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Causal Relationship between Lending Rate and Deposit Rate in Bangladesh: An Econometric Analysis

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Abstract: *This study attempts to examine the causal relationship between lending rate and deposit rate in Bangladesh for the period of 2003:07 to 2015:06. After collecting monthly data of lending rate and deposit rate, the study employed Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests for testing the stationarity of the series, Johansen Cointegration test to visualize the long run relationship between the two variables, Granger causality test to investigate the existence and direction of causality between the variables and impulse response function on a structured Vector Autoregressive (VAR) model to know the reaction of one variable to an impulse in other. The results of the unit root tests show that the series are non-stationary at level form but after differentiating they become stationary. Cointegration test shows the absence of long run equilibrium relationships between the two variables. The Granger causality test provides evidence that there is a unidirectional causality running from lending rate to deposit rate but not the way round. And the impulse response function shows significant reaction of variables due to one standard deviation shock to the error terms of the VAR model.*

Keywords: *Cointegration, Deposit rate, Granger causality, Lending rate, Bangladesh.*

I. Introduction

Lending rate means the cost of borrowing for the peoples who take loan from the banks and deposit rate is the reward or gain for the depositors for lending money. Both rates are determined by banks. Low interest rates attract more people to borrowing and spending more. Individuals take out loans to purchase automobiles, houses and so on. While corporations issue more bonds and use the profits to expand. However, when interest rates rise, people tend to save more and spend less. The cycle of raising expenditure when interest rates are low and reducing expenditure when interest rates are high warrant interest rates volatility to cause instability in output. Interest rates volatility implies higher risk which then translates into a higher risk premium on long-term bonds. Risk hardens financial decisions, lowers productivity and makes the economy less efficient. Thus, central banks are in the position to control risk by controlling short-term interest rates to stabilize the economy. These events are critical to the monetary policy transmission process. However, firms' and households' behaviors are more related to retail interest rates rather than the policy short-term interest rate [1]. It indicates that commercial banks have a crucial role in the monetary transmission mechanism by setting deposit and lending rates which are vital for lenders and borrowers. Some empirical investigations have found that in certain countries when policy interest rates are rising, retail lending rates respond quickly but deposit rates remain sluggish, while the opposite holds when policy interest rates are declining [2].

In the context of Bangladesh there seem to be a dilemma regarding the responses to rising policy interest rates as shown by Fig. 1 below. In comparing the lending rate against the deposit rate, the two variables move in the same direction for the entire period. Sometime banks manipulate them for their own gains. The lending-deposit margin would be widening as the horizon increases. The earlier case seems to suggest that Bangladesh Bank has a symmetric control and effect on deposit and lending rates to keep their spread within a certain margin. Hence, a long-run relationship between deposit and lending rates in Bangladesh is expected. These trends seem to suggest some kind of special relationship between the two macroeconomic rates. Hence, an empirical verification of the kind of relationship that holds between these two rates is necessary.

Nguyen, et al. [3] studied the relationship between the lending rate and the deposit rate in Bangladesh. The study utilizes monthly data for the period 1997:02 to 2010:02 focusing mostly on the post-reform period. An asymmetric error-correction model was estimated to examine short-run and long-run dynamics. The results reveal that the lending rate and the deposit rate affect the movement of each other. The results further suggest that the lending rate adjusts to the long-run equilibrium faster when a shock narrows compared to when it widens the basis. On the contrary, the deposit rate only responds when the basis is widening but not when it is narrowing. Sheefeni [4] analyzed the relationship between deposit interest rates and lending interest rates in Namibia. Using monthly data for the period 1992:01- 2012:12, the study employed time series techniques, namely unit root tests and the cointegration and Granger Causality. The study shows that there is no cointegration among the variables, implying that the long-run relationship between the deposit interest rate and

lending interest rate is nonexistent. This also suggests that Bank of Namibia does not have symmetric control on two variables and there is no linear relationship between them.

Eita [5] investigated the determinants of the interest rate spread in Namibia for the period 1996-2010 using cointegrated vector autoregression (VAR) or multivariate cointegration methods. The investigation reveals that the interest rate spread in Namibia is determined by Treasury bill rate, inflation rate, the size of the economy, financial deepening, bank rate or discount rate and exchange rate volatility. Treasury bill rate, inflation rate and bank rate are associated with an increase in interest rate spread. The size of the economy and financial deepening are associated with a decrease in interest rate spread. Afroze [6] gave an overall idea on the Interest Rate Spread (IRS) of the Commercial Banks in Bangladesh perspective. Based on the empirical yearly data for the period 1974-2011 and found statistically significant correlation between IRS and deposit rate but no correlation with the lending rate. The data series for IRS, deposit rate, and lending rate contained a unit root and were integrated of order one. However, the Granger causality test failed to indicate any bilateral causal relationship between IRS and deposit rate, IRS and lending rate, and also to deposit rate and lending rate. She also found that IRS prevailing in the Bangladeshi banking sector was high compared to that in its neighboring country.

Nguyen [7] examined asymmetric responses of commercial banks to monetary policy in a transitional economy in case of Vietnam. This study used monthly data on the State Bank of Vietnam discount rate to capture the Central Bank countercyclical monetary policy measures and the commercial bank lending rates over the period of 1996:01 to 2011:06. The empirical estimation of the TAR-VEC model reveals a bidirectional Granger-causality from the Central Bank discount rate to the commercial bank lending rate in the short run. Nguyen, et al. [8] documented asymmetries in the Taiwanese consumer loan-deposit rate spread (consumer loan premium). This study uses 1- month deposit rates and consumer loan rates over the period 1997:01 to 2013:04. Empirical results revealed that the consumer loan premium adjusts to the threshold faster when the deposit rates fall relative to the lending rates than when the deposit rates move in the opposite direction. This competitive rate setting behavior is consistent within the observed Taiwanese lending institutions, operating in a deregulated and liberated, competitive market over the post Asian financial crisis of 1997. Empirical results also revealed Granger causality from the deposit rate to the consumer loan rate indicating that the consumer loan rate is influenced by the 1-month deposit rate. This finding suggests that the Taiwan countercyclical monetary policy does matter in the short run.

Kalumbu and Nyambe [9] purposed to answer the question of whether or not there exist a causal relationship between the lending interest rate and credit volume available to households in Namibia. Analytical methods of unit root, Johansen cointegration, Granger-causality and the impulse response function were all used for estimation. The study period is the year 2000 to 2012 using panel data. Lending rate and credit stock available proved to be significant but with an inexistence of a long-run relationship between them. There is a one directional causal relationship between lending interest rate and credit available to households in Namibia which runs from credit availability to lending interest rate. They also found a positive relationship between credit availability and lending interest rate in Namibia, lending rate should be sustained at a slightly higher level in order for the economy to keep prices stable.

Ndung'u and Ngugi [10] found that high interest rate spread that exists in Bangladesh's banking sector is largely the outcome of inefficiencies and lack of competition in the banking system and, hence, ensuring a rational lending-deposit rate spread requires effective measures to address these weaknesses. They also opined that the scope of lowering lending-deposit rate spread through reducing the deposit rate is likely to be counterproductive as the deposit rate is low in real terms. Ahmed and Islam [11] found that spread in the banking sector has been persistently high over the years, which basically indicates the high cost of intermediation in the banking industry of Bangladesh. Mujeri and Islam [12] showed high IRS exists in Bangladeshi banking sector, the deposit rate is low in real terms, and hence scope of lowering IRS by reducing the deposit rate is likely to be counterproductive.

These literatures revealed that different researchers used different methodologies and techniques to conduct their researches. One group follows a traditional approach where it is assumed that the spread variables, such as the lending-deposit spread, are linear and symmetric. Hence, the variables used in such studies have tended to be linear. Under that assumption the usual techniques of causality and error correction can be used. The other group assumes that the variables are non-linear and the adjustment process is asymmetric. Hence, with this assumption, other techniques such as threshold vector autoregression or threshold vector error correction were applied. It is important at this stage to point out that results that do not conform to a particular group do not necessarily imply that the methodology used is wrong. Experience has taught us that different techniques are bound to produce different results at times. In the case of Bangladesh, the literature on the relationship between the lending rate and the deposit rate is very limited. The studies that come close to this topic is that by Afroze (2013) who gave an overall idea on the Interest Rate Spread (IRS) of the Commercial Banks in Bangladesh perspective by using yearly data and Nguyen, et al. (2010) studied the relationship

between the lending rate and the deposit rate in Bangladesh by utilizing monthly data for the period 1997:02 to 2010:02 focusing mostly on the post-reform period. From the experience of these research we are also motivated to conduct a research to examine the relationship between lending rate and deposit rate by using very recent data.

II. Data and Model Specification

2.1 Data

The study uses monthly time series data covering the period of 2003:07 to 2015:06. The data are taken from different publications of Bangladesh Bank [13] [14] [15] [16] [17] [18] [19], the central bank of Bangladesh. The graphical representation of data is given in Fig. 1.

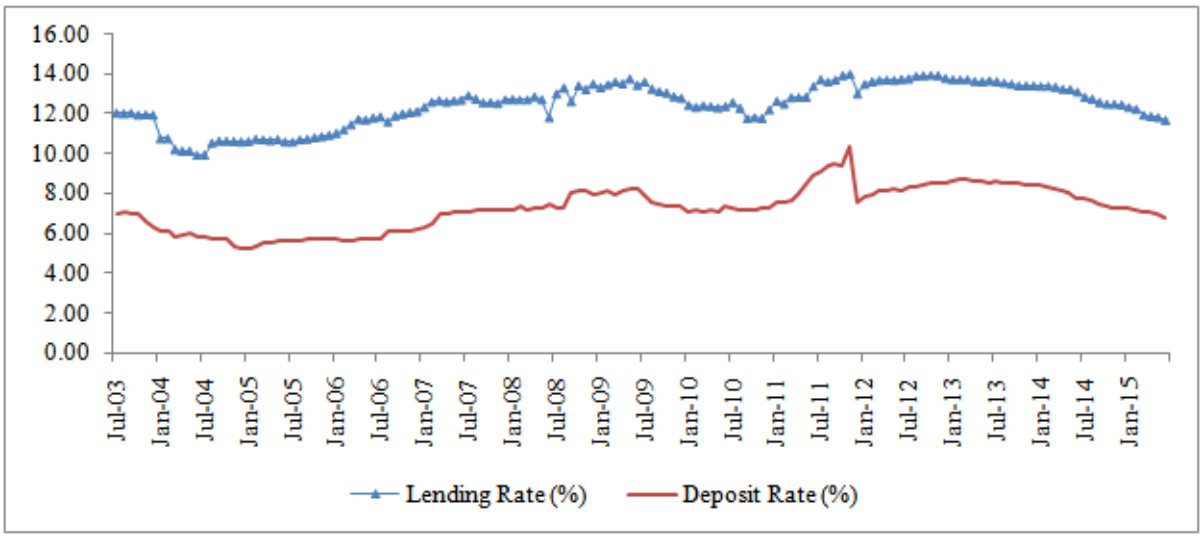

Figure 1: Lending rate and deposit rate in Bangladesh (2003:07 to 2015:06). Source: Bangladesh Bank.

2.2 Model Specification

The analysis process of this study follows four stages. These are as follows:

2.2.1 Stationarity Test

A time series is called stationary if its mean and variance remain constant over time, otherwise the series is said to be non-stationary. A non-stationary time series is not used in econometric analysis because it generates spurious regressions. To test the stationarity of the series, the Augmented Dickey-Fuller (ADF) [20] and the Phillips-Perron (PP) [21] unit root tests are applied based on the following three autoregressive forms:

Without intercept and trend:

$$\Delta LR_t = \delta LR_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta LR_{t-i} + u_t$$

$$\Delta DR_t = \delta DR_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta DR_{t-i} + u_t \quad (1)$$

With intercept:

$$\Delta LR_t = \alpha + \delta LR_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta LR_{t-i} + u_t$$

$$\Delta DR_t = \alpha + \delta DR_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta DR_{t-i} + u_t \quad (2)$$

With intercept and trend:

$$\Delta LR_t = \alpha + \beta T + \delta LR_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta LR_{t-i} + u_t$$

$$\Delta DR_t = \alpha + \beta T + \delta DR_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta DR_{t-i} + u_t \quad (3)$$

Where *LR* stands for lending rate, *DR* stands for deposit rate, Δ is the first difference operator, *t* is time, all Greek letters $(\alpha, \beta, \delta, \gamma)$ are parameters to be estimated and u_t is error term. In addition, the study used KPSS test to cross check the stationarity of the series.

2.2.2 Cointegration Test

If the variables under study are non stationary at level and become stationary at same order (cointegrated in same order) then Johansen Cointegration test can be applied to examine long run relationship

between the variables. Johansen [22] Cointegration technique uses two rank tests namely the Trace test and the Maximum Eigenvalue test. The Trace statistic examines the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of *n* cointegrating vectors based on the following equation:

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (4)$$

Where Maximum Eigenvalue statistic investigates the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of *r+1* cointegrating vectors and follows the equation below:

$$J_{max} = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (5)$$

In both equations, *T* is the sample size, *n* means number of variables, $\hat{\lambda}_i$ means the i^{th} largest canonical correlations and *r* = 0, 1, 2, 3 ..... (n-1).

2.2.3 Granger Causality Test

In autoregressive modeling, the use of lag value of dependent variable raises the issue of causality in economic variables. Based on the Granger [23] equations of two variables' causality, the following two equations can be developed to test the causality of variables under study:

(i) $\Delta LR_t = \sum_{i=1}^{n} \alpha_i DR_{t-i} + \sum_{i=1}^{n} \beta_i LR_{t-i} + u_{1t}$ (6)

(ii) $\Delta DR_t = \sum_{i=1}^{n} \lambda_i LR_{t-i} + \sum_{i=1}^{n} \delta_i DR_{t-i} + u_{2t}$ (7)

In equations 6 and 7, the disturbances u_{1t} and u_{2t} are assumed to be uncorrelated. If the calculated value of F exceeds the critical value of chosen level of significance, one can reject the null hypothesis of no Granger cause.

2.2.4 Impulse Response Function

Impulse response function identifies the responsiveness of the dependent variables (endogenous variables) in the Vector Autoregressive (VAR) when a shock is given to the error term. In other words, it traces out the response of current and future values of each of the variables to a one-unit standard deviation increase in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The implied experiment of changing one error while holding the others constant makes most sense when the errors are uncorrelated across equations. The reduced form of VAR which is used in estimating impulse response function is following:

$$y_t = \sum_{j=1}^{j} A_j y_{t-j} + u_t \quad (8)$$

Where y_t represents lending rate or deposit rate, A_j is a *2×2* matrix because there are only two variables under consideration and u_t is the error term where we put shock.

III. Empirical Analysis, Results and Discussion

3.1 Unit Root Test Results

The variables under study are tested based on the above three forms of equations with the help of EViews (Econometric Views), a statistical software developed by Quantitative Micro Software (QMS). For ADF test the critical values are taken from MacKinnon (1996) one-sided p-values. The maximum lag length is automatically selected by the method based on Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) both gave similar results. In Phillips- Perron (PP) test, the bandwidth is automatically selected by Newey-West using Bartlett kernel. The results of unit root tests are given below.

Table 1 represents that at level form there is a unit root, which means data are non-stationary. As the variables have a unit root in the level form so a unit root test for first difference should be employed. After the first difference, both LR and DR became stationary. KPSS is added as confirmatory test due to the fact that the ADF and the PP have limitations of low power.

Table 1: Results of Unit Root Tests- ADF and PP in Levels and in First Differences

Variables	Equation Includes	ADF		PP	
		Level	First Difference	Level	First Difference
Lending Rate	None	-0.236663	-13.57494**	-0.236238	-13.46452**
	Intercept	-1.399777	-13.52788**	-1.440260	-13.42220**
	Intercept and trend	-0.965369	-13.52702**	-1.440526	-13.42220**
Deposit Rate	None	-0.268348	-14.72680**	-0.256263	-14.59988**
	Intercept	-1.306955	-14.67475**	-1.503244	-14.67475**
	Intercept and trend	-1.578588	-14.63468**	-1.956912	-14.63468**

Source: Authors' compilation using EViews. **means the rejection of null hypothesis at 5%.

The result of KPSS test also confirmed that the data are non stationary at level but stationary at first difference which are furnished below in Table 2. It is used to cross check the stationarity of the data. The critical values are taken from Kwiatkowski-Phillips-Schmidt-Shin [24].

Table 2: Results of KPSS Test in Levels and in First Differences

Variables	Model Specification	Kwiatkowski-Phillips-Schmidt-Shin (KPSS)		
		Level	5% critical value*	First Difference
Lending Rate	Intercept	0.834946**	0.463000	0.180839
	Intercept and trend	0.193121**	0.146000	0.127134
Deposit Rate	Intercept	0.952045**	0.463000	0.139060
	Intercept and trend	0.168534**	0.146000	0.116824

Source: Authors' compilation using EViews. **means the rejection of null hypothesis at 5%.
*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

3.2 Cointegration Test Results

As the variables under study are non-stationary at level but they become stationary at first difference so we can apply Johansen Cointegration test to find out whether any long run relationship exists between the variables or not. The test followed both the Trace and Maximum Eigenvalue estimators. The critical values are taken from MacKinnon et al. [25]. Table 3 and 4 represent that both Trace and Maximum Eigen value indicate no cointegrating equation at 5% level. So there is no long run equilibrium relationship exists between the variables (LR and DR).

Table 3: Results of Johansen Unrestricted Cointegration Rank Test (Trace)

Type of trend	Lags Interval (in first differences)	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
Linear deterministic trend	1 to 4	None	0.067575	12.21244	15.49471	0.1470
		At most 1	0.017734	2.487161	3.841466	0.1148

Table 4: Results of Johansen Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Type of trend	Lags Interval (in first differences)	Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
Linear deterministic trend	1 to 4	None	0.067575	9.725278	14.26460	0.2306
		At most 1	0.017734	2.487161	3.841466	0.1148

Source: Authors' compilation using EViews, * denotes rejection of the hypothesis at the 0.05 level.
Both Trace and Max-eigenvalue indicate no cointegration at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.

3.3 Granger Causality Test Results

As Johansen cointegration test revealed that there is no long run equilibrium relationship exists between lending rate and deposit rate, the study employed Granger causality test to see whether lending rate does Granger cause deposit rate or deposit rate does Granger cause lending rate. The results disclosed that deposit rate does not Granger cause lending rate but lending rate does Granger cause deposit rate. The test results found from EViews are shown in Table 5.

Table 5: Results of Granger Causality Test

Null Hypothesis:	Observations	F-Statistic	Probability
Lending Rate does not Granger Cause Deposit Rate	141	3.89263	0.0227**
Deposit Rate does not Granger Cause Lending Rate		1.52271	0.2218

Source: Authors' compilation using EViews. **means the rejection of null hypothesis at 5%.

3.4 Impulse Response Function Results

A unidirectional causality running from lending rate to deposit rate motivated us to investigate the impulse response function of the autoregressive model. Using Choleski decomposition on a VAR model with ordering (i) lending rate and (ii) deposit rate we calculated impulse response functions for Bangladesh shown in Fig. 2.

(i) The first plot (Northwest) shows that a one standard deviation shock to deposit rate causes deposit rate to decrease in second month and then increase in third month before starting to decrease about fourth month and reaches to its previous value.

(ii) The second plot (Northeast) explains that a one standard deviation shock to the lending rate causes the deposit rate to peak about two to three months then it begins to decrease eventually in fourth month and after that reaches to its previous value.

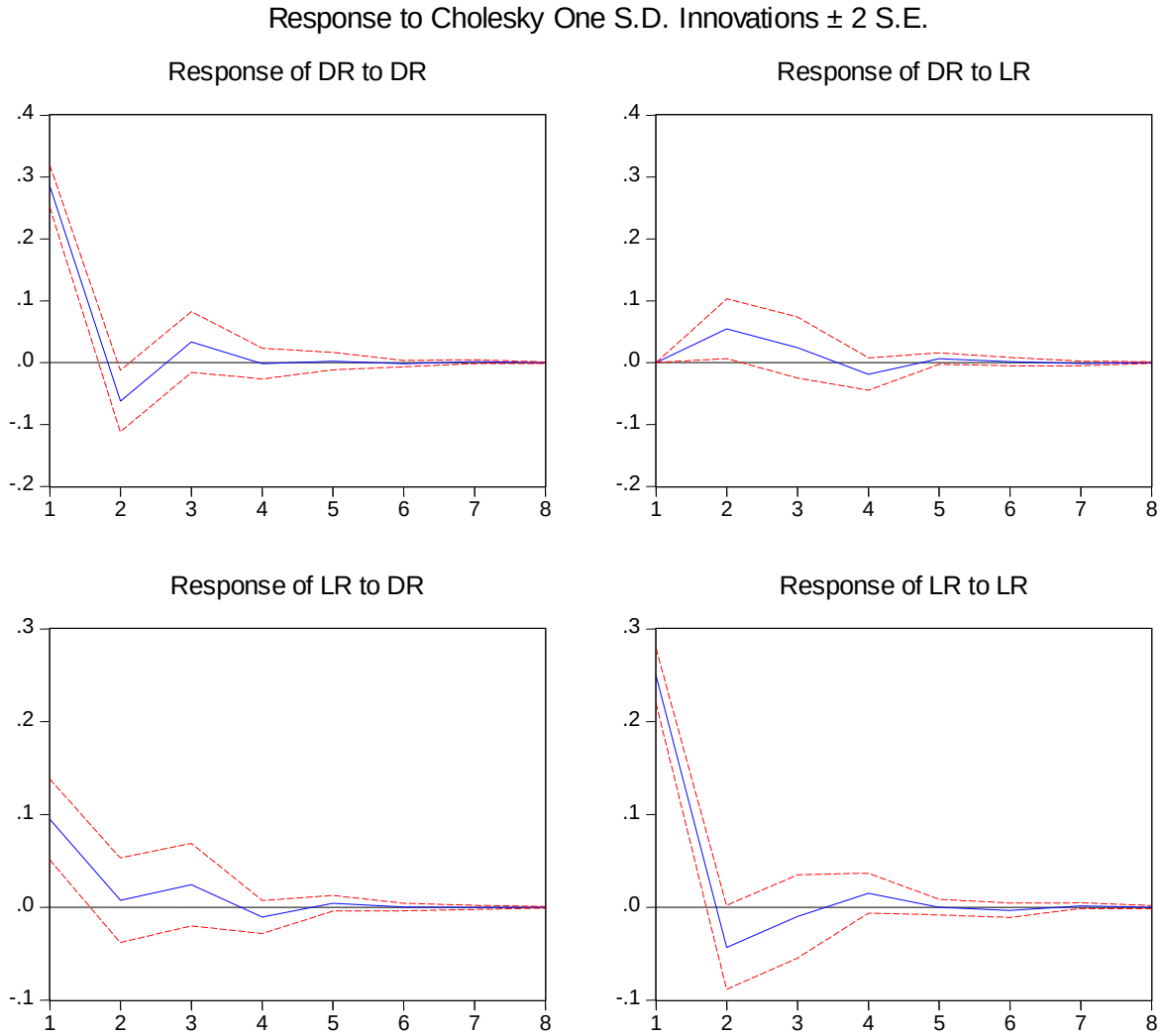

Figure 2: Result of impulse response function given by EViews.

(iii) The third plot (Southwest) reveals that a one standard deviation shock to the deposit rate causes the lending rate to decrease in second month and then increase in third month before starting to decrease about fourth month and reaches to its previous value.

(iv) The fourth plot (Southeast) discloses that a one standard deviation shock to the lending rate causes the lending rate to decrease to nadir then increase about three to four months and then start to decrease and goes back to previous situation.

IV. Conclusion

This study used vector autoregressive model to find out the casual link between lending rate and deposit rate in Bangladesh. At levels, data were non stationary but after differentiating they became stationary. Johansen cointegration test revealed the absence of long term relationship between the variables under question. Then we forwarded to investigate the presence and direction of causality between lending rate and deposit rate and found a unidirectional causality running from lending rate to deposit rate. The impulse response function

showed the reaction of variables due to one standard deviation shock in the error terms of VAR model. This study was conducted by using monthly data from different publications of Bangladesh Bank and covered the time from 2003:07 to 2015:06. Due to the unavailability of publications in the Library of Sylhet office of Bangladesh Bank we were not able to collect data of the years before 2003. So one can conduct further research based on the data from any year before 2003 as well as data of different countries in a panel. This study would help the monetary policy makers of Bangladesh to take effective decision to control the commercial banks of the country.

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