.2 (-4.73)

Note: Figures in brackets indicate percentage changes over end June of previous fiscal.

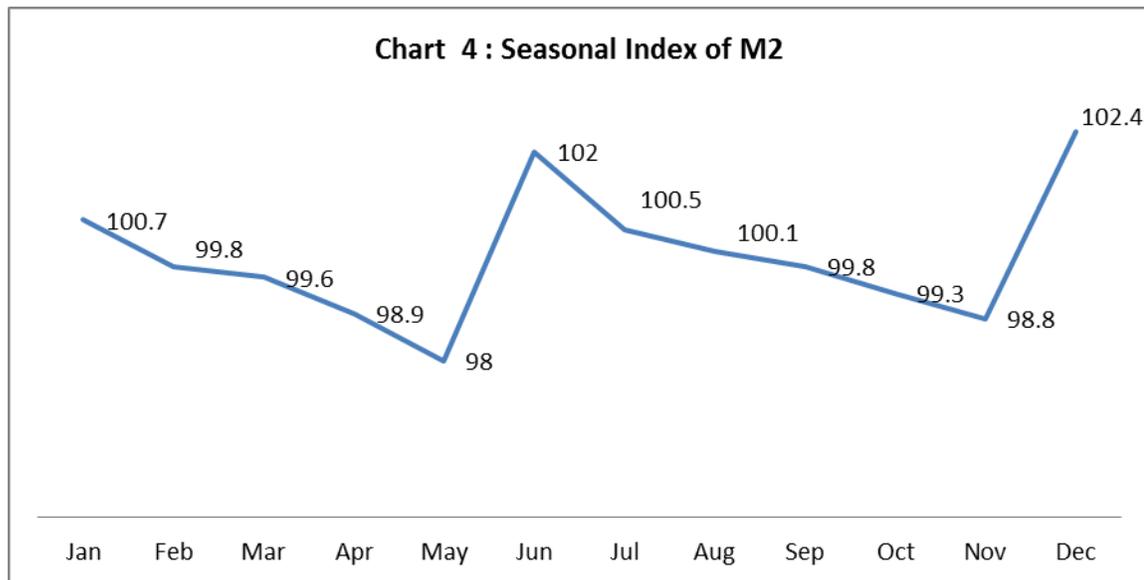
Chart 3



The deviation of actual and forecasted path of NFA, NDA, government and private sector credit and M2 is very minimum at the end of June 2013 (**Chart 3**). Deploying judgemental approach and econometric tools, I have forecasted the related variables of M2. As a result, the exercise of M2 and RM programme need to be meticulously followed combining four sectors of the economy.

It may be noted that forecasting of private sector credit and currency using ARIMA procedure can be attainable as it is stochastic. Using auto regressive process with seasonality, we can technically predict the private sector credit and currency subject to stability in mm. NFA of M2 and RM, government sector credit, claims on DMBs and time deposits are deterministic. As a result, prediction of these elements is unyielding using random technique.

Seasonality of M2 in Bangladesh monetary and credit programming (Chart 4)



In the seasonal index, oscillation is found for the month of June and December. For the surge of M2 during the mentioned period seasonal factor need to understand. Proper seasonal treatment is required to incorporate to watch in-depth each variable of monetary aggregates for monetary programming of Bangladesh.

Reserve money programming number in brief

In the NDA of RM (**Table-3**) claims on DMBs depend on liquidity need maintained through repo, special repo, LSF, refinancing programme, loan reverse repo. Refinancing is provided to export and small and medium enterprise (SME) for poverty alleviation generating employment. The growth programmed in this sector 5.29 percent at the end of June, 2013. The government sector credit is programmed 6.35 percent growth subject to over draft (current) and overdraft (blocked) account adjustment and loan requirement of the government for supporting development works. The RM growth is programmed as 6.26 percent, 10.35 percent and 14.95 percent at the end of December, 2012, March, 2013 and June, 2013. Accordingly, the MM are calculated as 5.17, 5.14 and 5.36 at the end of December, 2012, March, 2013 and June, 2013.

The government deposits all its cash balances with BB free of interest. BB provides up to Tk. 4000 crore for day to day operation of the government using ways and means account with

reverse repo rate (5.25 percent) as government has taxing capacity. Government can borrow money through overdraft paying reverse repo rate plus one percent (6.25 percent) with seigniorage effect and inflation if the borrowing is unplanned. 91-Day government treasury bill rate is applicable for government blocked account loan taken through over draft from BB. Claims on other public sector include SOEs elaborated in the SBS. According to exercise improvement of balance sheet position of SOEs is expected during FY 2011-13.

Table-3 Reserve money programme (In crore Taka)

(In crore taka)

Particulars	Outstanding stock (Actual)			Program 2012-13			
	June, 2010	June, 2011	June 2012	September 2012	December 2012	March 2013	June 2013
	1	2	3	4	5	6	7
Net Foreign Assets of Bangladesh Bank	61204.90	61388.70 (+0.30)	68971.70 (+12.35)	78730.50 (+14.15)	71139.20 (+3.14)	74060.90 (+7.38)	76123.70 (+10.37)
Net Domestic Assets of Bangladesh Bank	19305.40	28345.70 (+46.83)	28831.00 (+1.71)	21228.30 (-26.37)	32787.20 (+13.72)	33865.50 (+17.46)	36302.70 (+25.92)
Claims on Govt.(net)	22320.60	32049.70 (+43.59)	38044.00 (+18.70)	35859.10 (-5.74)	37298.00 (-1.96)	37800.10 (-0.64)	40458.20 (+6.35)
Claims on other public	830.70	736.70 (-11.32)	1181.90 (+60.43)	1027.30 (-13.08)	604.30 (-48.87)	600.21 (-49.22)	580.03 (-50.92)
Claims on DMBs	6613.90	18608.80 (+181.36)	22627.40 (+21.60)	15297.60 (-32.39)	21824.33 (-3.55)	23123.90 (+2.19)	23824.21 (+5.29)
Other items (net)	-10459.80	-23049.50 (+120.36)	-33022.30 (+43.27)	-30955.70 (-6.26)	-26939.43 (-18.42)	-27658.71 (-16.24)	-28559.74 (-13.51)
Reserve money	80510.30	89734.40 (+11.46)	97802.70 (+8.99)	99958.80 (+2.20)	103926.40 (+6.26)	107926.40 (+10.35)	112426.40 (+14.95)
<small>Reserve Money</small>							
<small>Reserve money recorded an increase of Tk.525.50 crore or 0.54 per cent during July-January, 2010-11. The increase of reserve money growth occurred mainly due to increase in net domestic assets of Bangladesh Bank by Tk. 174.30 crore or 0.48 per cent.</small>							
Currency Issued	50465.40	60526.90 (+19.94)	64896.50 (+7.22)	68244.90 (+5.16)	69702.01 (+7.40)	72279.60 (+11.38)	74582.40 (+14.93)
i) Currency outside banks	46157.10	54795.10 (+18.71)	58417.10 (+6.61)	61214.50 (+4.79)	63072.71 (+7.97)	65361.80 (+11.89)	67573.50 (+15.67)
ii) Cash in tills	4308.30	5731.80 (+33.04)	6479.40 (+13.04)	7030.40 (+8.50)	6629.30 (+2.31)	6917.80 (+6.77)	7008.90 (+8.17)
Deposits held with BB	30044.90	29207.50 (-2.79)	32906.20 (+12.66)	31713.90 (-3.62)	34224.39 (+4.01)	35646.80 (+8.33)	37844.00 (+15.01)
Of which: Excess reserves	12402.90	4082.50 (-67.08)	3363.30 (-17.62)	490.10 (-85.43)	6586.39 (+95.83)	3846.80 (+14.38)	3444.00 (+2.40)
Reserve money multiplier	4.51	4.91	5.29	5.36	5.37	5.35	5.36

Note: Note: Figures in brackets indicate percentage changes over end June.

BBs other item (net) comprises among others interest suspense account of unclassified assets Asian Clearing Union (ACU) and IMF Trust Fund (PRGF) of foreign liabilities. IMF loan increasing liability contributes in gross foreign exchange reserve building. The foreign exchange reserves is derived with the help of technical analysis for the first time using recent data and ultimately matched with the BOP different accounts for maintaining high foreign exchange reserves, which will contribute for better credit rating of the country.

Gross foreign exchange reserve US\$ 10111.0 million for end February 2012 covering different foreign currency (USD, pound, euro and other currency totalling US\$ 8717.0 million), SDR holdings (US\$727.61 million), Gold (US\$654.08 million), reserve position in the IMF (US\$0.66 million) and other foreign accounts (US\$11.77 million). Exchange rate of end June 2011 is used in this calculation to comprehend the erosion of foreign exchange over time in the BOP frontier. Appreciation of Dollar against SDR for instance will generate less amount of Dollar in a contract with the IMF. The gross foreign exchange reserve using current market rate is US\$ 10066.77 million for end February 2012. Stated that NFA of BB is equivalent to gross foreign exchange reserves deducting liabilities includes for example Asian Clearing Union (ACU) balance, project FC account and FC clearing account. The divergence between programme and actual RM is exhibited in **Table 4**.

Following monetary aggregates RM and M2 liabilities side currency figure is stochastic. Currency data of different period shows it's positively related to transaction demand with respect to GDP and inflation and inversely related to interest rate of banks and national savings certificates (NSC). Precautionary demand for money represented by broadly demand deposit (checking account) of real money balance (M1) is positively related to income. Speculative demand (time deposit) is inversely related to interest rate. It may be pointed out that printing of notes (Taka) for a year depends on GDP growth, inflation rate and amount of torn notes. Financial innovations include debit card, credit card and mobile banking reducing the amount of cash demand. DMBs maintain reserves with BB for daily transaction consequences. DMBs target is to acquire marginal efficiency in terms of keeping minimum reserves in Taka denomination. DMBs demand and time deposits 6 percent (CRR) along with foreign currency clearing account balance is preserved as reserves in the balance sheet of BB. To avoid the liquidity shortfall arising from cheque clearing DMBs retain Taka with BB more than cash reserve requirement (CRR). For liquidity management purpose excess reserves is calculated deducting CRR from local currency balance. Growth in currency reduces the excess reserves of DMBs. Largely deposit growth depends on financial engineering.

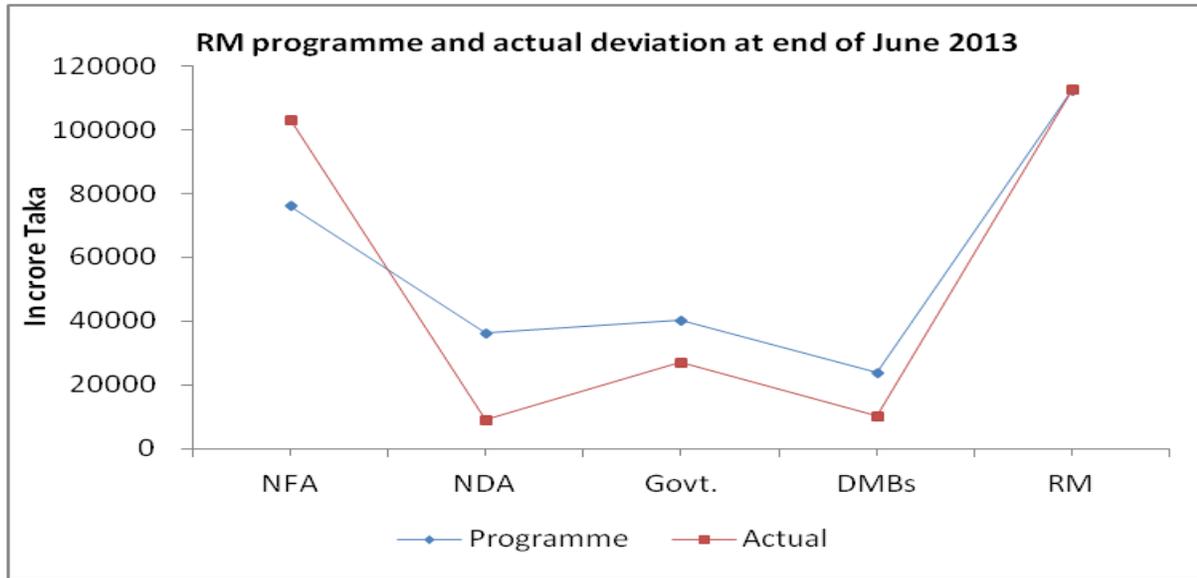
High currency deposit ratio and reserve deposit reserve ratio lower the MM increasing high powered money (RM). Accordingly OMO, repo, reverse repo and foreign exchange

sale/purchase is deployed allowing for short term liquidity management and keeping the desired rates. Auction of government treasury bills and bonds is used for debt management tools. These are the indirect instrument of monetary policy. Apart from those direct instruments CRR, SLR, bank rate and discount window is used sparsely. RM is mainly deterministic. BB reins M2 through MM. Currency deposit ratio and reserve deposit ratio elements of liability side of M2 and RM determine the magnitude of MM. RM is the operating target of monetary policy. Credit to government from the DMBs is complementary (necessary) element. On the other hand claim on government from BB is substitute owing to opportunity cost of funds with seigniorage and inflation effect. Eventually, the holders of Taka need to bear the cost of government seigniorage gain. Concentration of asset due to unproductive investment in private and public sector stimulate the income inequalities in the country impacting the benefit of GDP growth.

Table-4: Reserve money programme			(In crore Taka)
Particulars	Outstanding stock		
	June, 2013 (Programme)	June, 2013 (Actual)	Difference between Programme and Actual of June, 2013
1	2	3	4
Net Foreign Assets of Bangladesh Bank	76123.70	103246.00	-27122.30 (-35.63)
Net Domestic Assets of Bangladesh Bank	36302.70	9243.40	27059.30 (+74.54)
Claims on Govt.(net)	40458.20	27069.00	13389.20 (+33.09)
Claims on other public	580.03	1354.50	-774.47 (-133.52)
Claims on DMBs	23824.21	10219.00	13605.21 (+57.11)
Other items (net)	-28559.74	-29399.10	839.36 (-2.94)
Reserve money	112426.40	112489.40	-63.00 (-0.06)
Currency Issued	74582.40	75372.30	-789.90 (-1.06)
i) Currency outside banks	67573.50	67552.90	20.60 (+0.03)
ii) Cash in tills	7008.90	7819.40	-810.50 (-11.56)
Deposits held with BB	37844.00	37117.10	726.90 (+1.92)
Of which: Excess reserves	3444.00	3302.00	142.00 (+4.12)
Reserve money multiplier	5.36	5.36	0.00

Note: Figures in brackets indicate percentage changes over end June of previous fiscal.

Chart 5



The challenge of BB is to monitor the RM using OMOs tools. We observe (**Chart 5**) the programme and actual deviation of NFA, NDA, government sector credit and loans to banks. But the programme and actual RM are same at the end of June 2013 for effective formulating of RM. Surge in overall balance of BOP has contributed to increase in NFA resulting decline in NDA. NFA positively contributed to the economy. Government borrowed less in FY 2013 from the BB. DMBs amount are also decreased comparing programme due to less demand of money in this sector. BB has role to operate the OMOs prudently to manage the high powered money (RM) for maintain stability in MM.

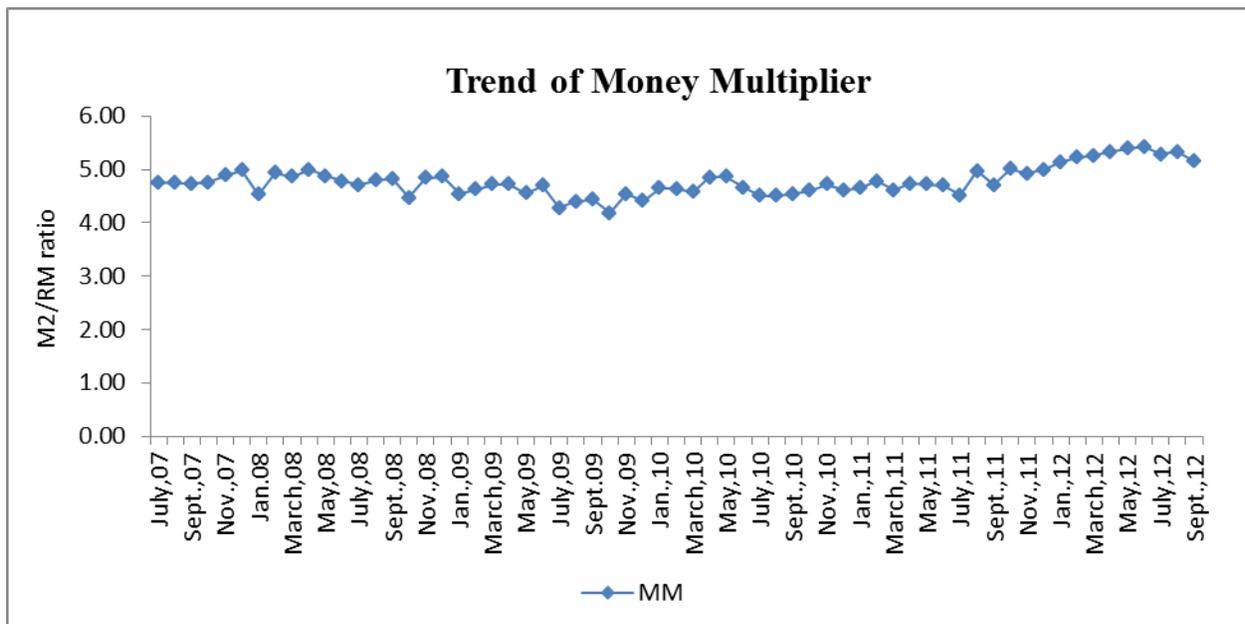
Money multiplier

In monetary and credit programming of Bangladesh RM is used as operating target. M2 is the intermediate target and inflation and GDP growth is ultimate target. Stability in MM $(1+c/d)/(c/d+r/d)$ is assumed in monetary programming, which is the research question of this paper. Stable and upward MM balances the inflation, GDP growth interest and exchange rate, from macroeconomic point of view. Central bank tools open market operations (OMOs) and government debt management tools includes banks finance to government are used to create the orderly situation in money market of Bangladesh. Currency outside banks and reserves are the two components of RM from liability side. Currency and reserve numbers are arrived from the Issue Department and Banking Department balance sheet of BB. Increase in currency outside banks and reserves (DMBs balance with BB) will reduce the MM. Increase in currency outside

banks increase the high powered money with inflationary impact. While increase in DMBs reserve with BB assuming constant deposit growth will reduce the MM without creating inflation that much. In such case, considering the economic situation BB can utilize the excess reserves of RM proving loan at discount rate to the small and medium enterprises (SME). Stable and upward MM (**Table-3**) through central bank operations will smooth monetary data generating process (DGP) with white noise econometric regression inference and less losing of degrees of freedom.

MM of Bangladesh observes volatility in some extent influencing interest rate, exchange rate and inflation. Currency deposit ratio (c/d) and reserve deposit ratio (r/d) determines the magnitude of MM. Deposit growth depends on currency demand and financial engineering. The monetization rate in Bangladesh is sixty percent of GDP in relation to interest rate sensitivity and its pass-through in the economy. Currency is a random factor. Excessive government borrowing from BB enlarge the RM creating volatility in MM. Money multiplier can enter solving $(1+c/d)/(c/d+r/d)$. Programmed currency and deposit amount for end June 2013 is Tk. 67576.50 crore and Tk.535129.60 crore. Reserve amount Tk.44852.90 crore contains cash in tills and balances with BB. To arrive MM 5.36 for end June 2013 the calculated c/d is 0.12628 and r/d is 0.08382. The long range MM can be found in **Chart 6**.

Chart 6



Balance of payments accounts programme in short

Export and import growth for FY 2011-13 is programmed 12.59 percent and 13.54 percent (**Table-5**) correspondingly keeping the momentum of the economy. Workers remittance is expected to uphold stable growth at 10.71 percent. As a result, US\$ 1251 million will be surplus in the current account. MLT loans expected to generate US\$ 2163 million (**Table-5**) in the financial account channelizing pipeline credit. Other long-term loan (net) will reach at US\$ 101 million at the end of June 2013. DMBs contribute about US\$ 55 million. Altogether the overall surplus US\$ 894 million is intended. Increase of BBs asset position US\$ 686 million and decrease of liabilities number US\$ 208 million is calculated in this regard.

According to IMF BOP Manual (BPM-6) Income and Current Transfer head of BPM-5 will be termed as Primary Income and Secondary Income of Current Account Balance (CAB). There is also among others difference in sign treatment between BPM-5 and BPM-6 for debit and credit entry. Export of Trade Balance is compiled using Export Promotion Bureau (EPB) data on value of goods without shipment cost (f.o.b. price). BB data is used for calculation of Import at f.o.b. (freight on board) price. Service head Debit mainly includes transportation and travel cost for instance comprising medical and education cost abroad. FDI, Portfolio Investment, Other long-term and Short-term interest is included in the Debit account of Primary Income. Grant component Food aid and Commodity aid is included in the Official Transfers of Secondary Income of CAB.

Table-5: Balance of payments Programme			(In million USD)
Particulars	FY 2011-12 (Actual)	FY 2012-13 (Actual)	FY2012-13 (programme)
Trade balance	-7995	-7009	-9304
Exports f.o.b(including EPZ) ^{1/}	23992	26567	27013
	(+4.28)	(+10.73)	(+12.59)
Imports f.o.b(including EPZ)	31987	33576	36317
	(+5.44)	(+4.97)	(+13.54)
Services	-2566	-3162	-2345
Credit	2684	2830	2780
Debit	5250	5992	5125
Primary income	-1508	-2369	-1865
Credit	195	120	140
Debit	1703	2489	2005
Of which:Official interest payment	373	476	193
Secondary income	13699	14928	14765
Official transfers	105	97	160
Private transfers	13594	14831	14605
<i>of which : Workers' remittances (current a/c. portion)</i>	<i>12843</i>	<i>14338</i>	<i>14218</i>
	(+10.24)	2388	(+10.71)
Current account balance	1630	629	1251
Capital account	469	629	512
Capital transfers	469	0	512
Others	0	2863	0
Financial account	-955	1726	-869
i) Foreign direct investment(net)	995	368	1017
ii) Portfolio investment (net)	198	123	28
iii) Other investment(net)	-2148	769	-1914
MLT loans ^{2/}	1460	2085	2163
MLT amortization payments	789	906	889
Other long-term loans (net)	-57	-150	101
Other short-term loans (net)	242	-100	-139
Trade credit (net)	-1450	-250	-1890
Other assets	-1606	0	-1315
DMBs & NBDCs(net)	52	90	55
Assets	443	396	440
Liabilities	495	486	495
Errors and omissions	-650	-752	0
Overall balance	494	5128	894
Reserve assets	-494	-5128	-894
Bangladesh Bank(net)	-494	-5128	-894
Assets	293	5196	686
Liabilities	201	68	208
1/ Excludes local sales reported by EPB. Some adjustments necessiated by BOP considerations have been made.			
2/ Excluding supplier's credit, reclassified as trade credit below.			

Project aid is integrated in the Capital Account. Portfolio Investment relates to investment in the capital market. FDI is the most precious investment of Financial Account. Financing through Economic Relations Divisions such as loan from World Bank, ADB or other agencies together with specific country is counted in the Medium and Long Term Loans head of Financial Account. Other long-term loans (net) speak about private sector loan. Bangladesh Petroleum Corporation loan is built-in Other short-term loan account. Difference between EPB and BB

export data is known as Trade Credit (net). Difference mainly relating to export and import of Export Promotion Zone (EPZ) is captured in Other Assets account. Reporting error and exchange rate difference is reflected in the Errors and Omissions account of Financial Account. Positive sign in the Asset side of BB means increases of liability may be from IMF. Negative sign indicates increase of Liability. Overall Balance of BOP emerges in the table increasing the liabilities of BB following BPM-6. Overall balance of BOP can be increased considering higher foreign exchange reserves. Performing technical analysis with the past short term range data of foreign exchange may increase the NFA of BB. Technical exercise implies foreign exchange reserves can be increased at higher level addressing BOP accounts. ARIMA exercise can be deployed in this regard. We know that the NFA of BB is derived from the overall balance of BOP. If the balance of a particular year (end June) is US\$ 100 and the overall balance of BOP is US\$ 10 then the total NFA of BB will be US\$110. In technical analysis, the overall balance of BOP may be generated as US\$ 20. Then the total NFA will be US\$120. The extra US\$ 10 need to be distributed in the MLT accounts of BB. So, the increased amount in MLT of BOP will increase the overall balance of BOP. Good governance, confidence of foreign remitter in home country investment, increase in export and FDI can ensure extra amount of inflow of foreign funds through MLT and other relevant accounts of BOP and contributes in pilling up substantial foreign exchange reserves. The foreign exchange reserves is derived with the help of technical analysis for the first time using recent data and ultimately matched with the BOP different accounts for maintaining high foreign exchange reserves, which will contribute for better credit rating of the country. BOP programme and actual position can be found in **Table-6**. **Chart 7** is signifying the difference of BOP programme and actual numbers.

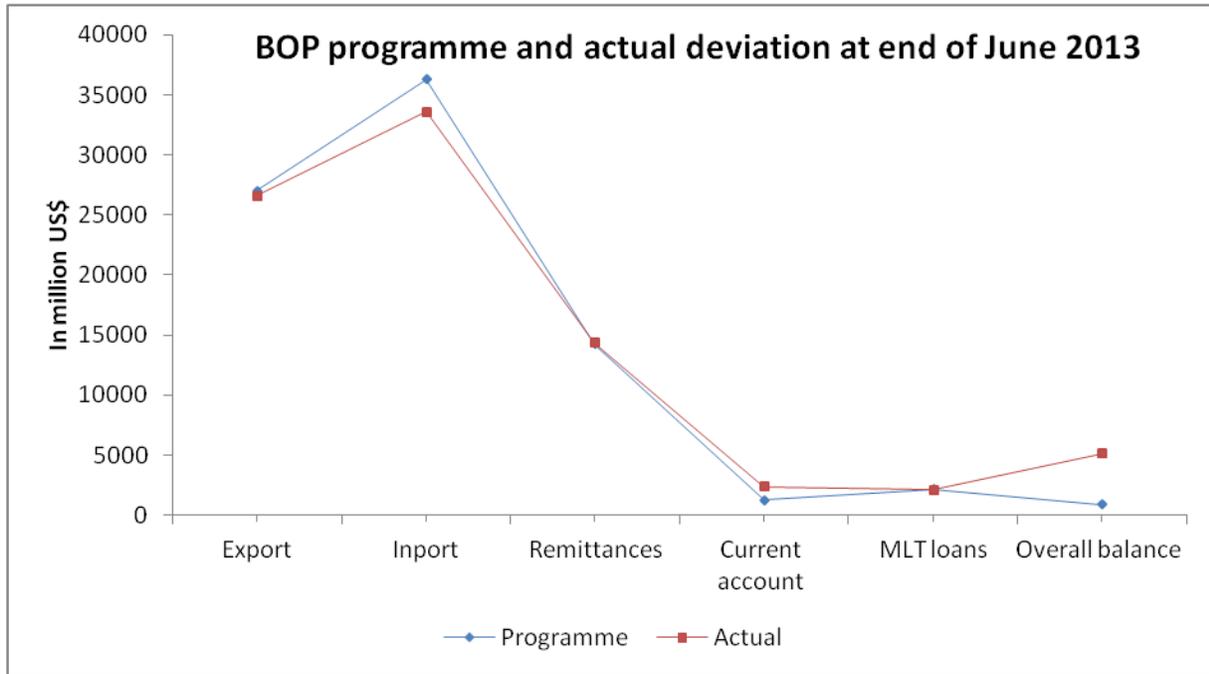
Monetary, external, fiscal and real sector development and their interaction can be quantified in tabular form (**Table-7**). This is how I can establish the sectoral relationship of the economy.

Table-6: Balance of payments programme		(In million USD)	
Particulars	FY2012-13 (programme)	FY2012-13 (Actual)	
Trade balance	-9304	-7009	
Exports f.o.b(including EPZ) ^{1/}	27013	26567	
	(+12.59)	(10.73)	
Imports f.o.b(including EPZ)	36317	33576	
	(+13.54)	(4.97)	
Services	-2345	-3162	
Credit	2780	2830	
Debit	5125	5992	
Primary income	-1865	-2369	
Credit	140	120	
Debit	2005	2489	
Of which:Official interest payment	193	476	
Secondary income	14765	14928	
Official transfers	160	97	
Private transfers	14605	14831	
<i>of which : Workers' remittances (current a/c. portion)</i>	14218	14338	
Current account balance	1251	2388	
Capital account	512	629	
Capital transfers	512	629	
Others	0	0	
Financial account	-869	2863	
i) Foreign direct investment(net)	1017	1726	
ii) Portfolio investment (net)	28	368	
		123	
iii) Other investment(net)	-1914	769	
MLT loans ^{2/}	2163	2085	
MLT amortization payments	889	906	
Other long-term loans (net)	101	-150	
Other short-term loans (net)	-139	-100	
Trade credit (net)	-1890	-250	
Other assets	-1315	0	
DMBs & NBDCs(net)	55	90	
Assets	440	396	
Liabilities	495	486	
Errors and omissions	0	-752	
Overall balance	894	5128	
Reserve assets	-894	-5128	
Bangladesh Bank(net)	-894	-5128	
Assets	686	5196	
Liabilities	208	68	

1/ Excludes local sales reported by EPB. Some adjustments necessiated by BOP considerations have been made.

2/ Excluding supplier's credit, reclassified as trade credit below. P= Provisional. R= Revised

Chart 7



Higher overall balance (**Chart 7**) of BOP has contributed to increase the foreign exchange reserves in the country. Consequently, BB needs to apply proper sterilization policy to maintain the Taka rate against US dollar. NDA is derived from RM minus NFA. As a result, we have watched the lower growth in NDA (**Chart 5**) of RM. Other components of BOP follows stable programmed and actual paths.

Table- 7 Bangladesh: National Accounts Indicator

	Actual		Provisional	Estimated	Projection
	2008-09	2009-10	2010-11	2011-12	2012-13
A. Real Sector(%)					
National income and prices (percent change)					
Nominal GDP growth (% change)	12.6	12.9	13.4	15.9	14.1
Real GDP	5.7	6.1	6.7	7.0	7.2
CPI Inflation (average)	6.7	7.3	8.8	9.5	7.5
Total Domestic Investment as percent of GDP	24.4	24.4	24.7	25.9	26.6
Domestic saving	20.1	20.1	19.6	20.2	19.9
National saving	29.6	30.0	28.4	26.3	26.8
B. Fiscal Sector (%)					
Total revenue	10.4	10.9	11.8	12.6	13.4
Tax	8.6	9.0	10.1	10.6	11.2
No-ntax	1.8	1.9	1.7	2.0	2.2
Total expenditure	14.3	14.6	16.2	17.7	18.5
Revenue expenditure	11.2	11.0	12.0	13.2	13.2
Annual Development Program	3.2	3.7	4.2	4.5	5.2
Budget overall balance (Excluding grant)	-3.9	-3.7	-4.4	-5.1	-5.0
Financing (net) in percent					
Domestic financing	3.1	2.3	3.8	3.8	3.3
Banking source	2.2	-0.3	3.2	3.2	2.4
non-bank	0.9	2.6	0.6	0.6	0.9
Foreign financing	0.8	1.3	0.6	1.3	1.8
C. Monetary Sector					
Money and credit (percent change)					
Net domestic assets	17.8	18.8	25.0	21.9	15.8
Private sector	15.9	17.6	28.4	19.1	18.0
Broad money (M2)	19.2	22.4	21.4	17.0	16.0
C. External Sector					
Balance of payments (percent change)					
Exports, f.o.b.	10.1	4.2	41.7	14.5	14.5
Import, c.i.f.	4.2	5.4	41.8	15.0	15.0
Remittances(US\$ billion)	9.7	11.0	11.7	12.9	14.5
Current account balance (%of GDP)	2.7	3.7	0.9	0.4	0.2
Gross official reserves (US\$ billion)	7.5	10.7	10.9	9.7	10.7
Gross official reserves (months of import)	3.8	5.1	3.6	2.9	2.7

Source: Medium-Term Macroeconomic Outlook : FY11-FY17 Finance Division, Ministry of Finance GOB
Bangladesh Economic Review, 2012

Unconventional monetary policy for ensuring inclusive GDP growth

The other objectives of monetary policy are ensuring inclusive GDP growth following unconventional monetary policy for reduction of poverty and minimizing the income inequalities. In this regard credit to small and medium enterprises (SME), progressive tax policy, green banking, mobile banking, refinancing from BB for supporting agriculture and export are pursuing for ensuring inclusive growth and robust financial sector.

Section IV

Conclusion

Presenting the crucial and dynamics of monetary policy is the noteworthy outcome of this paper. Yearly and quarterly Bangladesh monetary and credit program path derivation approach will help the stakeholders to move the economy in desired direction. Quantity theory of money and other fundamental technical analysis are lucidly described in this paper for moving towards higher growth frontier with optimum inflation. Central bank core function can be consulted by the stakeholders as the paper concentrated on Bangladesh monetary and credit program path derivation with due diligence.

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Brief on econometrics exercise related to monetary variables of Bangladesh are highlighted next.

1. ARMA model

Bangladesh GDP stability test

The 8th model is an autoregressive moving average process, ARMA(5,5) process with one lag interval, which can be elaborated as:

$$\text{bd_growth} = a + b \text{bd_growth}(-1) + c \text{bd_growth}(-3) + d \text{bd_growth}(-5) + \text{ma}(1) + \text{ma}(3) + \text{ma}(5) + u$$

$$\text{bd_growth} = 0.19 + 0.88 \text{bd_growth}(-1) - 0.26 \text{bd_growth}(-3) + 0.37 \text{bd_growth}(-5) - 0.99 u_{t-1} + 0.39 u_{t-3} - 0.36 u_{t-5}$$

$$\text{Adjusted } R^2 = 0.62 \quad \text{Schwarz criterion} = 2.85$$

Here coefficients of growth at lag 1, lag 5 and with error term at lag 1 are highly significant; coefficient of growth at lag 3 and coefficients of error term at lag 5 are statistically significant; and coefficients of error term at lag 3 is tending toward statistical significance. Goodness of fit is improved significantly.

From the above models, the model 8 is better than all other models from the viewpoint of goodness of fit, the significance of the coefficients and Schwarz criterion.

However, in determination of appropriate model, it has to satisfy the conditions of no serial correlation, no heteroskedasticity and non-normality error. **The stability of GDP test result is robust following diagnostic test.** The diagnosis of these tests for model is given below:

Serial Correlation test: The correlogram of residuals (Q-stat) at lag 4, 8 and 12 are shown below:

Q-stat at lag 4: 3.57 (0.06), lag 8: 5.21(0.39), lag 12 :7.69 (0.57)

Q-stat at all conventional lags indicates that there is no serial correlation in the residual.

Heteroskedasticity test: The correlogram of squared residuals at lag 4, 5 and 12 are shown below:

lag 4: 3.35 (0.07), lag 5: 5.23 (0.39), lag 12 : 5.59 (0.78)

After taking correlogram of squared residuals, I do not find any evidence of heteroskedasticity at conventional lags length.

Non-normality test: To test non-normality error, Jarque-Bera test is made and found the following results

Jarque-Bera : 1.83 (0.40)

The value of Jarque-Bera indicates that there has been non-normality error in the distribution. Basically the distribution has an excess kurtosis.

OLS model

Drawing OLS regression model stating dependent and independent variables:

$$Y = \beta_1 + U_i$$

$$Y = \beta_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \beta_5 X_4 + \beta_6 X_5 + U_i$$

Here, dependent variable is ACI stock price denoted by Y and the independent variables are: X_1 = DSE all share price index; X_2 = Risk free rate of return; X_3 = Consumer Price index (CPI); X_4 = Gold Price and X_5 = Petroleum Price.

Correlation coefficient

	DSE	TBILL	CPI	Gold	Petroleum
DSE	1				
TBILL	0.128	1			
CPI	0.234	0.148	1		
Gold	0.286	0.277	0.348	1	
Petroleum	0.149	0.301	0.136	-0.064	1

Source: Authors' Calculation

Empirical Results (ACI and DSE)

Variable	Coefficient	t-Statistic	Probability	F-statistic
DSE	1.1377	5.1794	0.0000	26.8259

Source: Authors' Calculation

Empirical Results (ACI and all variables under consideration)

Variable	Coefficient	t-Statistic	Probability
DSE	1.2447	5.5122	0.0000
T-Bill	-0.2318	-1.0074	0.3209
CPI	-3.3427	-1.7364	0.0915
Gold Price	-0.1081	-0.0025	0.9980
Petroleum Price	18.6000	0.6609	0.5131

F-statistic=6.5115

Source: Authors' Calculation

2. ARDL model

The Interrelationship between Money Supply and Nominal GDP in Bangladesh

Granger Causality Test

Hypothesis	Probability
GDP does not Granger cause M2	0.041
M2 does not Granger cause GDP	0.323

Source: Statistics Department of BB and Bangladesh Bureau of Statistics (BBS). Year:2014

Empirical Results and Analysis

Unit Root Test for Stationarity

The choice of most appropriate unit root test is difficult in practice. Ender (1995) suggested that a safe choice is to use unit root test—the Augmented Dickey–Fuller (ADF) (1981) test. The Augmented

Dickey-Fuller (ADF) test is widely applied for unit root tests. Therefore, to test stationarity, we conducted the widely used method of unit root tests—the ADF test—on the variables M2 and nominal GDP for Bangladesh. The unit root tests were performed at level and at first difference with the trend and intercept term. The optimum lag was selected by using the Akaike Information Criterion (AIC). A summary of the ADF unit root test result is presented in Table.

Augmented Dicky Fuller Test of Unit root

Variables	Model	T-statistic	Integration
GDP	Trend and intercept	-6.005[0.000]	I(0)
M2	Trend and intercept	-5.499[0.000]	I(1)

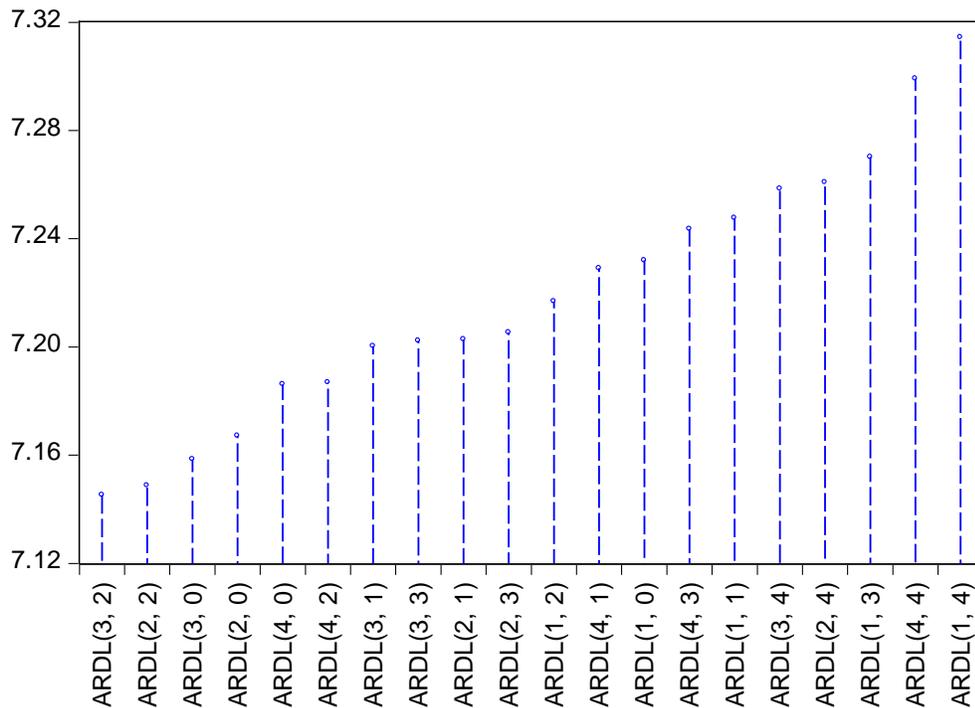
Source: Statistics Department of BB and Bangladesh Bureau of Statistics (BBS), 2014

Shows that GDP is I(0) and M2 is I(1), which is in a mixed form. None of variable is I(2). This suggest to perform ARDL Bound test approach (Pesaran, 2001).

Model Selection Criterion

The criterion for variables lag order selection is presented in the following graph. On the basis of the Akaike Information Criterion (AIC), the optimal lag length has been selected. According to the AIC, among the top 20 model our best model for this study is ARDL (3,2) model.

Akaike Information Criteria



Source: Statistics Department of BB and Bangladesh Bureau of Statistics (BBS), 2014

Results of the ARDL Bounds Tests:

In order to determine the presence of a long run relationship between the variables M2 and nominal GDP the bounds test is conducted. The result of Bounds test is presented in Table.

It is evident from Table that the computed F-statistic based on Wald test is 6.045 which exceeded the all upper bounds value. As the co-integration exists among the variables used in the model, therefore, the result presented for the long run are reliable.

Bounds Test Result

F-statistic = 6.045		
Level of Significance	Lower Bound Value	Upper Bound Value
10%	3.02	3.51
5%	3.62	4.16
2.5%	4.18	4.79
1%	4.94	5.58

Source: Statistics Department of BB and Bangladesh Bureau of Statistics (BBS), 2014

Long Run Estimation

Dependent Variable: GDP				
Variables Name	Coefficient	T-Ratio	Std. Error	P-Value
M2	0.401936	0.233080	1.724457	0.0953
C	6.238098	4.324278	1.442576	0.1599

Source: Statistics Department of BB and Bangladesh Bureau of Statistics (BBS), 2014

Short Run Estimation and ECM

Dependent Variable: GDP				
Variables Name	Coefficient	T-Ratio	Std. Error	P-Value
D(GDP(-1))	0.133802	0.142892	0.936381	0.3568
D(GDP(-2))	-0.127510	0.100318	-1.271051	0.2138
D(M2)	0.061721	0.228660	0.269926	0.7891
D(M2(-1))	-0.428651	0.220000	-1.948417	0.0611
CointEq(-1)	-1.144009	0.275178	-4.157337	0.0003
Cointeq = GDP - (0.4019*M2 + 6.2381)				

Source: Statistics Department of BB and Bangladesh Bureau of Statistics (BBS), 2014

According to the AIC an ARDL (3,2) model is selected in this study. Long-run and short run estimated coefficient of ARDL is presented in Tables. The estimated coefficient of GDP is 0.40, which is significant at 10% level. GDP coefficient suggests that nominal GDP rises by 40 basis point due to 1 unit change in M2. The error correction term is -1.14 and significant at 1% level, which implies that disequilibrium in long-run equilibrium, is adjusted to steady path if there is shock in the system.

Autocorrelation Diagnostic checking

Breusch-Godfrey Serial Correlation LM test and unit root of the model residuals are examined to see if there is any autocorrelation. The LM test is performed at different lags which are given below:

Lag	LM F-statistic	P-value
1	0.273	0.605
2	0.224	0.801

The F statistic value of LM test up to lag 2 is insignificant at 5% level of significance, suggesting there is no autocorrelation in the model residuals.

Correlogram Q-statistics up to 16 lags shows that none of the statistics is significant. This result also conform to the findings from Breusch-Godfrey Serial Correlation LM test that there is no serial correlation in the residuals.

Heteroskedasticity Test

It is likely that time series data shows variability over time that is residuals can be heteroskedastic. So, Autoregressive Conditional Heteroskedasticity (ARCH) test is used to see whether the conditional variances of errors identical or varying across time. The following table gives the result of ARCH test for heteroskedasticity.

Lag	Chi-Square value	p-value
1	0.065	0.799

The above results shows that the probability values of chi-square for selected lag are greater than 5% level of significance, which suggests the null hypothesis that there is no ARCH up to the order specified by the lag cannot be rejected.

Model Specification Test

The model specified in this study is correctly formed according to Ramsey RESET (Regression Specific Error Test) test which is a general test to check the correctness of the specification of the model. The results of Ramsey RESET test is furnished in the following manner:

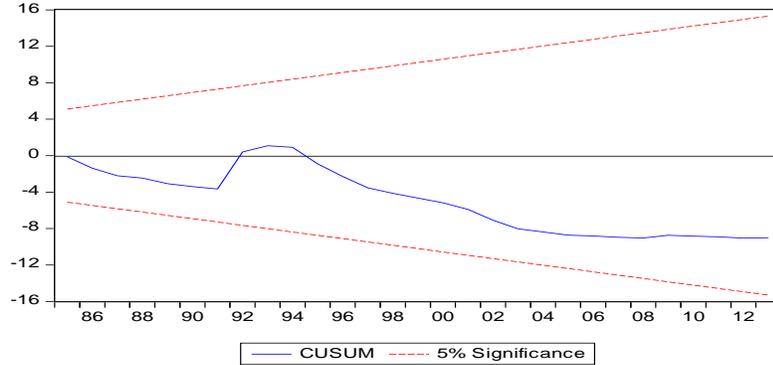
Omitted variables	F statistic	p-value
Squares of regressors	0.306	0.585

The p values of F statistic indicates the null hypothesis that the coefficients of omitted variables (squares of fitted regressors) is zero cannot be rejected at 5% level of significance. It means that the model without any quadratic terms of specified regressors is a good fit.

Stability Test

Cumulative sum (CUSUM) test has been examined to test the stability of long run coefficient. The result obtained is given in the following figure

Stability test of coefficient



Source: Statistics Department and Bangladesh Bureau of Statistics (BBS), 2014

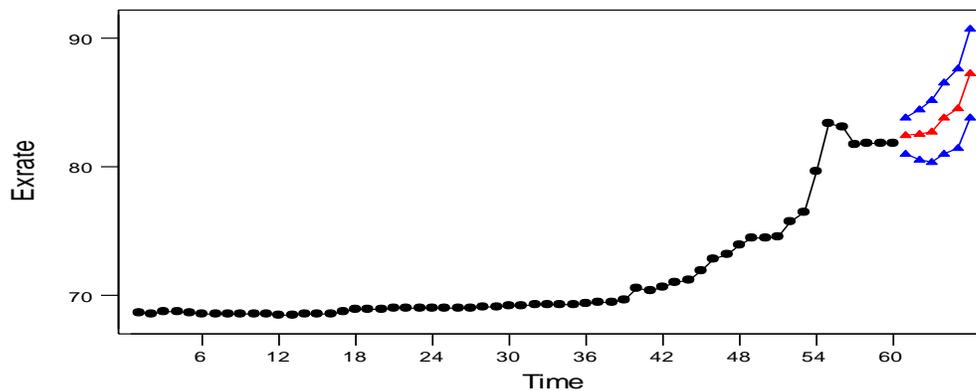
It can be seen from the above Figure that the plot of CUSUM stays within the critical 5% bounds which confirms the stability of coefficient in the long run.

3. ARIMA model

Forecasted monthly (average) exchange rate plot using ARIMA with seasonal treatment

Time Series Plot for Exrate

(with forecasts and their 95% confidence limits)



95 percent confidence level (with seasonality) (Taka/US\$ exchange rate)

Month average	Forecast	Lower	Upper	Actual
July 12	82.432	81.0529	83.8112	81.7715
August 12	82.5303	80.5743	84.4863	81.5160
September 12	82.7584	80.3559	85.1610	81.7286
October 12	83.8163	81.0340	86.5985	81.3123

November 12	84.5619	81.4422	87.6815
December 12	87.2837	83.8563	90.7111

Source: Authors' Calculation

4. VAR model

Variance Decomposition of LNREMIT:

Period	S.E.	EXRATE	LNEXPORT	LNIMPORT	LNREMIT
1	0.074232	14.98364	25.11464	2.450293	57.45143
2	0.080250	24.93988	21.71999	2.804236	50.53589
3	0.096091	28.91536	17.08647	3.345848	50.65231
4	0.101997	33.75897	15.16939	4.301009	46.77063
5	0.109251	36.08092	13.55246	4.750810	45.61581
6	0.113257	38.31229	12.63199	5.560966	43.49475
7	0.117049	39.58967	11.95621	6.099145	42.35498
8	0.119648	40.62891	11.48602	6.836234	41.04884
9	0.121898	41.27726	11.15878	7.439006	40.12496
10	0.123650	41.73331	10.91049	8.132011	39.22419

Cholesky Ordering: EXRATE LNEXPORT LNIMPORT LNREMIT

Source: Authors' Calculation

Forecasting of Exchange Rate of Bangladesh using VAR model

Form VAR monthly average forecasted exchange rate for July, 2012= $-4.137+1.389-0.828+0.692+0.016$ = -2.868 percent growth over June, 2012 exchange rate (81.820)=79.474 (under-cast comparing actual 81.772 of July,2012). VAR analysis and forecasting imply that economy of Bangladesh observing interdependence relationship with co-integrating vector.

5. VECM

Estimated coefficient of Reserve Money (RM) and inflation and other variables

Johansen's Co-integrated Tests

Null Hypothesis	Alternative Hypothesis	Trace Test		Maximum Eigen Value Test	
		Statistics	95% Critical Value	Statistics	95% Critical Value
r=0	r=1	51.70752*	47.85613	25.59641	27.58434
r≤1	r=2	26.11111	29.79707	15.66276	21.13162
r≤2	r=3	10.44835	15.49471	8.740594	14.26460
r≤3	r=4	1.707753	3.841466	1.707753	3.841466

*(**) denotes rejection of the hypothesis at 5%(1%) level

Trace test indicates 1 co-integrating equation; Max-eigenvalue test indicates no co-integration at the 0.05 level

Source: Authors' Calculation

$$Dginflation_t = a_0 + \sum_{j=1}^k a_1 DX1_{t-j} + \sum_{j=1}^k a_2 DX2_{t-j} + \sum_{j=1}^k a_3 DX3_{t-j} + \sum_{j=1}^k a_4 DX4_{t-j} + ECT_{t-k} + u_{1t}$$

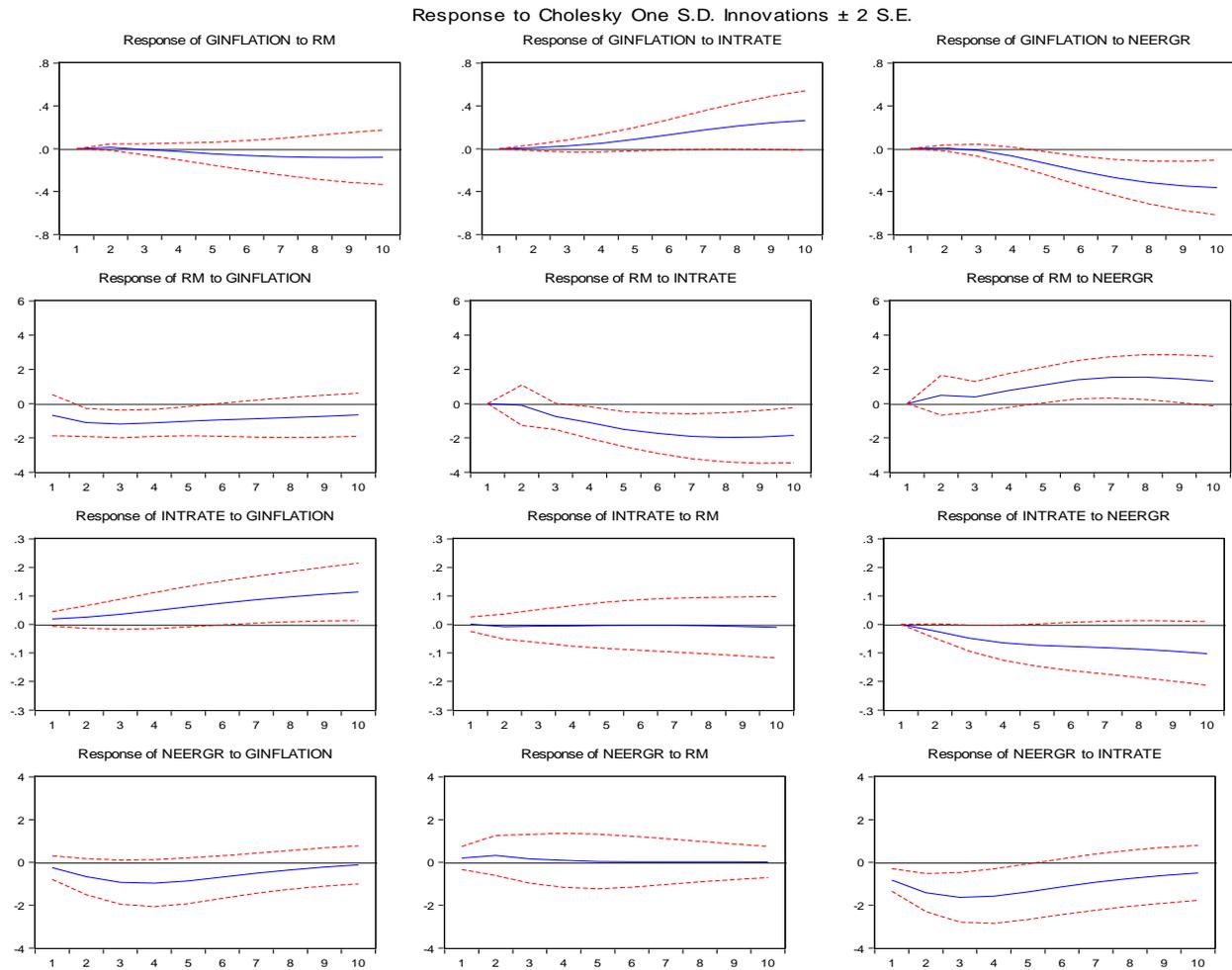
$$DGINFLATION = 12.09 + 0.36 DRM(-1) - 1.36 INTRATE(-1) - 0.33 NEERGR(-1) - 0.04 ECT(-1)$$

(3.13) (-0.91) (-1.66) (-2.42)

1 percent change in Reserve Money (RM) increases 0.36 percent of inflation with 3.13 t-statistics.

Impulse Response Function (IRF)

IRF of ginflation to RM band overlap the 0 (mean) line. Where, RM to inflation band did not converge to 0 line. The IRF implies general inflation has more power to impact high powered money. If the inflation raises it will create more RM. Higher currency in circulation of RM contribute more inflation rather higher growth in Deposit Money Banks reserve in RM. Other variables are showing convergence and divergence with respective time period.



6. DSGE model

- Filtering of de-seasonalized logarithmic data with the Hodrick-Prescott (HP) filter or by de-trending
- Determination of priors and potential priors
- Comparing priors and posteriors mean for interest rate increase to curb inflation for example.
- Conditional variance decomposition of the interested variables.