

## **Dynamics of Interest Rate Pass-through in Bangladesh An Econometric investigation for 2003 to 2015**

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### ***Abstract***

*This article empirically examines the dynamics of the interest rate pass-through mechanism for Bangladesh, by formulating and using an independent variable 'weighted average policy rate' (a combine rate constituted by using all policy rates of Bangladesh Bank - the central bank of Bangladesh) and lending rate, deposit rate and call money rate as dependent variables representing the lending, deposit and money market channels, respectively. We have used quarterly data for the period of 2003,Q1 -2015,Q4 published by Bangladesh Bank. The commonly used error correction and Engle-Granger (EG) models are used to examine the short-run and long-run pass-through respectively; a vector error correction (VECM) impulse response function (IRF) were employed to measure the short-run speed of the pass-through. Further, the Wald Test of Coefficient was used to measure the magnitude of the long run pass-through. We find that there is a symmetric, incomplete and very sluggish pass-through in Bangladesh for all lending, deposit and money market channels. We also found the greatest impact on the lending rate channel (40 percent) in short-run, while the adjustment speed is very slow in the all channels. In our understanding such paled profile of Interest Rate Pass-through in Bangladesh is due to non-reliance of Bangladesh Bank on interest rate tool for implementation of monetary policy.*

**Key Words:** Interest rate pass-through, cointegration, monetary Policy, Policy rates, Bangladesh.

**JEL Classification:** E43, G21.

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<sup>1</sup> This paper does not bear any opinion of Bangladesh Bank. All errors are authors' responsibility.

## Introduction

To the central banks across the world interest rate pass-through (IRPT) is one of the most relied channels of monetary policy. Theoretically it is assumed that policy rates have direct influence on both short term and long term money market rates which later, in turn, affect bank retail rates (i.e. both deposit and lending rates). IRPT, thus, is used as a package of economic stimulus in conventional monetary policy. After assessment of the trend of the business cycle and trend of price level of the economy, central bank usually sets its desired policy rates in open market operation (OMO) activities to keep the economy on track. Let us make a visit of the theoretical discourses of the interest rate and money supply and their implications on market and economy.

Now, the quantity theory of money postulates a direct and proportional relationship between money supply and price level. The traditional quantity theory of money as presented by Fisher's equation is as follows :

$$MV = PY \dots \dots \dots (1)$$

Where, the symbols have their usual connotations in economics. Under the classical assumption of full employment and the short run stability of the velocity (V), equation (1) postulates the proportional relationship between money (M) and price (P). Equation (1) can also be written as:

$$P = MV / Y \dots \dots \dots (2)$$

This equation (2) implies the proportionality between money and price. By taking natural log in both side of equation (2), it can be rewritten as

$$P^{\wedge} = M^{\wedge} + V^{\wedge} - Y^{\wedge} \dots \dots \dots (3)$$

Where  $\wedge$  indicates the growth rate of the relevant variables. Due to the full employment Output (Y) and by assumption velocity (V) in short run are fixed, so we can say that

$$P = f(M) \dots \dots \dots (4)$$

In other words,  $M \uparrow (\downarrow) \Rightarrow P \uparrow (\downarrow) \dots \dots \dots (5)$

This is how classical school establishes proportional relation between money supply and price level of an economy.

However, Keynesians criticized and rejected the proportionality between money and price. They argued that money has effects both on price and output level. According to them increasing money supply causes inflation but also reduce inflation. However, Keynes or his followers did not assume full employment. Therefore, there is a direct but not necessarily proportional relationship between money and price.

Again, some economist believe that through the competitive manner of money market, the policy rates are also expected to transmit into lending and deposit rates of the banking system which ultimately should bring desired changes in consumption and investment or aggregate demand of the economy. The process can be delineated as follows:

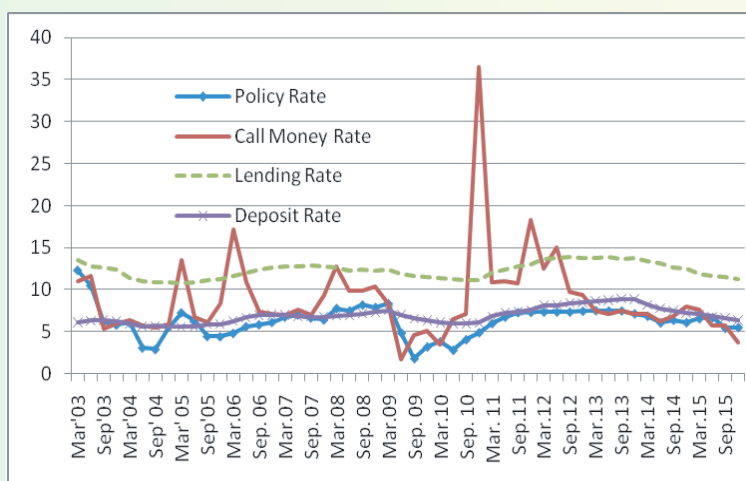
$$M\uparrow(\downarrow)\Rightarrow IR\downarrow(\uparrow)\Rightarrow I\uparrow(\downarrow)\Rightarrow Y\uparrow(\downarrow).$$

$$M\uparrow(\downarrow)\Rightarrow IR\downarrow(\uparrow)\Rightarrow S\downarrow(\uparrow)\Rightarrow C\uparrow(\downarrow)\Rightarrow Y\uparrow(\downarrow).$$

According to the transmission channel above, an expansionary monetary policy (M?) leads to a decrease in interest rate (IR?) which lower the cost of capital and increases investment (I?) or lower the earning of savings (S?) and increases Consumption (C?). This increase in investment and consumption will lead an increase in aggregate output (Y?) of the economy.

But, always there are some debates that whether empirical data supports this highly simplified theoretical assumption of IRPT. Monetary policy is considered to be effective if changes in the policy rates are completely passed through to retail interest rates over reasonably short period (Hoffmann and Mizen, 2004). However, empirical evidence in this regard is mixed. Accordingly, many empirical research based on data of different parts of the world have failed to substantiate that IRPT from policy rates to bank retail rates holds satisfactorily. Besides of contrasting conclusions of the some studies in the issue of the size and speed of the adjustment of IRPT some other studies show that pass through of policy rates to bank retail rates not only incomplete and sluggish but also asymmetric.

**Figure1:Co-movement of lending, deposit and market rates with policy rates in Bangladesh for 2003- 15.**



If the interest rate pass through to retail rates (i.e. deposit and lending rate) is incomplete, sluggish and asymmetric, then the use of monetary policy as a tool to control aggregate demand in the economy becomes a questionable action of the central bank. So, if the interest rate channel does not effective it cannot transmit monetary policy impulse to the real economy. A reduction in the nominal interest rate may be achieved by an expansion of the money supply, but it does not guarantee that the real interest rate will decline too (Taslim, 2014). It is, therefore, essential to know the degree, the speed and how symmetrically (or asymmetrically) retail interest rates are making response to a change in policy rates of the central bank.

### **Monetary Policy tools and approaches in Bangladesh**

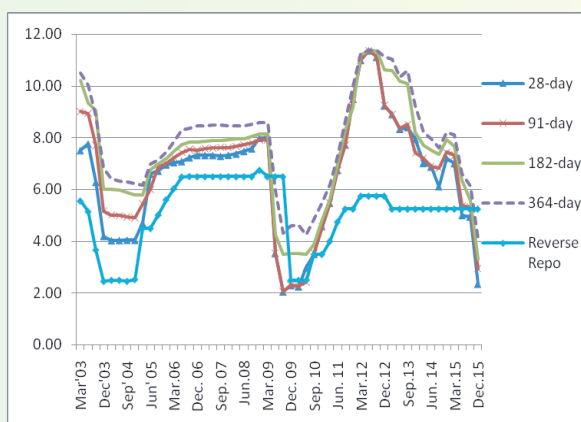
Monetary policy in Bangladesh, as outlined in Bangladesh Bank (BB) order 1972, is formulated around exchange rate and price level stability, and employment and output growth rates as the basic policy targets. To achieve these targets a rule based monetary aggregates such as reserve money, broad money and domestic credit (both private sector and government) are also projected, monitored and controlled to achieve desired targets.

In line with above law BB proclaims monetary programs for each financial year (July-June), accommodating monetary growth adequate for attaining the projected real GDP growth with inflation in the targeted range. Broad money (M2, currency in circulation plus time and demand deposits) growth path is the intermediate target in the program, with Reserve Money (RM, currency in circulation and balances of scheduled banks with BB) growth path as operating target of BB. The program also tracks the growth paths of several other aggregates/sub aggregates on the asset and liability side (domestic and foreign assets, credit to public and private sectors, currency in circulation, demand and time deposits and so forth), to help assess the growth supportiveness and likely inflationary impact of monetary expansion. Reverse repo, special repo, liquidity support and repo interest rates are BB's day to day instruments influencing the growth path of reserve money, ultimately to influence inflation via growth path of broad money. Besides, BB uses different tenure Bangladesh Bank Bills and Treasury Bills rates to keep broad money in its desired long run track. Cash reserve ratio (CRR) and statutory liquid ratio (SLR) for scheduled banks are the other monetary policy tools, used sparingly in situations of drastic imbalances stem from major shocks. In the back drop of necessity reverse repo operations are also being used sparingly to keep credit condition on its intended path in different sectors like agriculture, large and SME industries. (Monetary Policy Stance (MPS), BB, H1:2010)

Since monetary policy goals cannot be influenced directly, like most central banks BB uses a set of indirect instruments. As described above, the M2 can be influenced

indirectly by changes in policy instruments that target and monitor the RM via the money multiplier (MM). The primary mechanism employed for this purpose is the direct control of liquidity on a day-to-day basis achieved by the repo, reverse-repo, occasional BB Bills and the T-bill auctions for different tenures such as 28-days, 91-days, 182-days and 364-days, 3-years, 5-years and 9-years. The later instruments would in turn have an impact on the inter-bank call money rate for overnight transactions, which is the equivalent of the federal funds rate in the US. Usually, BB uses all avenues of policy options simultaneously to influence the credit market. Figure 2 is showing the co-movement of some selected policy rates in this regard which are highly synchronized i.e. policy actions by BB is always highly harmonized so that a concrete influence can take place.

**Figure 2: The co-movement of some selected policy rates.**



It is also noteworthy that the BB has been encouraging the activation of the inter-bank call money market instead of the reliance of commercial banks on the rediscount window the central Bank. As the time lag between policy actions and the eventual impact on goals is usually perceived as a short term, additional information variables such as foreign reserves, short-term interest rates, liquidity situation and domestic credit growth appear handy for BB to adapt and revise its policy measures if and as needed. As interest rate path is determined by the market forces which sometimes works whimsically BB does not rely on it and tries to control money and credit supply in the economy.

Consequently, the BB puts greater reliance on monetary targeting focused on the RM, and thus via the mm, on broad money, i.e., M2,. Therefore, BB programs the required limit of monetary expansion, M2 in this case, based on estimates of GDP growth, Consumer Price Index (CPI) and changes in the income velocity of money (v). The simple relationship between M2 and RM (see appendix 1 & 2) allows the later to be used

as an intermediate target, which is convenient since the policy instruments may directly target RM effectively. While the details of the instruments and modalities are described above, note that the essence of this approach relies on routinely (BB does it in daily basis) monitoring and influencing the supply of liquidity in the private credit market that would be consistent with BB's judgment of the inflation and GDP outlook. That is, the success of this strategy squarely depends on a good understanding of the underlying inflationary process and the GDP forecast built into the target money stock growth. The above process also postulates that interest rate strategy becomes a tertiary policy of BB which ultimately makes it a less useful tool of monetary policy in Bangladesh.

## Data

Our data set covers the quarterly series of repo, reverse repo, special repo and liquidity support rates, 28-day, 91-day, 182-day, 364-day T-Bill, and occasional BB bill rates, lending, deposit and call money rates for the period of 2003,Q1 - 2015,Q4. Here, all data are weighted average in nature. By using this data set we have derived weighted average policy rate (WAPR) that was virtually applied during this period. During calculation of weighted average rate we have given the weight for each of the item above as per their volume or quantity. The formula for calculating the WAPR is as follows:

$$\text{WAPR} = \frac{\sum (\text{Rate} \times \text{Amount})}{\sum (\text{Amount})}$$

We believe that an weighted average rate calculated by the above way and formula can give us a representative policy rate applied for the economy. Again the time period (2003-2015) is selected because of availability of data and BB started repo, reverse repo and special repo operation from first quarter of 2003 with a view to regular market fine tuning. Market was properly deregulated (for example floating exchange rate introduced in May, 2003) from that period as well. So, it is perceived that true application of modern techniques of monetary policy or open market operation (OPO) have been started to apply from early 2003. So, we have used all the data of the variables used for the purpose of controlling money supply and interest rates of the economy. It would have been better if we could have use monthly data. But unfortunately data of all required variables are not available in monthly frequency. Sample size of the data for the above period constitutes a size of 52 which is fairly large. This sample can be considered asymptotic in line with Gujrati (2003; Page 485) criterion that a sample size 50 or more observations is considered plausibly large. Therefore, our sample size is reasonably large for empirical analysis. Data source is various issues of monthly and quarterly publications of Statistics Department of BB which are various issues of Economic Trend, BB Bulletin and Bangladesh Bank Quarterly (BBQ).

## Literature Review

Techniques and results of the various studies are different and mix in nature. Here we have focused on only some studies whose basis was Bangladesh. We did not include any foreign study in this review section to keep the paper in a reasonable size.

Zaman et. al. (2007) has shown that policy rates and call money rate in Bangladesh have long run cointegrated. Using monthly data of from 2003 to 2007 of repo and reverse repo rates as proxy rates of policy rate and GARCH model as tool of analysis they have shown that if any volatility arises in the call money market for some reason it corrects swiftly and come in the equilibrium trend. However, the paper did not focused on the influence of the policy rates on other important ultimate rates like lending and deposit rate of the economy and also did not presented any concrete revelation about the speed and magnitude of the pass-through of policy rate to call money rate.

Islam (2008) has shown that controlling the RM and M2 by using SLR, CRR, repo, reverse repo and other open market operation is failed due to autonomous character of the two important components of RM - government borrowing from central bank (NCTG) and Net Foreign Assets (NFA). Using quarterly data of 1979,Q3 - 1997,Q2 and Structural Vector Autoregression Model he found that BB has no virtual control over base and broad money of Bangladesh. However, he did not focused on the influence and consequence of any interest rate changes of the market.

Akhtar et. al. (2005), has found that call money rates suffers from high volatility particularly in festival season in Bangladesh when excess reserve of the banks with BB falls sharply. Their assessment also pointed out that such hyper volatility in the call money market in Bangladesh is due to lack of efficiency in liquidity management by commercial banks of the country which can be mitigated by a small reduction of long term investment by the banks. They have also mentioned that proper guidance by BB is also necessary in this regard.

Ahmed et.al. (2006), has shown that besides reform of legal, institutional and policy framework through Financial Sector Reform Program (FSRP) in early 1990s empirical investigation says that bank lending and exchange rate channel have very weak impact on transmission channel of aggregate output and price level. The paper puts this empirical evidence by using the unrestricted vector autoregressions (VARs) approach using quarterly data for the period of July-September 1979 to April-June 2005. This paper also did not evaluate the consequence of changing policy rates on deposit and call money rates of Bangladesh. Further, they did not assess the magnitude and speed of influence of policy changes on lending and exchange rates as well.

Yunus (2006) examines whether monetary policy transmits through bank assets or liabilities or both. The sample period covered in the study is 1976:3 to 2004:1. Quarterly data are employed to see the trend and correlation among the monetary policy (measured by the M2 supply, bank deposits or credit) and other macroeconomic variables e.g., the nominal exchange rate and real GDP growth in Bangladesh. Monetary policy shows close relationship with bank deposits and credit. In other words, by the correlation matrix and trend analysis she shows that both the money channel and the credit channel operate in Bangladesh very well. A major weakness of this paper is that it did not use any econometric model and the intention of the paper was not analysing interest rate dynamics of monetary policy rather the consequences of monetary policy changing in real sector indicators of the economy.

All the paper above suffers from procedural deficiency and coverage of data period and issues focused (speed, magnitude of IRPT etc.). So, our paper contemplates to overcome these lacks. Analysis of IRPT is a hot and voluminous issue among researchers around the world. However, for Bangladesh it is quite nascent. This paper differs from the earlier of them regarding data used, econometric techniques applied and area of issues covered. Therefore, contribution of this paper is filling of existing literature gaps in the concerned field of Bangladesh.

### **Relationships to be Tested**

We are in an attempt to test a set of questions and hypothesis relating to the interests rate pass-through. First of all, whether monetary policy rate transmits to market interest rate i.e. is there any one to one correlation between the policy rate and to the market rates? The second one is that whether changes in policy rates have any influence on banking sector retail rates i.e. on deposit rate and lending rate of the banks? The third type of hypothesis is that the magnitude, speed and symmetrical or asymmetrical nature of the IRPT of the monetary policy in Bangladesh. Therefore, our hypotheses are as follows:

- 1)  $H_0$  : Policy Rates have influence on Money Market Rates (Call Money Rate).
- 2)  $H_0$  : Policy Rates have influence on Bank Retail Rate (Deposit and Lending Rate)
- 3)  $H_0$  : The above two relations are complete, not sluggish and symmetric.

### **Methodology**

Post Keynesian structuralist theory stresses endogeniety of money supply in terms of bank lending channel. This theory specifies that money supply is endogenously determined by demand for commercial banks credit. Therefore, this theory puts emphasis

on evaluation microeconomic behaviour of profit seeking commercial banks and their reaction to changes in credit market conditions. However, two necessary conditions have to be satisfied for bank lending channel to operate. First, bank loans and market finance (commercial paper, bonds etc.) have to be imperfect substitutes. Otherwise, the lack of bank lending would be compensated by firms through issue of securities in financial market. Second, banks have to react to liquidity shortages by cutting down their lending and/or keeping low required reserve to central bank. In other words, if banks react to a restrictive monetary policy simply by issuing additional certificates of deposits the bank lending channel cannot operate (Freixas and Rochet, 2008).

Now, in line with above model assume that banks balance sheet is given by the following equation:

$$\text{Reserve (R)} + \text{Loan (L)} = \text{Deposit (D)} + \text{Paid up Capital (PK)}$$

$$\text{So, } D = R + L - PK$$

Assume that commercial banks provide loans and get deposit at the rate of interests at  $i_l$  and  $i_d$  respectively. Then

$$\text{Net Interest Income} = i_l L - i_d D = i_l L - i_d (R+L-PK)$$

Again, assume that, like a standard, competitive and well functioning financial system, the demand for loans has a downward sloping function for banks and demand for deposits is an upward sloping function. As clearing is conducted through central bank, commercial banks whose balance falls below the required reserves have to pay a liquidity penalty  $i_p$  equivalent to the official policy rate multiplied the difference between required reserves (R) and balance after clearing settlement or actual reserve ( $\tau R$ ) where  $0 < \tau < 1$ . Therefore, total penalty is given as

$\pm i_p (R - \tau R)$ ; here the sign is  $\pm$  as when actual reserve is higher than required level, bank will have gain net interest from the central bank and opposite will be in case of shortfall.

Considering banks loan management marginal costs at the rate of  $\Phi$  (which is a constant in short run)

$$\text{Total loan management cost} = \Phi L$$

So, the profit maximisation function  $\pi(L,R)$  is derived from combining equations above

$$\pi(L,R) = i_l L - i_d (R+L-PK) \pm i_p (R - \tau R) - \Phi L$$

profit maximising commercial banks equate their marginal revenue to marginal cost. Therefore, first order conditions with respect to L and R yields:

$$\delta\pi (L,R)/\delta L= i_l - i_d - \mu = 0; \Rightarrow i_l - i_d = \Phi$$

$$\delta\pi (L,R)/\delta R= i_d \pm i_p\tau = 0; \Rightarrow i_d = \pm i_p\tau$$

Substituting  $i_d$  from the first condition we have  $i_l \pm i_p\tau = \Phi$  which means that

$i_l = \Phi \pm i_p\tau$ ; this is the equation what gives us a basic foundation of the empirical investigation which says that, largely, Lending Rate ( $i_l$ ) is a linear function of central bank policy rate. In other words

$$\text{Lending Rate} \Rightarrow LR = \alpha_1 + \beta_1 PR. \dots\dots\dots(6)$$

The same of impact Policy Rate is supposed to fall on Deposit Rate as well. Therefore, Deposit Rate function can be written as

$$\text{Deposit Rate} \Rightarrow LR = \alpha_2 + \beta_2 PR. \dots\dots\dots(7)$$

Similarly the impact policy rate is believed to fall on call money rate and in that case mathematical function for call money rate should be as follows:

$$\text{Call Money Rate} \Rightarrow CMR = \alpha_3 + \beta_3 PR \dots\dots\dots(8)$$

**Estimation Techniques**

Based on the perception of the existing literature techniques at first we use Least Square Estimation (LSE) method for running regression to determine the long run relationship among dependent variables (deposit, lending and call money rate) and independent variable (WAPR). As monetary policy is short term in nature most of the research papers have used Error Correction Model (ECM) or Vector Error Correction Mechanism (VECM) techniques for estimation purpose and to determine whether any short run relationship is there in the IRPT process. In case of ours' after investigation of the LSE model we have detected violation of the assumptions of the Classical Linear Regression Model (CLRM) techniques which means estimated parameters (i.e. estimated long-run relationship) are spurious and subsequently we have tried to remedying the violations. We have used Generalized Methods of Moments (GMM) techniques where CLRM assumptions are not necessary. By solving assumption problems of CLRM to establish the LSE parameters as the long-run estimator of the IRPT, we have resorted Augmented Dickey-Fuller (ADF) test to determine the presence of unit root for all the individual time series variables. According to the unit root test results we have understood that instead of

ARDL Model, Johansen or Engle-Granger (EG) test can be applied to confirm the co-integration between two variables. After that we have relied on ECM model to investigate the short-run dynamics. And then we have resorted VECM IRF of Choleski S.D. Innovation and Wald coefficient test method to measure the speed and magnitude of the IRPT. Finally, we are also confirmed by LSE of CLRM, Engle-Granger (EG) and ECM method that IRPT in Bangladesh is symmetric.

### Unit Root Test

Before applying OLS we have checked the Stationarity of our time series variables through Phillips-Peron and Augmented Dickey-Fuller Unit Root Tests. The result of the Stationarity of the variables are reported in the following table 01 where figure inside the parentheses are probability of the test statistic:

Variables in Level	PP Test		ADF Test		Decision
	With Intercept	With intercept & Trend	With Intercept	With intercept & Trend	
Weighted Policy Rate (PR)	3.61 (0.01)	3.56 (0.04)	3.48 (0.01)	3.56 (0.04)	No Unit Root
Lending Rate (LR)	2.20 (0.21)	2.40 (0.34)	2.81 (0.06)	3.81 (0.02)	No Unit Root
Deposit Rate (DR)	-3.71 (0.04)	-4.63 (0.01)	-4.05 (0.01)	-5.32 (0.01)	No Unit Root
Call Money Rate (CMR)	-4.30	-4.21	-4.30	4.25	No Unit Root

The result of the unit root tests show that all of the concerned variables are stationary at levels. As all the variables are stationary at levels we decided to apply LS regression method for running regression of our derived models above. So, first and foremost, we have estimated LSE regression by using the following econometric equations:

$$\text{For Lending, } LR = \alpha_1 + \beta_1 PR + u_1 \text{-----(9)}$$

$$\text{For Deposit, } LR = \alpha_2 + \beta_2 PR + u_2 \text{-----(10)}$$

$$\text{For Call Money Rate, } CMR = \alpha_3 + \beta_3 PR + u_3 \text{-----(11)}$$

where  $\alpha_i$  are intercepts,  $\beta_i$  are the estimated parameters and  $u_i$  are the error terms of the lending and deposit channels of the IRPT respectively. The results are summarized in the following table:

**Table 1: Results of the LSE of CLRM**

Dependent Variable: LNLR, LNDR & LNLCMR

Sample: 2003Q1 2015Q4

Included observations: 52

	Lending Rate	Deposit Rate	Call Money Rate
Intercept	2.27	1.59	1.07
t-statistic	49.01	18.13	3.32
(Prob.)	0.00	0.00	0.00
Policy Rate	0.13	0.19	0.56
t-statistic	5.23	4.00	3.17
(Prob.)	0.00	0.00	0.00
R-squared	0.36	0.25	0.17
Adj. R -squared	0.35	0.23	0.15
Durbin -Watson Statistic	0.41	0.25	1.39

The different test applied to confirm the validity of all assumptions of CLRM and our results are positive except autocorrelation and normality of the error terms of above three regression models. The presence of autocorrelation can be traced by the given D-W Statistic ( $< 2.00$ ) as well. By using Correllogram Squared Residuals and Serial Correlation LM (Lagrange Multiplier) Test we confirmed about autocorrelation and by using Histogram Normality Test we could detect positive non-normality in the residuals of the above regression models. Again, for non-normality of the error terms we have performed some econometric tests like Jarque-Bera (J-B) test where Null Hypothesis  $H_0$  : Normal Distribution Error is Present. The results are given summarized in table 2.

**Table:2 Jarque-Bera (J-B) Test :**

	Lending Rate	Deposit Rate	Call Money Rate
Jarque -Bera (J -B) Statistic	0.61	0.18	57.90
Probability	0.74	0.91	0.00

The non-normality of errors for the LNLCMR regression is not considered to have an impact on our analysis because the data is considered to be asymptotic. As Brooks (2008, P 164) points out, for sufficiently large samples, the normality-of-errors assumption is virtually inconsequential based on the central limit theorem. This is reinforced by Gujrati (2007, p. 364) with the additional comment that it is vital to assume fixed exogenous variable values in repeated trials and homoskedasticity (error variance to be constant).

Breusch-Godfrey Serial Correlation LM (Lagrange Multiplier) Test (where Null Hypothesis  $H_0$  : Autocorrelation is Present) result is reported in Table 3. By the result we are confirmed that the above three LSE regressions are suffering from the presence of autocorrelation.

**Table:3 Breusch-Godfrey Serial Correlation LM Test**

Lending Rate			
F-statistic	37.86	Prob. F(2,48)	0.00
Obs*R -squared	31.83	Prob. Chi -Square(2)	0.00
Deposit Rate			
F-statistic	70.46	Prob. F(2,48)	0.00
Obs*R -squared	38.79	Prob. Chi -Square(2)	0.00
Call Money Rate			
F-statistic	3.34	Prob. F(2,48)	0.04
Obs*R -squared	6.35	Prob. Chi -Square(2)	0.04

After detection of the presence of autocorrelation we then depend on GMM estimation where for a large sample violation of CLRM assumption does not capable to hinder getting BLUE statistic. In GMM estimation we have got very small but significant coefficient of LNWPR which means that we have got WPR has long run effect on lending, deposit and call money rate in Bangladesh.

Dependent Variable: LNLR, LNDR & LNCLR

Method: Generalized Method of Moments

Sample: 2003Q1 2015Q4

Included observations: 52

Linear estimation with 1 weight update

Estimation weighting matrix: HAC (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Standard errors & covariance computed using estimation weighting matrix

Instrument specification: LNDR, LNLR and Constant term C respectively

Variable	Lending Rate	Deposit Rate	Call Money Rate
Coefficient of LNWPR	1.40	1.71	1.16
Std. Error	0.05	0.04	0.05
t-Statistic	30.00	30.49	24.45
Prob.	0.00	0.00	0.00
R-squared	-30.10	-5.09	-0.02
Adj. R -squared	-30.10	-5.09	-0.02
Durbin -Watson Statistic	0.71	0.71	1.38

In case of GMM estimation above we have chosen Inverse of Excess Liquidity as instrumental variable as excess liquidity and WPR are inversely related meaning that high excess liquidity lessens WPR and vice versa. Correlation between Inverse of Excess Liquidity and WPR is very strong 0.74 i.e. selection criteria of Instrumental Variable for GMM is satisfied. Again correlation between Three Error Terms series and Inverse of Excess Liquidity are very low which are as follows:

**Table: 03 Correlation of Inverse of Excess Liquidity with Error Term of Equations 09, 10 & 11.**

Correlation of Inverse of Excess Error Term of Liquidity with	Correlation Co-efficients	Prob. of J Statistic
Equation 09	+0.03	0.33
Equation 10	-0.02	0.45
Equation 11	-0.11	0.27

Theoretically, correlation coefficients between Instrumental Variable and Error terms of OLS estimations should be zero but in real case getting zero correlation coefficient is very rare. However, Correlation Co-efficients presented in table 03 are very close to zero means that Orthogonality condition is also satisfied. Probability of the J Statistics are also quite large.

After GMM regression we have relied another type of econometric method (EG test) to check the long run relationship between WPR and our concerned three dependent variables. To perform that test at first we have conducted the ADF test to test for the presence of a unit root in determining the stationarity of each individual series in levels. The results confirm that all the variables are stationary in levels i.e. they are I(0). Result of Unit Root Test is given in table 3.

**Table 03: ADF Test in Level (Null Hypothesis H0: Unit Root)**

Augmented Dickey-Fuller test statistic	t-Statistic	Prob.
LNLR	-2.81*	0.06
LNDR	-3.22**	0.03
LNCMR	-4.30***	0.00
LNWPR	-3.48**	0.01

\*, \*\* and \*\*\* are significant at 10, 5 and 1% level of Significance

Next, the errors ( $u_1$ ,  $u_2$  and  $u_3$ ) generated from equations (1), (2) and (3) are tested separately using the ADF. The results show that all four regression errors are stationary in levels, confirming the combined integration. Table 4 reveals these findings.

**Table 04: ADF Test in Level (Null Hypothesis H0: Unit Root)**

Augmented Dickey-Fuller test statistic	t-Statistic	Prob.
u <sub>1</sub>	-7.09***	0.00
u <sub>2</sub>	-6.15***	0.00
u <sub>3</sub>	-5.00***	0.00

\*, \*\* and \*\*\* are significant at 10, 5 and 1% level of Significance

After confirming unit root for all residual terms at level then the EG test is carried out to confirm the co-integration between the variables of each equation. The first step is to run the CLRM and estimate the error (residual) series u<sub>1</sub>, u<sub>2</sub> and u<sub>3</sub> for the lending, deposit and call money rate channels, respectively. These series have already been estimated in equations (12), (13) and (14). The second step is to run the following auxiliary regressions:

Lending,  $\Delta u_1 = \gamma_1 u_{1t-1} + e_1$  .....(12)

Deposit,  $\Delta u_2 = \gamma_2 u_{2t-1} + e_2$  .....(13)

Call Money Rate,  $\Delta u_3 = \gamma_3 u_{3t-1} + e_3$  .....(14)

Where  $\Delta$  represents the first difference between the error values calculated from equations (12), (13) and (14), the  $\gamma$  terms are the computed t-statistic values calculated using the EG test, and  $e_1$ ,  $e_2$  and  $e_3$  are the residuals from the auxiliary regression of the lending, deposit and call money rate channels, respectively. The results of the second step of the EG test are placed in Table 5.

**Table 5: Results of Engle- Granger (EG) Test**

	Lending Rate	Deposit Rate	Call Money Rate
u	-0.50***	-0.15**	-0.72***
t-statistic	-2.65	-2.44	-5.32
Prob.	0.010	0.02	0.00

\*, \*\* and \*\*\* are significant at 10, 5 and 1% level of Significance

The computed values are negative (as mentioned in the literature) and significant relative to the 1 and 5 percent critical values. The regressions in equations (12), (13) and (14) are, therefore, cointegrated, confirming that the results of LSE too were not spurious. The regression coefficients or  $\beta$  terms estimated from equations (12), (13) and (14) can be considered long-run parameters and, hence, there is equilibrium at least in the long run.

Now we shall turn our eyeballs for short run influence of WPR on these three dependent variables. Having confirmed the co-integration, we apply an ECM to estimate the short-

run parameters, using the following regressions:

$$\text{Lending,} \quad \text{LR} = \mu_1 + \lambda_1 \Delta\text{WPR} + \theta_1 u_{1t-1} + \varepsilon_{1t} \dots \dots \dots (15)$$

$$\text{Deposit,} \quad \text{DR} = \mu_2 + \lambda_2 \Delta\text{WPR} + \theta_2 u_{2t-1} + \varepsilon_{2t} \dots \dots \dots (16)$$

$$\text{Deposit,} \quad \text{CMR} = \mu_3 + \lambda_3 \Delta\text{WPR} + \theta_3 u_{3t-1} + \varepsilon_{3t} \dots \dots \dots (17)$$

where  $\Delta$  represents the first difference between the current and lagged values of LR, DR and CMR; the  $\lambda$  terms are the slope coefficients;  $\varepsilon_{1t}$ ,  $\varepsilon_{2t}$  and  $\varepsilon_{3t}$  are the first-lag error values estimated from equations (12), (13) and (14), respectively; and  $\varepsilon_{1t}$ ,  $\varepsilon_{2t}$  and  $\varepsilon_{3t}$  are the residuals from equations (15), (16) and (17) respectively. Table 6 gives the empirical parameters of the ECM.

**Table 6: Results of ECM Models**

	Lending Rate	Deposit Rate	Call Money Rate
Intercept	2.51	1.93	2.07
t-statistic	371.62	224.67	78.11
(Prob.)	0.00	0.00	0.00
Weighted Policy Rate	0.04*	0.05*	0.16*
t-statistic	1.80	1.79	1.80
(Prob.)	0.08	0.08	0.08
ut-1	1.04***	1.11***	1.02***
t-statistic	8.81	13.58	15.50
(Prob.)	0.00	0.00	0.00
R-squared	0.62	0.79	0.83
Adj. R-squared	0.60	0.79	0.83
Durbin-Watson Statistic	0.56	0.54	0.55

\* & \*\*\* indicate significant at 10 & 1% level of Significance respectively

The above findings reveal that the errors are significant even at a 1 percent level of significance, thus reconfirming the use of the estimated  $\Delta\text{WPR}$  parameters as short-term pass-through estimates. The findings indicate the impact on the endogenous variables in the short-run based on a 1 percent increase in the weighted policy rate proxy or policy shock.

To confirm whether there is a complete pass-through in market retail rates due to a policy shock in the long-run, the estimated parameters ( $\beta$  terms) of market lending and deposit rates from equations (12), (13) and (14), respectively, are tested using the Wald coefficients test (Table 7).

**Table 7: Wald test where Null Hypothesis  $H_0: \beta_i = 1$  and  $i=1,2 \& 3$** 

	Test Statistic	Value	df	Probability
Lending Rate	t-statistic	34.30	50	0.00
	F-statistic	1176.33	(1, 50)	0.00
	Chi-square	1176.33	1	0.00
Deposit Rate	t-statistic	16.85	50	0.00
	F-statistic	283.81	(1, 50)	0.00
	Chi-square	283.81	1	0.00
Call Money Rate	t-statistic	2.48	50	0.02
	F-statistic	6.13	(1, 50)	0.02
	Chi-square	6.13	1	0.01

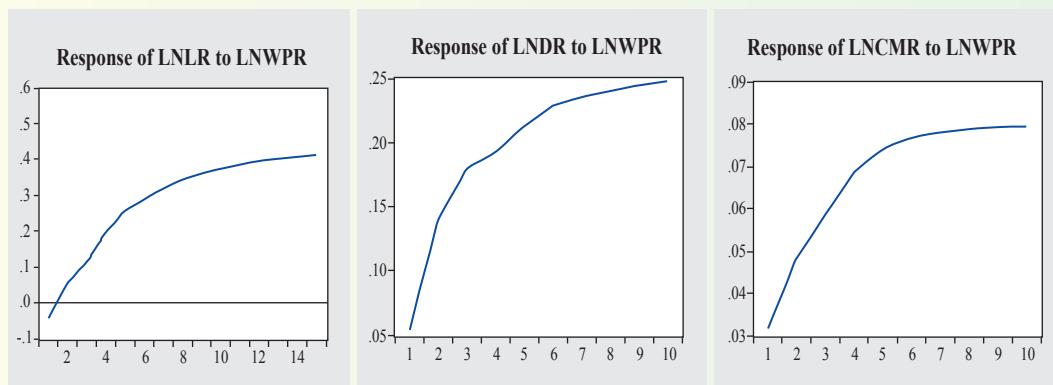
The Wald coefficient test's null hypothesis implies interest rate pass-through ( $H_0: \beta=1$ ) to market retail rates in the long run. The results reveal that the estimated parameters in table 1 are not any of them equal to 1. Hence, complete pass-through from a policy shock to Bangladesh's financial system in the long run does not hold among for the lending, deposit and call money rate channels, as indicated by the probability values in Table 7. We, therefore, we can reject the null hypothesis of complete pass-through to market retail rates. This result is also supported by the correlation matrix (table 8) analysis. Cross correlations are good indicators to measure the degree of pass-through between contemporaneous data (Amarasekera, 2009). The correlation matrix given bellow shows that both deposit and lending rate has from moderate to high correlation with WP Rate. It is also worth to mention that lending and repo rates are close correlated with deposit and reverse repo rates respectively. It is very obvious because the deposit rate is expected has an effect on lending rate, as deposit rate makes up a part of bank's cost of funds.

**Table 8: Correlation Matrix Among Retail and Policy Rates in Bangladesh**

	Lending Rate	Call Money Rate	Deposit Rate	REPO Rate	Rev. REPO Rate	Bank Rate	WP Rate
Lending Rate	1.00						
Call Money Rate	0.06	1.00					
Deposit Rate	0.91	0.02	1.00				
REPO Rate	0.34	0.08	0.24	1.00			
Rev. REPO Rate	0.49	0.08	0.48	0.86	1.00		
Bank Rate	0.17	-0.11	-0.18	0.17	-0.11	1.00	
WP Rate	0.65	0.22	0.54	0.51	0.41	0.46	1.00

Finally, we use the VECM Impulse Response Function (IRF) to determine the speed of the short-run pass-through. Figure 1 shows its estimated duration and the variations in the endogenous variables due to a weighted policy rate shock of 100 bps (1 percent).

**Figure 1: Response to Choleski one S.D. Innovations**



We were in attempt to measure short run speed of the IRPT by Choleski one SD Innovation method. We have got that, on average, a 100 bps increase in the WPR leads to a 40 bps (approx) increase in the incremental LNLN over more than 12 quarters, which is thereafter consolidated at this level almost after 3 year (approx). A 100 bps policy shock leads, on average, to a 25 bps (approx) increase in the LNDR over 8 quarters (approx) means 2 years are needed for full affect come into validation. Finally, A 100 bps policy shock leads, on average, to a 8 bps (approx) increase in the LNCMR over 6 (approx) quarters i.e 1.5 years needs to impact come.

### **Inference and Decision**

In Bangladesh monetary policy is formulated in June/July during inception of the fiscal year (FY) and if necessary is revised in January. Usually it is devised keeping coherence with fiscal stance so that inflation and output growth rates - the basic policy targets- are achieved. The stance of monetary policy is revealed through rule based monetary aggregates targets such as RM, M2 and domestic credit (both credit to private sector (CPS) and NCTG) which are projected, monitored and controlled to achieve desired real sector targets of the economy. Such program growth targets and actual growth performance (year on year) for last few years are shown in the following table 9.

**Table 9: Program and Actual levels of some key monetary indicators of Bangladesh for 2004-16.**

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NFA	Actual	16.3	14.2	7.8	49.4	15.1	27.2	34.6	6.2	7.8	50.1	38.6	21.3	21.7
	Prog.	13.0	10.0	15.7	12.5	25.5	14.1	27.9	4.2	-1.6	0.9	14.0	16.8	11.1
NDA	Actual	13.4	17.1	19.7	12.5	18.1	17.8	15.8	24.7	19.2	11.1	10.1	9.9	11.6
	Prog.	11.8	14.8	15.2	15.9	10.5	18.1	13.1	17.6	22.1	19.0	18.4	16.4	16.2
RM	Actual	7.6	13.0	28.1	17.7	20.6	31.9	17.1	21.1	9.0	15.0	15.4	14.3	20.9
	Prog.	8.5	11.0	11.5	12.5	12.0	17.2	7.0	13.0	16.0	13.8	16.1	15.9	14.3
DC	Actual	11.9	17.5	20.5	19.9	21.8	15.9	18.4	27.5	19.2	10.9	11.6	10.1	13.2
	Prog.	11.4	15.0	17.0	15.5	13.4	20.4	15.6	17.9	20.0	18.6	18.9	17.4	15.5
NCTG	Actual	7.8	17.2	27.0	14.4	11.8	23.2	9.4	34.6	17.4	11.1	8.8	-2.5	-2.4
	Prog.	17.7	17.7	26.5	21.7	16.5	27.3	13.8	25.3	28.1	20.8	20.3	24.8	18.7
CPS	Actual	10.3	17.0	18.3	15.1	24.9	14.6	21.1	25.8	19.7	10.8	12.3	13.2	16.4
	Prog.	12.0	14.8	14.5	14.4	15.4	18.5	16.7	16.0	18.0	18.0	18.5	15.5	14.8
M2	Actual	13.8	16.8	19.5	17.0	17.6	19.2	18.8	21.4	17.4	16.7	16.1	12.4	14.0
	Prog.	11.9	14.2	14.3	15.5	15.0	17.5	15.5	15.2	18.5	16.5	17.7	16.5	15.0

According to the desired targets BB tries to inject high powered money and credits to the economy which are nominally anchored at the initial stage of the FY. However, keeping all variables always within target levels can't be kept because of autonomous nature of some indicators (such as NFA, NCTG etc.). By this tactic of monetary policy it is clear that interest rate is not an adopted and espoused policy by BB.

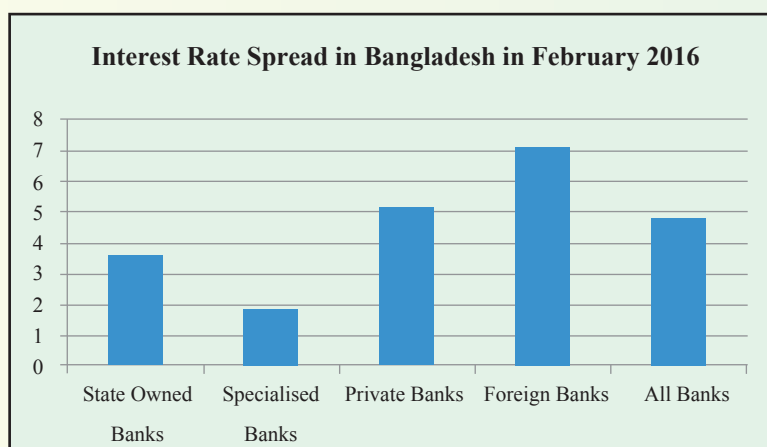
In the above backdrop where interest rate channel is not a handy and useful arm for BB. The empirical importance IRPT research has very little use value. However, among various channel we are in attempt in this research to examine just the accuracy of interest rate pass-through in case of Bangladesh. We have focused here only about the efficacy, magnitude and speed of IRPT channel of monetary policy in Bangladesh.

We have found evidence that, the speed of pass-through in the short run for the LR, DR and CMR is very low, incomplete and sluggish which is reinforced by the ECM's short-run parameter for the LR, DR and CMR as well. Further, BB intention for repo, reverse repo, liquidity support, special repo, T-Bills and T-Bond operation is only to manipulate that call money rate of the money market. So, clearly DR and LR is out in focus of the BB's interest rate policies though occasionally it apply practice of moral suasion to keep interest rates in a reasonable position.

Moreover, in economies where fiscal indiscipline is high and gradual accumulation non-performing loan is paramount, as in Bangladesh's case, the pass-through for lending rates is incomplete mainly because banks are unable to cut down lending rate as per central

bank policy signal. In every econometric tests above coefficients related to deposit rate is higher than coefficient of lending rate which means banks are adjusting the deposit rates more quickly than central bank policy rates than lending rate. Additionally, the spread of the banking sector stands at high levels ( about 5 percent) between the LR and DR, again indicating the inefficiency, low degree of competition and also lack of regulatory efficiency in Bangladesh's banking sector.

**Figure 6: The IRS in State-owned & Specialized, Private and Foreign banks in Bangladesh in Feb. 2016**



**Source:** Statistics Department of Bangladesh Bank

In addition to the above, due to the injection of funds intermittently by government to state-owned banks (Particularly for Sonali, BASIC, Bangladesh Krishi Bank and Rajshahi Krishi Unnoyan Bank (RAKUB) the banking industry has been experienced several state sponsored market distortions. This has resulted in lower competition within the banking system and has induced banks not to pass on the increase in policy rate to their deposit and lending rates.

Further, at the same time, central bank is offering different refinance scheme for entrepreneurs ( i.e. SME, EEF, Agricultural loan etc.) with mandatory low rates which is another market distortion that hinders interest rate signals in the market.

The above may be the possible reasons for the incomplete and low profile pass-through in the lending and deposit channels.

## Conclusion

A well-functioning financial sector is of course essential for an effective transmission of monetary policy. Such transmission is achieved through various channels or mechanisms.

The same channel is not equally effective in all countries or at all times. As analysis of all channels is a gigantic job we here evaluated only one channel - interest rate channel. It is very obvious that influence of policy rates will be quickly reflected in bank retail rates to eventually influence the aggregate demand and inflation scenario of the economy. Only then applying of monetary policy will be able to offset turmoil arises for different shocks in the economy i.e. a good knowledge on the transmission mechanisms is essential for successfully conducting monetary policy in the future. As Mishkin (1995) said, "Monetary policy is a powerful tool, but one that sometimes has unexpected or unwanted consequences. To be successful in conducting monetary policy, the monetary authorities must have an accurate assessment of the timing and effect of their policies on the economy, thus requiring an understanding of the mechanisms through which monetary policy affects the economy". So, we need to know cogency of the pursuing monetary policy. We believe that the bank lending or deposit channel i.e. credit channel to be the most important transmission mechanism of monetary policy, especially in a developing country like Bangladesh. In light of above importance of credit channel of monetary policy we have tried to examine effectiveness of monetary policy through analysing IRPT in Bangladesh.

Our analysis says that the interest rate pass-through from a policy shock to the market lending, deposit and money market rates is significant both in short and long run albeit incomplete and very tiny in Bangladesh, even in the long run. The empirical evidence is that changes in the policy rate have a significant but very little reaction or impact on the lending, deposit and market rates. Although the pass-through on the lending rate channel is reasonably higher (40 percent) than on the deposit and market rate, it remains inconsequential particularly for money market channel. The speed of IRPT in Bangladesh is also very slow and sluggish (14 quarters for lending rate) in all lending, deposit and money market channels. The overall paled facet of IRPT in Bangladesh may be due to the inefficiency of the financial market and the non-reliance of BB on interest rate measures for conducting and implementation of its monetary policy. The lower pass-through to the lending and deposit channel lead to a higher interest rate spread for the country's banking industry and policy rate has almost no influence on real sector of the economy. It also means that interest rate tool is no longer effective for stabilising the fluctuation of the business cycle of the economy. This may degraded the effectiveness of the monetary policy stance and ultimately lead to lower banking competition. Further, credit channeling to thirsty sectors of the economy by using interest rate elasticity is also not possible in such circumstances. So, the low interest rate pass-through is a clear challenge for monetary policy implementation and it may be responsible for the higher the risk premium of financial intermediaries as well. Finally, policy rates are not the sole source of ramifications for Call Money, Lending and Deposit rates. A large number of macro and microeconomic variables can have influence on these rates which are not considered in this paper.

**Appendix 1:**

**RM, BM, MM and V of Bangladesh Economy**

Taka in Crore

Year	NDA	NFA	RM	Balances of scheduled banks with BB	CIC	Time Deposit (TD)	Demand Deposit(DD)	BM= CIC+TD+DD	mm=BM/RM	V= PY/M2
	1	2	1+2+4=3	4	5	6	7	5+6+7=8	mm= 8/3	
1989-90	5190.3	1025.5	6215.8	2265.0	3860.5	17800.7	3591.9	21114.4	3.4	4.5
1990-91	5363.5	1137.2	6500.7	2150.8	4235.7	20268.7	4184.6	25004.4	3.8	4.4
1991-92	3435.5	3386.6	6822.1	3925.8	4671.3	22473	4582.5	28525.9	4.2	4.2
1992-93	3281.9	5662.9	8944.8	5200.4	5019.0	25235.9	5751.1	31535.6	3.5	4.0
1993-94	3057.1	8250.8	11307.9	3441.5	6107.5	29088.5	6614.3	36403.0	3.2	3.7
1994-95	1765.9	8864.1	10630.0	3103.7	7188.5	31300.6	7336.1	42267.9	4.0	3.6
1995-96	5614.3	5388.7	11003.0	3939.8	7899.3	35544.0	7735.2	45690.5	4.2	3.6
1996-97	7382.4	5012.1	12394.5	3017.8	8454.7	41699.3	8928.2	50627.5	4.1	3.6
1997-98	8312.5	5305.1	13617.6	3655.9	9076.6	46812.2	9056.9	55869.1	4.1	3.6
1998-99	10125.5	4617.2	14742.7	3812.5	9713.5	53095.4	9931.7	63027.1	4.3	3.5
1999-00	11398.0	5666.1	17064.1	4183.4	11264.4	63528.0	11234.4	74762.4	4.4	3.2
2000-01	14115.0	4812.4	18927.4	3385.7	12832.8	74656.9	12517.3	87174.2	4.6	2.9
2001-02	13342.6	7230.4	20573.0	6692.8	13880.2	85302.6	13313.4	98616.0	4.8	2.8
2002-03	9631.8	11809.7	21441.5	6099.2	15342.3	99382.9	14611.6	113994.5	5.3	2.6
2003-04	10328.1	13542.3	23870.4	6583.0	17287.4	113076.8	16644.4	129721.2	5.4	2.6
2004-05	12722.2	14678.2	27400.4	7072.5	20327.9	132243.9	19202.5	151446.4	5.5	2.5
2005-06	15314.4	18640.3	33954.7	9060.6	24894.1	158067.8	22606.5	180674.3	5.3	2.3
2006-07	10664.3	28758.4	39422.7	10635.3	28787.4	184651.3	26853.1	211504.4	5.4	2.2
2007-08	14748.3	32813.8	47562.1	11913.6	35648.5	218250.8	30544.0	248794.8	5.2	2.2
2008-09	19521.9	43227.5	62749.4	23300.7	39448.7	262059.5	34440.2	296499.7	4.7	2.1
2009-10	12961.8	61181.0	74142.8	23677.4	50465.4	315315.1	47716.1	363031.2	4.9	1.9
2010-11	28392.3	61342.1	89734.4	29207.5	60526.9	385551.4	54968.5	440519.9	4.9	1.8
2011-12	28872.6	68930.1	97802.7	32906.2	64896.5	459515.6	57593.9	517109.5	5.3	1.8
2012-13	9243.4	103246.0	112489.4	37117.1	75372.3	540707.1	62798.5	603505.6	5.4	2.0
2013-14	-17621.3	147496.6	129875.3	44390.1	85485.2	628299.6	72323.9	700623.5	5.4	1.9
2014-15	-28918.8	177401.3	148482.5	50328.6	98153.9	706075.5	81538.6	787614.1	5.3	1.9

## Appendix 2

### NDA and its components of Bangladesh bank

Year	Components of NDA					NDA
	GNB	CONFP	Pvt.	CDMB	Others (Net)	
	1	2	3	4	5	1+...+4 = 6
1989-90	1489.2	870.5	0	4109.4	-1085.6	6468.7
1990-91	1677.7	932.6	0	3939	-1185.8	5363.5
1991-92	1196.9	902.6	0	3373	-2037	3435.5
1992-93	1447.8	882.6	0	2897.2	-1945.7	3281.9
1993-94	1009.6	1635.9	0	2576.7	-2073.4	3148.8
1994-95	1254.0	1056.8	15.7	2733.8	-3202.7	1857.6
1995-96	3036.8	1195.5	15.7	3413.7	-1955.7	5706.0
1996-97	4488.9	1192.6	15.7	3600.3	-1823.4	7474.1
1997-98	5295.5	1404.8	15.7	3749.4	-2152.9	8312.5
1998-99	6359.9	1365.6	808.4	4622.8	-3031.2	10125.5
1999-00	8098.0	1320.7	900.4	4289.2	-3210.3	11398.0
2000-01	10107.3	1305.1	987.5	4368.6	-2653.5	14115.0
2001-02	12834.3	1277.6	1008.1	4729.3	-6506.7	13342.6
2002-03	7353.3	1281.9	1141.7	4846.8	-4991.9	9631.8
2003-04	11847.6	1241.1	1241.3	5852.1	-9854	10328.1
2004-05	15674.3	1105.6	1341.4	6132.5	-11531.6	12722.2
2005-06	25026.1	1016	1429.9	6346.3	-18503.9	15314.4
2006-07	25931.1	988	1576.1	6442.1	-24273	10664.3
2007-08	25997.3	946.4	1696.8	7334.2	-21226.4	14748.3
2008-09	28955.4	853.1	2022.1	6846.8	-19155.5	19521.9
2009-10	22320.6	830.7	2588.7	6613.9	-19392.1	12961.8
2010-11	32049.7	776.7	3143.7	18608.8	-26186.6	28392.3
2011-12	38044.0	1181.9	3598.7	22627.4	-36579.4	28872.6
2012-13	27069.0	1354.5	4180.2	10219	-33579.3	9243.4
2013-14	3840.6	1202.7	4272.7	6279.2	-33216.5	-17621.3
2014-15	810.5	2160.8	4645.6	5659.2	-42194.9	-28918.8

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