

Exploring the Linkage Between Financial Development and Economic Growth: the ARDL Bounds Testing approach

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Exploring the linkage between financial development and economic growth: the ARDL bounds testing approach

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Abstract

This study investigates the cointegration, short and long run dynamics and causal links between financial development and economic growth in Bangladesh for the period 1973 to 2015. We applied the Autoregressive Distributed Lag (ARDL) Bounds Testing approach and the Granger causality test. The ARDL bounds tests and other cross-checking test confirmed the long run cointegration between economic growth and financial development indicators in Bangladesh. The two financial development indicators, growth in broad money to gross domestic product (GDP) ratio and growth in total deposit liabilities to GDP ratio appeared to have time variant impact on economic growth: the former having significant positive impact in the short- run but negative impact in the long- run, while the latter has significant negative impact in the short- run but positive impact in the long- run. The Granger causality analysis indicated a bidirectional, co-evolutionary process between financial development and economic growth.

Keywords: Financial development; economic growth; ARDL model; Bangladesh.

JEL Codes: O11; O40; C22.

1.0 Introduction

Since the independence in 1971, Bangladesh has gone through waves of policy reforms, resulting in a more liberalized and capitalist outlook. The private sector was made “the engine of growth” and the country entered into a Financial Sector Reform Program (FSRP) from the early 1990s. The major reforms include: denationalization and privatization, financial liberalization, encouraging foreign direct investment, etc. (Islam, M. F., 1999). The efficacy of these reform programs are better reflected in the economic growth and financial development situation of the country.

Researchers found the theoretical and empirical evidence of correlation, cointegration and causality between financial development and economic growth. However, most studies advocated for financial liberalization and the results based on single country study of correlation, cointegration and causality between financial development and economic growth are fairly mixed and dependent mainly on country specific economic fundamentals and data.

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Against this context, this study aims to explore the empirical cointegration, short and long run dynamics and causal links between financial development and economic growth in Bangladesh. The principal objectives of the study are as follows:

- 1) To explore if financial development and economic growth in Bangladesh are cointegrated or not;
- 2) To unfold the short-run and long-run dynamics between financial development and economic growth in Bangladesh;
- 3) To see the direction of causal relationship (no direction, unidirectional i.e., whether ‘supply-leading’ or ‘demand-following’, or bi-directional, i.e., co-evolutionary) between financial development and economic growth.

The main contributions of this paper are: (i) we have used two main indicators of financial development, the ratio of broad money to GDP and the ratio of total deposit liabilities to GDP, while most of the past studies on finance-growth nexus deal with one indicator of financial development (see Rahman et al, 2015; Shahbaz and Rahman 2014 and 2012 for example) ; (ii) unlike the previous studies we have used the variables in growth form, as it provides information about the direction of movements of the variables in the current period in terms of the previous period; hence it provides valuable intuition; (iii) we have used the autoregressive distributed lag (ARDL) bounds testing approach to co-integration which is appropriate even for a small sample size, and which has some additional advantages including solving the endogeneity problem of variables; and (iv) our study is contemporary in Bangladesh covering a long period of up to date time series data.

2.0 Financial Development and Economic Growth in Bangladesh: A Brief Overview

Financial sector development can have many dimensions (Hussein. K., 1999 and Ang & Mckibbin, 2007) and, therefore, it is not possible to incorporate all aspects of financial development in a single variable (Abu-Bader and Abu-Qarn, 2008). Saci and Holden (2008, p. 1549) also noted: *“In the literature on the interaction between growth and financial development, the problem of measuring financial development is a difficult one”*.

To capture different aspects of the financial system, various indicators are suggested in the literature. In the absence of any precise definition of “financial development”, and following the existing literature (King and Levine, 1993a & 1993b; Levine, 1997&1999; and Levine and Zervos, 1998) certain indicators of financial development can be used to examine the long and short run dynamics and causal relationships of financial development and economic growth in Bangladesh. Accordingly, two alternative indicators of financial development have been used that are representative of development in the two key sectors such as monetary sector, and banking system for the Bangladesh economy. In addition, we have used an additional indicator to represent the external sector which is associated with either financial development or economic growth. These indicators are: 1) ratio of broad money (M2) to GDP, 2) ratio of total deposit liabilities to GDP, and 3) ratio of total trade (export plus import) to GDP.

The first indicator, broad money to GDP ratio (M2GDP) is basically the liquid liabilities of the financial system, which includes currency plus demand and interest-bearing liabilities of financial intermediaries. This is the broadest and most common measure of financial development. It also exhibits the degree of monetization in terms of the real economy.

The second indicator of financial development, following Khan et al. (2005), Boulila and Trabelsi (2004) and Demetriades and Hussein (1996), among others, is total deposit liabilities as a ratio of GDP (denoted by DLGDP). This is a relatively broader measure of financial development aiming to gauge the overall size of the financial intermediary sector. An increase in this ratio implies a development in financial deepening in the economy (Garcia and Liu, 1999; Boulila and Trabelsi, 2004 and Naceur et al., 2007).

The third indicator, total trade (export plus import) ratio to GDP (denoted by TRGDP) is an indicator of openness and overall development of the external sector of Bangladesh. It is assumed that this variable could also have an impact on economic growth. In view of this, following Jalil. and Ma (2008), Al-Malkawi, et al. (2012), Kiprop, et al. (2015), Sunde, (2012) and Nyasha, & Odhiambo (2016), we also use trade openness variable in our analysis..

The data, as shown in Table 1 below, indicate that the five-year periodic averages of nearly all the indicators display mostly a steady increasing trend, implying widening and deepening of the financial system in Bangladesh over time along with the trade openness.

Table 1

Trends of the Indicators of Financial Development and Economic Growth in Bangladesh

Period	M2GDP	DLGDP	TRGDP	Gr-avg*
1976-80	16.25	14.01	21.29	2.79
1981-85	23.52	21.03	24.18	3.83
1986-90	28.64	27.52	22.29	3.92
1991-95	34.21	32.84	27.52	4.49
1996-00	30.11	29.29	28.22	5.34
2001-05	39.46	38.06	32.41	5.71
2006-10	49.23	46.54	41.60	6.23
2011-15	52.76	50.04	39.34	6.38

*Real GDP has been re-calculated for the base year 1995-96

Source: Bangladesh Bank

In addition, as can be seen from the Figure 1 and Table 1, the five-year periodic averages of the economic growth in Bangladesh also maintained impressive and steady progress, exhibiting a similar pattern and moving together with financial development indicators revealing a close association. As seen, the Bangladesh economy grew from an average of 2.79 percent during 1976-80 to about 6.38 percent in 2011-15.

Figure 1

Trends in the Economic Growth in Bangladesh



Source: Bangladesh Bank

3.0 Literature Review

The first empirical study to investigate the finance-growth link is the study of Goldsmith (1969) that uses data for 35 countries and finds evidence of a positive correlation between financial development and economic growth and argues that financial development causes economic growth. A very enlightening literature survey on finance-growth link was provided by Levine (1997) and well-argued how financial development helps decrease market frictions and contributes to economic growth.

Cross-country studies reveal the evidence in favor of the Schumpeterian (1911) view: *financial development promotes economic growth* (King and Levine, 1993a and 1993b; Fry, 1978 and 1997; Levine, 1999; and Beck, Levine and Loayza, 2000), since introducing financial development brings about key benefits such as “reduction in transaction costs, information asymmetries, market frictions and also pools risks” (Levine and Zervos, 1998: 539 and Levine, 1997: 690). To affirm the Schumpeterian view and the findings of Goldsmith (1969) King and Levine (1993a) apply the concept of correlation and regression and conclude that different measures of financial development are strongly connected to real per capita GDP growth. Levine and Zervos (1998) signify that banking development along with stock market liquidity is meaningfully correlated with economic growth while Fry (1978 and 1997) show that financial liberalization augments savings and economic growth.

Studies based on time series techniques are dominated with the evidence of bidirectional causality (Shan et al., 2001; Demetriades and Hussein, 1996; Luintel and Khan, 1999; and Hansson and Jonung, 1997). On the other hand, studies by Choe and Moosa (1999) on Korean data in the Granger Causality approach and that by Xu (2000) on 41 developing countries in a multivariate VAR model find unidirectional causality where financial development causes economic growth. In another study by Fase and Abma (2002) on 9 emerging economies, the same findings are also revealed. In contrast, Singh and Weisse (1998), Singh (1997), Arestis and Demetriades (1997), Jappelli and Pagano (1994), Deveraux and Smith (1994) and including Robinson (1952) also found the evidence that financial development does not always promote

economic growth. Diedda and Fattouh (2001) find no or even negative impact on growth and also suggest that the impact of growth on financial development may differ depending on the stage of economic growth.

Recently the time series investigation on the nexus of financial development and economic growth, for a single country study, using ARDL (Auto Regressive Distributed Lag) Bounds Testing approach to cointegration and Granger Causality tests has gained much popularity. Among many researchers the studies of Shahbaz and Rahman (2014 and 2012) on Pakistan Sunde (2012) on South Africa and Kyophilavong, et al. (2014) on Laos found a positive and bidirectional causal link. Rahman et al (2015) on Australia, Anwar, et al. (2011) on Pakistan, Al-Malki, and Al-Assaf, (2014) on Saudi Arabia, and Kiprop, et al (2015) on Kenya explored a positive relationship and indicate a supply-leading causality while Simwaka, .et al. (2012)'s study on Malawi resulted in positive and significant relationship but found rather a demand-following causality. Other studies using ARDL approach include Nyasal and Odhiambo (2016) on Australia where they found that bank-based financial development has a short-run positive impact but market-based financial development has no significant impact on economic growth both in the short and long runs. Jalil and Ma (2008) found financial indicators to be significant for Pakistan, but for China the result was mixed. Kargbo and Adamu (2009)'s study on Sierra Leone found investment to be an important channel through which financial development causes economic growth. On the other hand, some studies such as Al-Malkawi et al (2012) found statistically significant negative relationship and a bi-directional causal link between financial development and economic growth in the United Arab Emirate (UAE).

Previously, Islam et. al. (2004) and Rahman (2004) conducted research on Financial Development and Economic growth in the context of Bangladesh. Islam, et al (2004) explored causality between financial development and economic growth in Bangladesh for the period of 1975 to 2002 using five alternative financial development indicators (M2 to GDP, M3 to GDP, financial savings to GDP, private sector credit to GDP and banking sector credit to GDP) and found causal direction from economic growth to financial development; while Rahman (2004), using structural vector autoregressions (SVARs), found the impact of the financial development and investment on per capita income. So a new study using an improved methodology and up to date data period is warranted for Bangladesh. This study aims to fill up this gap which will bring new evidence that would be helpful for the policy makers.

4.0 Data and Methodology

4.1. Variables, Data and Model

To explore the short and long-run dynamics as well as the causal link between financial development and economic growth in Bangladesh, four variables are used in the growth form. Growth form of a variable provides information regarding the direction of movements of a variable in the current period with respect to the past period, which can be used to gain valuable intuition regarding future movement of the variable too. On the other hand, a variable in simple ratio form provides information for the current period only. Therefore, growth form of a variable provides more information.

In this study, we use real GDP growth as proxy for economic development. The remaining three variables are from three sectors: monetary system, banking system, and external economy. The first two variables are the indicators of financial development. The description of all the variables is as follows:

GR: Real GDP Growth

BM: Growth in Broad Money (M2) to Real GDP Ratio

DL: Growth in Total Deposit Liability to Real GDP Ratio

TR: Growth in Total Trade (Import plus export) to Real GDP Ratio

We have used the time series data of Bangladesh economy for the period of 1973 - 2015. The data source

is the various issues of the Economic Trends and other publications of Bangladesh Bank (the central bank of Bangladesh). We formulate the following model to achieve our objective.

$$GR_t = \alpha + \beta_1 BM_t + \beta_2 DL_t + \beta_3 TR_t + \varepsilon_t$$

Where, α is the intercept, and β_1 - β_3 are coefficients of the independent variables; all other variables are the same as described above.

4.2 Unit Root Test

In general, the stationarity issue holds supreme importance in the econometric analysis of times series data, since a stationary series would have time invariant mean and variance. Also, even in the absence of any meaningful relationship among the variables, non-stationary series containing unit root will result in a high co-efficient of determination (R^2), thereby leading to spurious regression (Granger and Newbold, 1974).

According to Pesaran and Shin (1999) and Pesaran *et. al.* (2001), for the ARDL bounds testing methodology variable should not be integrated of order 2 or I(2). Therefore, the stationarity of each variable should be checked before proceeding to the next level of analysis and inference. For the Unit Roots Testing of the variables under study, the Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root testing methods will be used.

4.3 Cointegration Test

The ARDL bounds testing technique developed by Pesaran and Shin (1999) and Pesaran *et. al.* (2001) will be employed to investigate the cointegration among the variables used. The ARDL bounds test methodology of Pesaran and Shin (1999) and Pesaran *et. al.* (2001) has some advantages over traditional cointegration test: (i) it is very flexible and allows analysis with a mixture of I (0) and I (1) data; (ii) it involves just a single-equation set-up, which is simple to implement and interpret, (iii) unlike the conventional method, different variables can be assigned with different lag-lengths in the model, (iv) it is very suitable for small samples, (v) it gives unbiased estimation of long run link and long run parameters, and (vi) the endogeneity and autocorrelation problems are properly addressed (Harris and Sollis, 2005),

The basic form of an ARDL regression model used in this study is:

$$GR_t = \beta_0 + \sum_{i=1}^p \beta_i GR_{t-i} + \sum_{i=0}^{q_1} \gamma_i BM_{t-i} + \sum_{i=0}^{q_2} \delta_i DL_{t-i} + \sum_{i=0}^{q_3} \sigma_i TR_{t-i} + \varepsilon_t \dots \dots \dots (1)$$

where GR, BM, DL and TR are variables used and ε_t is a "well-behaved" random "disturbance" term, i.e., ε_t is serially independent and normally distributed.

For bounds testing of cointegration, the above model is modified in the following manner:

$$\begin{aligned} \Delta GR_t = & \beta_0 + \sum_{i=1}^p \beta_i \Delta GR_{t-i} + \sum_{i=0}^{q_1} \gamma_i \Delta BM_{t-i} + \sum_{i=0}^{q_2} \delta_i \Delta DL_{t-i} + \sum_{i=0}^{q_3} \sigma_i \Delta TR_{t-i} \\ & + \theta_0 GR_{t-1} + \theta_1 BM_{t-1} + \theta_2 DL_{t-1} + \theta_3 TR_{t-1} + \varepsilon_t \dots \dots \dots (2) \end{aligned}$$

The model in equation (2) is a specific type of Error Correction Model (ECM), where the coefficients are not restricted. It is termed as a "conditional ECM" by Pesaran *et. al.* (2001).

The correct values for the maximum lags, p , q_1 , q_2 and q_3 will be determined by employing one or more of the "information criteria" - Akaike Information Criterion (AIC), SC (BIC), HQ, *etc.*

For the above equation the null and alternative hypotheses can be as follows:

- H_0 : No cointegration exists
- H_1 : cointegration exists.

The F-test for the joint significance of the coefficients of the lagged levels of the variables will be used to test the null hypothesis. Thus

- $H_0: \theta_0 = \theta_1 = \theta_2 = \theta_3 = 0$
- $H_1: \theta_0 \neq 0, \theta_1 \neq 0, \theta_2 \neq 0, \theta_3 \neq 0$

Pesaran *et al.* (2001) provided *bounds* on the critical values for the *asymptotic* distribution of the F-statistic. However, since the sample size of this study is relatively small, we shall also compare the computed F-test value with the bounds critical values supplied by Narayan (2005), as these are more suitable for small samples.

The lower bound is set assuming that all of the variables are I (0), and the upper bound is set assuming that all of the variables are I (1). If the computed F-statistic falls below the lower bound, the variables are I(0), so no cointegration exists. If the F-statistic exceeds the upper bound, cointegration exists. Finally, if the F-statistic value is within the both bounds, the test is inconclusive.

Following Giles (2013), it is also necessary to conduct, as a cross-check, a "Bounds t-test" as noted below:

- $H_0: \theta_0 = 0$, against $H_1: \theta_0 < 0$.

The decision rule for this test is as follows:

If the t-statistic for GR_{t-1} in equation (2) is greater than the "I (1) bound", this implies that there is a long-run relationship between the variables. If the t-statistic is less than the "I(0) bound", the conclusion is that the data are all stationary.

The short run parameters are estimated employing the error correction mechanism (ECM) as depicted in equation (3) below:

$$\Delta GR_t = \beta_0 + \sum_{i=1}^p \beta_i \Delta GR_{t-i} + \sum_{i=0}^{q_1} \gamma_i \Delta BM_{t-i} + \sum_{i=0}^{q_2} \delta_i \Delta DL_{t-i} + \sum_{i=0}^{q_3} \sigma_i \Delta TR_{t-i} + \alpha ECT_{t-1} + \varepsilon_t \dots \dots \dots (3)$$

The ECM results show the speed of adjustment back to long run equilibria after a short run shocks. The ECM integrates both the short-run and long-run coefficients. Under ECM technique, the long run causality is shown by the negative and significant value of the error correction term (ECT) coefficient α , and the short run causality is depicted by the significant value of regressor variables.

4.4 Diagnostic Tests of the Model

For testing serial independence, both 'Q-Statistics' and 'Breusch-Godfrey Serial Correlation Lagrange Multiplier (LM) test' will be used; and for testing normality of the errors of the model, 'Jarque-Bera' test will be used. The 'Breusch-Pagan-Godfrey' test will be employed for checking the heteroscedasticity.

4.5 Stability Test of the Model and Granger Causality Test

It is indispensable to ensure the 'dynamic stability' of any model that contains autoregressive structure. cumulative sum of recursive residuals (CUSUM) and CUSUM of squares (Brown, Durbin, and Evans, 1975) estimates the stability of the model. Pesaran and Pesaran (1997) also suggested these tests for measuring the parameters' stability. The causality test will be performed following Toda-Yamamoto (1995) procedure².

5.0 Results and Discussion

5.1 Unit Root Test Results

The unit root test results of the Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) are displayed in Table 2:

Table 2
Results of Unit Root Test

Variables	ADF H ₀ : Variable has a unit root		KPSS H ₀ : Variable is Stationary	
	LEVEL		LEVEL	
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
1) GR	-1.310367 (0.6130)	-1.384674 (0.8469)	0.324469***	0.162549***
2) BM	-3.141236** (0.0314)	-4.085544** (0.0135)	0.179352***	0.090343***
3) DL	-2.032696 (0.2722)	-3.021826 (0.1392)	0.405472***	0.100826***
4) TR	-7.688773*** (0.0000)	-8.780198*** (0.0000)	0.314753***	0.063853***
	First Difference		First Difference	
1) GR	-7.053234*** (0.0000)	-7.014645*** (0.0000)	0.321514***	0.152813***
2) BM	-6.320431*** (0.0000)	-6.427239*** (0.0000)	0.50000***	0.407467
3) DL	-6.628534*** (0.0000)	-6.635181*** (0.0000)	0.208840***	0.174610***
4) TR	-12.04880*** (0.0000)	-11.90453*** (0.0000)	0.217293***	0.099827***

*, ** and *** denote statistical significance, respectively, at the 10%, 5% and 1% levels; p-values are shown in the parentheses.

Under KPSS test all variables are found stationary at levels and hence of order $I(0)$. However under ADF test, GR and DL are non-stationary at levels but attain stationarity after first differences and therefore, are of order $I(1)$, while all other variables are stationary at the levels. Therefore, the true order of integration of the variables GR and DL are inconclusive. This uncertain and mixed order of integration of the

²For a detailed discussion of the procedure, see Dave Giles (2011)

variables justifies using the ARDL approach of co integration. However, the results of the ADF and KPSS unit root test confirm that no variable is I(2).

5.2 ARDL Model Estimation

To determine the optimum lag length of the model, the 'Akaike Information Criterion (AIC)' has been used. The selected model is ARDL (2, 4, 4, 0). Therefore, the optimum lag lengths of the variables GR, BM, DL and TR are: $p = 2$, $q_1 = 4$, $q_2 = 4$, and $q_3=0$, respectively.

5.3 Diagnostic Tests Results of the Model

As far as the diagnostic checks are concerned, this model passes all the diagnostic tests and hence it is good fit. . The R-squared is 0.874092 (Adj-R²: 0.800645), implying that almost 87.5 percent variations in the dependent variable are explained by the model and the rest is explained by the error term. The Durbin-Watson (DW) statistics is 2.012823, confirming no spurious results. The computed F-statistic (11.90106) clearly rejects the null hypothesis. As illustrated in Table 3, the model passes the serial correlation test (Q-Statistics and Breusch-Godfrey Serial Correlation LM tests), Normality test (Jarque-Bera test) and Heteroscedasticity test ('Breusch-Pagan-Godfrey' test).

Table 3
Model Diagnostic Tests Results

Test	χ^2	Probability
Breusch-Godfrey Serial Correlation LM test	0.026341	0.9869
Breusch-Pagan-Godfrey Heteroskedasticity test	10.32160	0.7383
Jarque-Bera test	3.321773	0.189971

The Q-Statistics (E-Views output) in Figure 2 below also show that all the spikes are within range in both the cases, which re-affirm that the errors of the model is not serially dependent.

Figure 2
Q-Statistics result from E-Views 9.0

Date: 08/22/16 Time: 21:00
Sample: 1973 2015
Included observations: 39
Q-statistic probabilities adjusted for 2 dynamic regressors

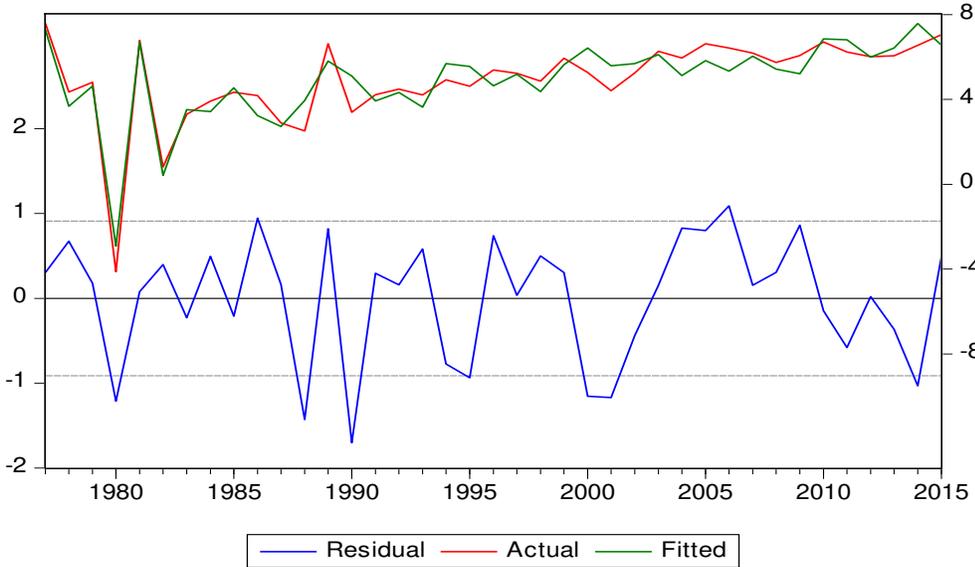
Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob*	
		1	-0.015	-0.015	0.0092	0.924
		2	0.001	0.000	0.0092	0.995
		3	-0.058	-0.058	0.1569	0.984
		4	-0.244	-0.246	2.8685	0.580
		5	-0.027	-0.041	2.9040	0.715
		6	-0.131	-0.146	3.7294	0.713
		7	0.146	0.115	4.7908	0.685
		8	-0.161	-0.245	6.1196	0.634
		9	-0.170	-0.236	7.6663	0.568
		10	0.155	0.087	8.9905	0.533
		11	0.014	0.048	9.0023	0.622
		12	0.091	-0.048	9.4945	0.660
		13	0.091	0.019	10.009	0.693
		14	-0.023	-0.048	10.042	0.759
		15	-0.089	-0.065	10.573	0.782
		16	-0.174	-0.135	12.689	0.695

*Probabilities may not be valid for this equation specification.

5.4 Fit of the Model

The Actual/Fitted/Residual plot of the unrestricted ECM of our model shows that the fit of model is good enough in terms of explaining the level of GR variable (Figure 3).

Figure 3
Actual/Fitted/Residual plot (E-Views 9.0 output)



5.5 ARDL Bounds Test Results

The results of the associated F-test of our ARDL model is as follows:

Table 4

Result of ARDL Bounds Testing

Variables	F-Statistics	Result
F(GR/BM DL TR)	14.13421***	Cointegration

*** denotes significance at 1% level.

For three independent variables (k=3), the relevant critical values with unrestricted intercept and linear trend of Pesaran *et al.* (2001) and of Narayan (2005) is given below:

Table 5

Bounds Testing Critical Values from Pesaran and Narayan

Critical Values	Pesaran		Narayan	
	Lower Bound I(0)	Upper Bound I(1)	Lower Bound I(0)	Upper Bound I(1)
1%	5.17	6.36	6.238	7.740
5%	4.01	5.07	4.510	5.643
10%	3.47	4.45	3.760	4.795

Clearly, the computed F-statistic exceeds critical values of the upper bound, even at the 1% significance level, of the Pesaran and Narayan relevant table. Therefore, we can conclude that *there is evidence of a long-run relationship between the time-series of our model.*

Cross Checking for Co integration:

In addition, the t-statistic on GR_{t-1} is -7.232627. However, the I(0) and I(1) bounds for the t-statistic at the 1%, 5%, and 10% significance levels are [-3.96,-4.73], [-3.41,-4.16], and [-3.13,-3.84] respectively. As seen, the computed t-statistic on GR_{t-1} far exceeds the corresponding value for I(1), even at the 1% significance level, confirming our conclusion that a long-run relationship among the variables exists.

5.6 Long Run and Short Run Relationships

5.6.1 Long Run Dynamics

The long run estimated results of the ARDL approach are noted in Table 6:

Table 6

Estimated Long Run Coefficients using ARDL Approach

Variables	Coefficient	t-Statistic	Probability
BM	-55.034010**	-2.361624	0.0267
DL	51.296553**	2.376805	0.0258
TR	1.397866	0.776925	0.4448
C	4.752900***	4.261138	0.0003
@TREND	0.177124***	7.104501	0.0000

** and*** denote statistical significance at 5% and 1% levels, respectively

The above result shows that the coefficients are significant for the variables BM (Growth of M2 to GDP ratio) and DL (Growth of Total Deposit Liability to GDP ratio) but insignificant for TR (Growth of Total Trade to GDP ratio). This indicates that money supply growth has negative and total deposit liability growth has positive impact on the Economic growth in the long run that is confirmed by the sign and statistical significance of their coefficients as depicted in the Table 6. It is also confirmed that the long run impact of total trade growth or openness is insignificant.

Although the long-run money supply growth coefficient for Bangladesh has negative sign, it is not unique in the literature. Some other studies have also found evidence of negative link between the two (see De Gregorio and Guidotti, 1995; Adu *et al.*, 2013; Nyasha and Odhiambo 2016; Al-Malkawi. *et al.*, 2012, for example).

5.6.2 Short Run Dynamics

The short run dynamics in ARDL (2,4,4,0) framework is shown in Table 7 below:

Table 7
Estimates from the Error Correction Mechanism

Variables	Coefficient	t-Statistic	Probability
D(GR(-1))	0.001729	0.011699	0.9908
D(BM)	-0.041612	-0.004707	0.9963
D(BM(-1))	13.582783	1.475214	0.1532
D(BM(-2))	17.206355***	2.882940	0.0082
D(BM(-3))	22.063707***	3.332042	0.0028
D(DL)	2.459368	0.248021	0.8062
D(DL(-1))	-2.152558	-0.223838	0.8248
D(DL(-2))	-23.005596***	-3.570047	0.0015
D(DL(-3))	-12.415554*	-1.839914	0.0782
D(TR)	1.343499	0.742753	0.4648
D(@TREND())	0.170235***	5.394584	0.0000
CointEq(-1)	-0.961107***	-4.4882	0.0002

*,**and***denote statistical significance at 10%, 5% and1% levels, respectively.

The short-run dynamics along with the long-run relationships is shown by the value and sign of lagged error correction term (ECT) coefficient α [CointEq(-1)]. ECT has a negative sign and it is significant even at 1% level. This represents a long term relationship between the dependent variable and the regressors. The value of ECT coefficient (-0.961107) signifies strong and a faster speed of adjustment to equilibrium. Thus 96% of the disequilibrium converges back to the long term equilibrium within one period (one year).

From the same table it is seen that as in the long run, TR (Total Trade Growth) does not have any impact on economic growth in the short-run also, which is confirmed by its statistically insignificant coefficient. However, BM (Growth in Money Supply) has mostly positive and significant impact on economic growth in the short run, confirmed by the statistical significance and sign of the coefficients of its second and third lagged values in the first differences. This is in contrast with its long run impact which is negative (Table 6). The variable DL (Total Deposit Liability growth) has a significant but mostly negative impact on economic growth in the short-run. This is assured by the statistical significance and sign of the coefficients of its second and third lagged values in the first differences. Like BM, the result is also in contrast to its long run impact which is positive (Table 6).

Therefore, we may conclude that the overall impact of both BM and DL on GR is time variant, i.e., having opposite short run and long run impact on economic growth. In addition, we may conclude from the foregoing discussion that monetary and bank-based financial development, rather than openness, propels the real sector in Bangladesh.

5.7 Stability of the Model

For checking the robustness of our results, structural stability tests on the parameters of the long-run results are performed by the cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals of squares (CUSUMSQ) tests. A graphical representation of CUSUM and CUSUMSQ statistics are shown in Figure 4 and Figure 5 below. The plots of both the CUSUM and CUSUMSQ are within the boundaries (shown by the dotted red lines) within 5 percent critical bound, and therefore, these statistics confirm the model stability.

Figure 4

Plot of CUSUM Tests

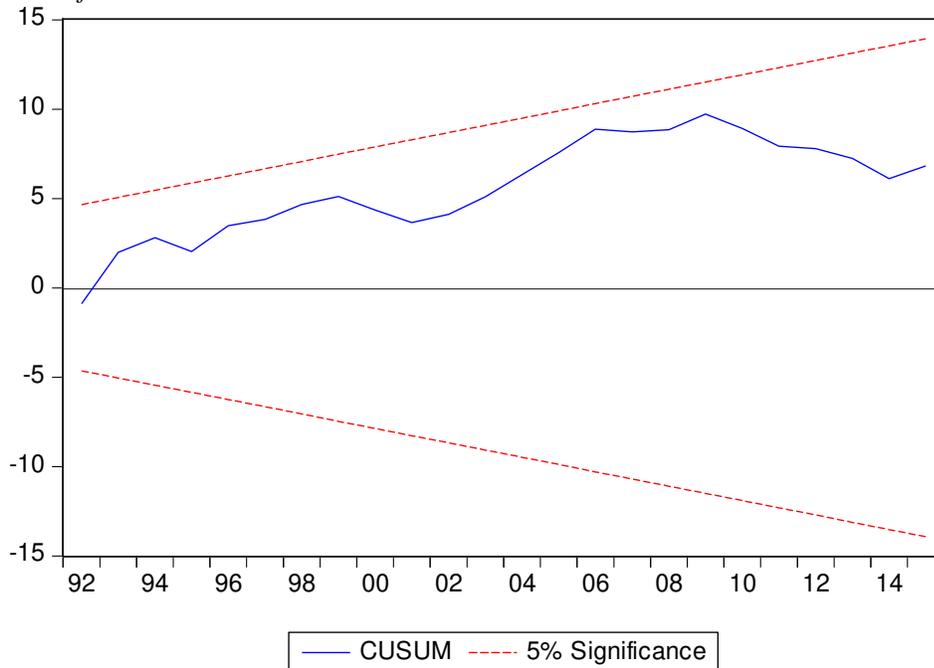
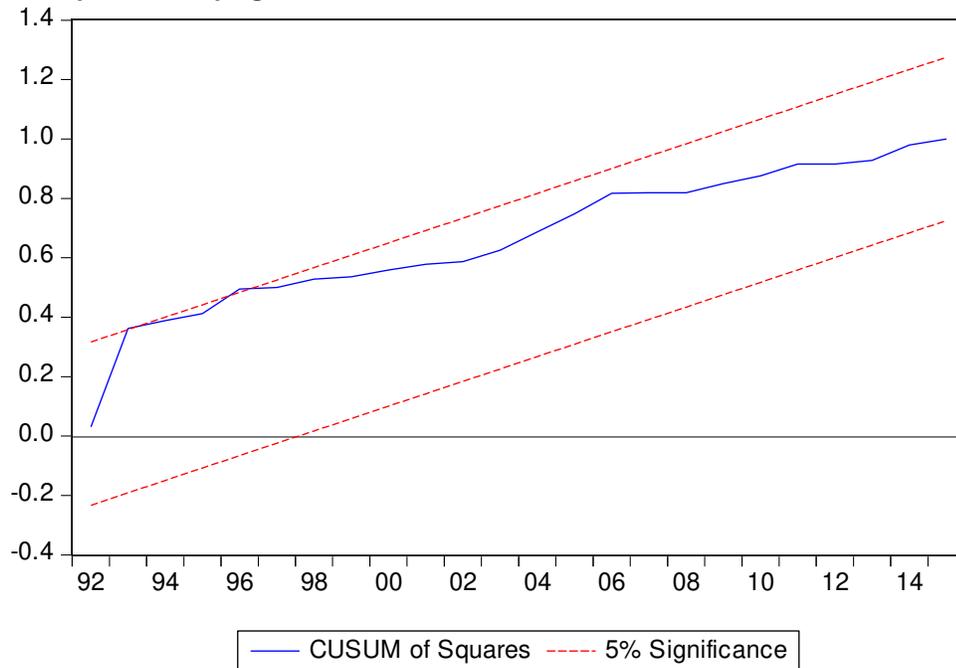


Figure 5
Plot of CUSUM of Squares Tests



5.8 Granger Causality Test Results

After establishing the long run relationship between the variables, we test the Granger between the variables. We examine the causal link between financial development and economic growth in Bangladesh within an augmented Vector Autoregressive (VAR) framework in line with Toda-Yamamoto (1995) procedure. The Table 8 and the arrow diagram in Figure 6 below demonstrate the short-run Granger causality among the variables.

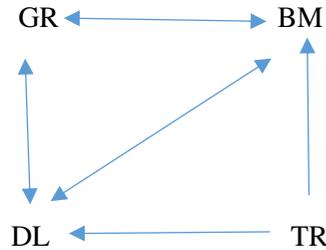
Table 8
Granger Causality/Block Exogeneity Wald Tests

	Dependent Variable				Direction of Causality
	GR	BM	DL	TR	
GR	---	8.116316**	13.31659***	1.502639	GR→BM; GR→DL
BM	10.12209**	---	11.23983**	1.276714	BM→GR; BM→DL
DL	7.749200*	17.05351***	---	2.452185	DL→GR; DL→BM
TR	4.220478	10.31926**	11.32280**	---	TR→BM; TR→DL

*, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively.

Figure 6

Causal Channels



As seen, in the context of Bangladesh, financial development indicators such as broad money growth and total deposit liability growth has short-run bidirectional causality with economic growth (GR & BM and GR & DL), but total trade growth (TR) does not have any direct causal link with economic growth. In addition, among the financial development indicators, BM and DL has bidirectional causality between them, while TR Granger causes both BM and DL, but not the other way around.

Although TR does not have any direct causal link with GR, it causes BM and DL while both BM and DL have bidirectional causality with GR; hence we may infer that TR indirectly causes GR, or in other words, TR causes GR through the channels of BM and DL.

Therefore, in the context of Bangladesh, we do not find any strong and conclusive evidence for either 'supply-leading' or 'demand-following' hypothesis (except for total trade growth (TR) which may cause GR indirectly through the channels of BM and DL thus showing a very weak evidence of the 'supply-leading' hypothesis). Rather, on the whole, there is evidence of strong both way or bi-directional causality between financial development and economic growth in Bangladesh which favors the view of a joint evolution of the real and financial sectors during the growth process as stated by Al-Malkawi, et al. (2012), Shan et al. (2001), Luintel and Khan (1999), Hansson and Jonung, (1997), and Demetriades and Hussein, (1996).

In this sense, we may conclude that there exists a co-evolutionary process between financial development and economic growth in Bangladesh, i.e., the evolution of financial development and economic development are jointly determined. This is in contrast to the result of Islam, et al (2004), who found unidirectional causality running from economic growth to financial development, i.e., evidence for 'demand following hypothesis'.

The limitation of this study may be noted that we have not considered 'domestic credit to private sector as % of GDP' as another indicator of financial development. This indicator is also used by the researchers. However, we believe that use of this indicator will not invalidate our findings.

6.0 Conclusion and Policy Implications

This study has explored has examined the empirical cointegration, long and short run dynamics and causal link between financial development and economic growth for the case of Bangladesh over the period 1973 to 2015. We applied the ARDL bounds testing approach developed by Pesaran and Shin (1999) and Pesaran *et al.* (2001) to investigate cointegration, Unrestricted Error Correction Model (UECM) of Pesaran and

Shin (1999) and Pesaran *et al.* (2001) for short and long run dynamics and the Toda-Yamamoto procedure for Granger causality in a VAR framework.

The analysis was conducted employing three different indicators of financial development and external sector in the growth form, namely: the ratio of broad money (M2) to GDP, the ratio of total deposit liabilities to GDP, and the ratio of total trade (export plus import) to GDP. The ARDL bounds tests and additional cross-checking confirmed long run cointegration between economic growth and financial development indicators in Bangladesh.

The estimated long run and short run results indicate that except for TR, the other two financial development indicators, growth in broad money to GDP ratio (BM) and growth in total deposit liabilities to GDP ratio (DL) appeared to have time variant impact on economic growth: BM mostly appears to have significant positive impact in the short run but negative impact in the long run, while DL showed mostly significant negative impact in the short run but positive impact in the long run on economic growth. These results imply that the monetary and bank-based indicators of financial development influence the economic growth in Bangladesh.

The results of the short-run Granger causality analysis indicate the existence of mostly bi-directional causality between financial development and economic growth: GR and BM, GR and DL, except TR which has no direct causal relationship with economic growth in the short run. Among the financial indicators, BM and DL also show bi-directional causality between themselves while unidirectional causal link running from TR to BM and TR to DL. In this situation, because TR causes both BM and DL which have bidirectional causal links with GR, we may conclude that TR causes GR indirectly through the BM and DL channels. On the whole, we found a co-evolutionary process between financial development and economic growth in Bangladesh, i.e., the evolution of financial development and economic development are jointly determined in the context of Bangladesh.

The above findings and analysis imply that Bangladesh should continue its efforts for the economy wide reform and liberalization programs. Financial and banking sector development should get proper attention to continue its long run positive impact on economic growth because, a well-functioning financial system helps mustering savings and promotes investment and thus contributes toward greater economic growth. The long run negative impact of broad money growth on the economic growth also posits a caution regarding careful and proper planning and implementation of the monetary policy in Bangladesh and to find out an optimum level of money supply in the economy. This study also suggests for improvements in the external sector and openness of the economy because of its perceived influence on the economic growth through the monetary and banking sector channels.

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List of Abbreviations:

ARDL- Autoregressive Distributed Lag
 GDP-Gross domestic product
 FSRP- Financial Sector Reform Program
 DLGDP- deposit liabilities as a ratio of GDP
 TRGDP-Trade-GDP ratio
 M2GDP- Broad money to GDP ratio
 Gr-Avg- Growth average
 UAE-United Arab Emirate
 SVARs- Structural vector autoregressions
 ADF- Augmented Dickey-Fuller

KPSS- Kwiatkowski-Phillips-Schmidt-Shin
AIC- Akaike Information Criterion
Sc- Schwarz Criterion
BIC- Bayesian **information criterion**
HQ- Hannan Quinn
ECM-Error correction model
ECT-Error correction term
CUSUM- cumulative sum of recursive residuals
VAR-Vector Autoregressive
GR: Real GDP Growth
BM: Growth in Broad Money (M2) to Real GDP Ratio
DL: Growth in Total Deposit Liability to Real GDP Ratio
TR: Growth in Total Trade (Import plus export) to Real GDP Ratio
VECM-Vector error correction model

Declarations:

- **Availability of data and material:** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
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- **Authors' contributions:** M. A. Kashem developed the concept, collected and analysed the data, run the regression, and wrote the manuscript. M.M. Rahman supervised the project, helped in variable selection and interpreting the results, edited and administered the paper as a corresponding author.
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Figures



Figure 1

Trends in the Economic Growth in Bangladesh Source: Bangladesh Bank

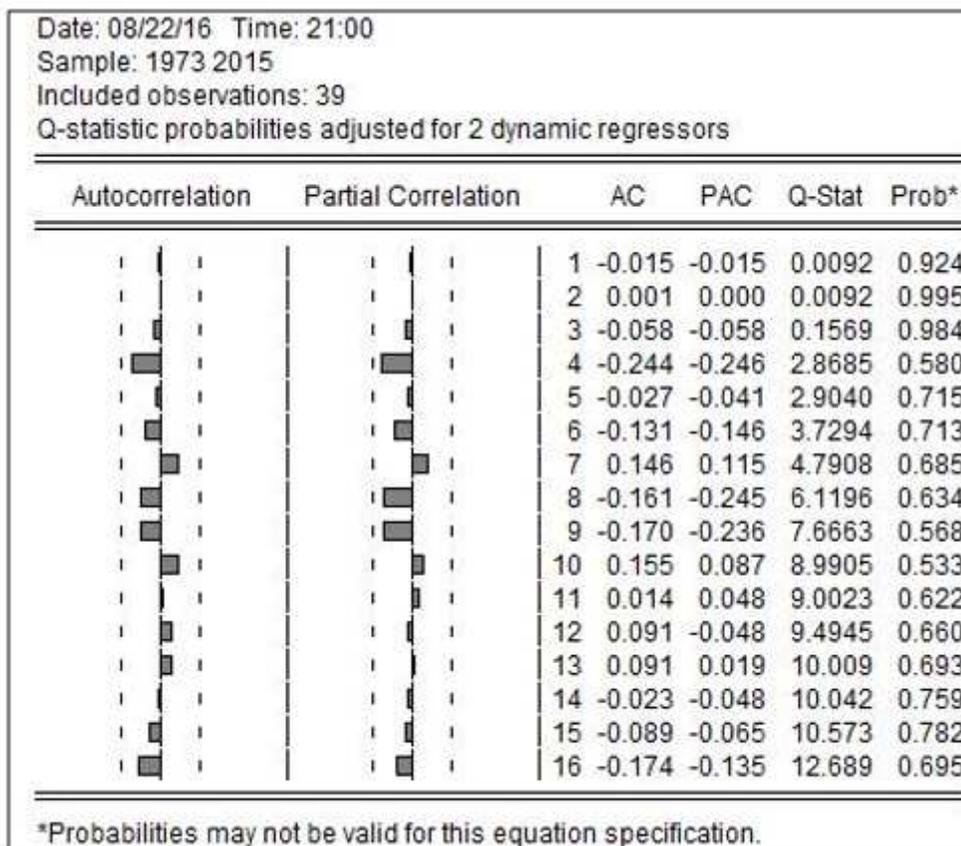


Figure 2

Q-Statistics result from E-Views 9.0

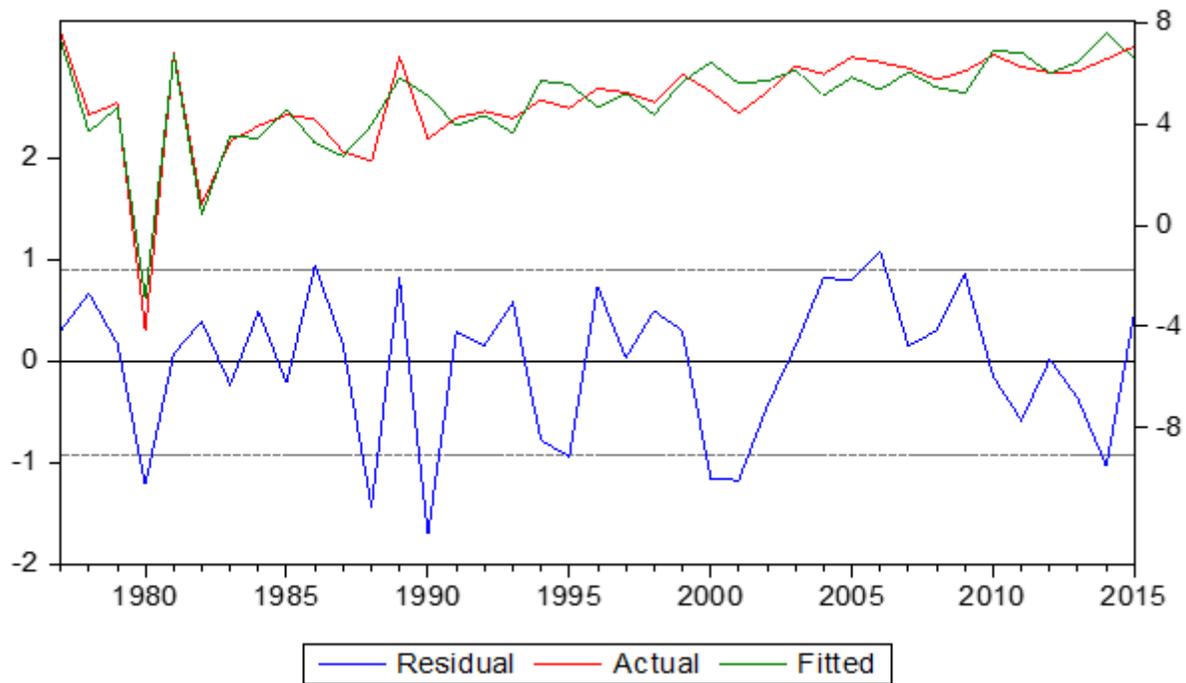


Figure 3

Actual/Fitted/Residual plot (E-Views 9.0 output)

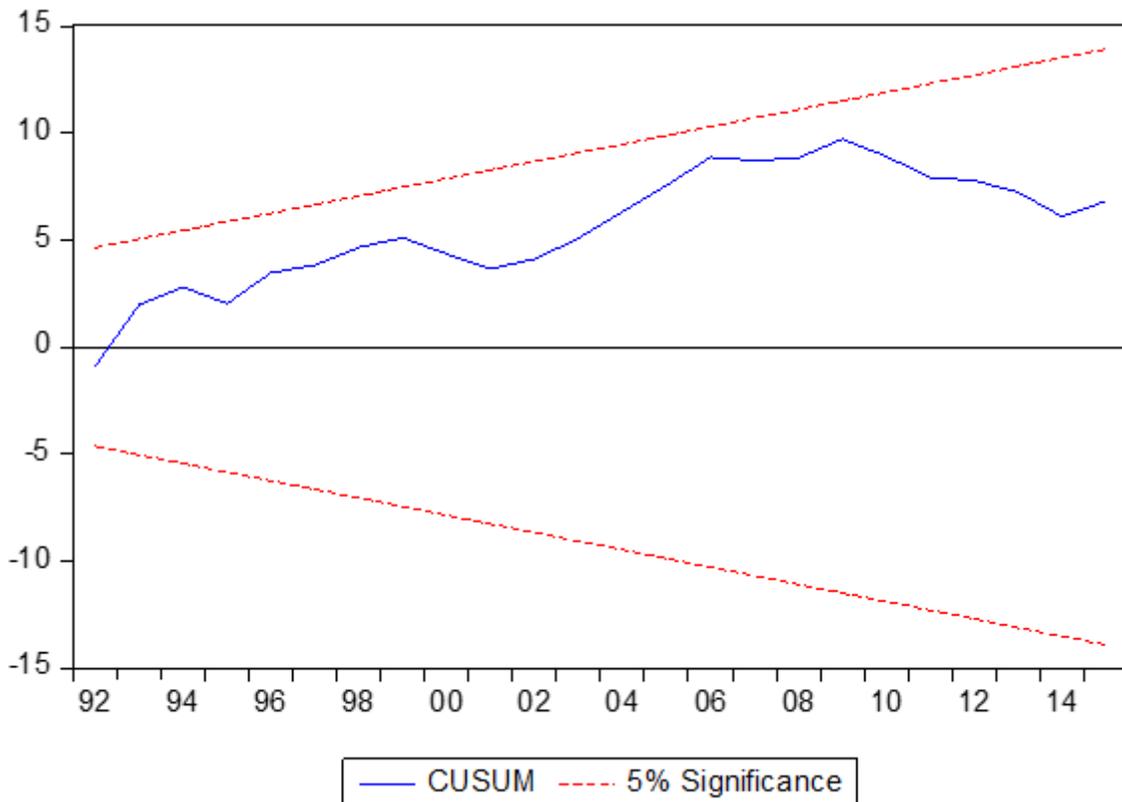


Figure 4

Plot of CUSUM Tests

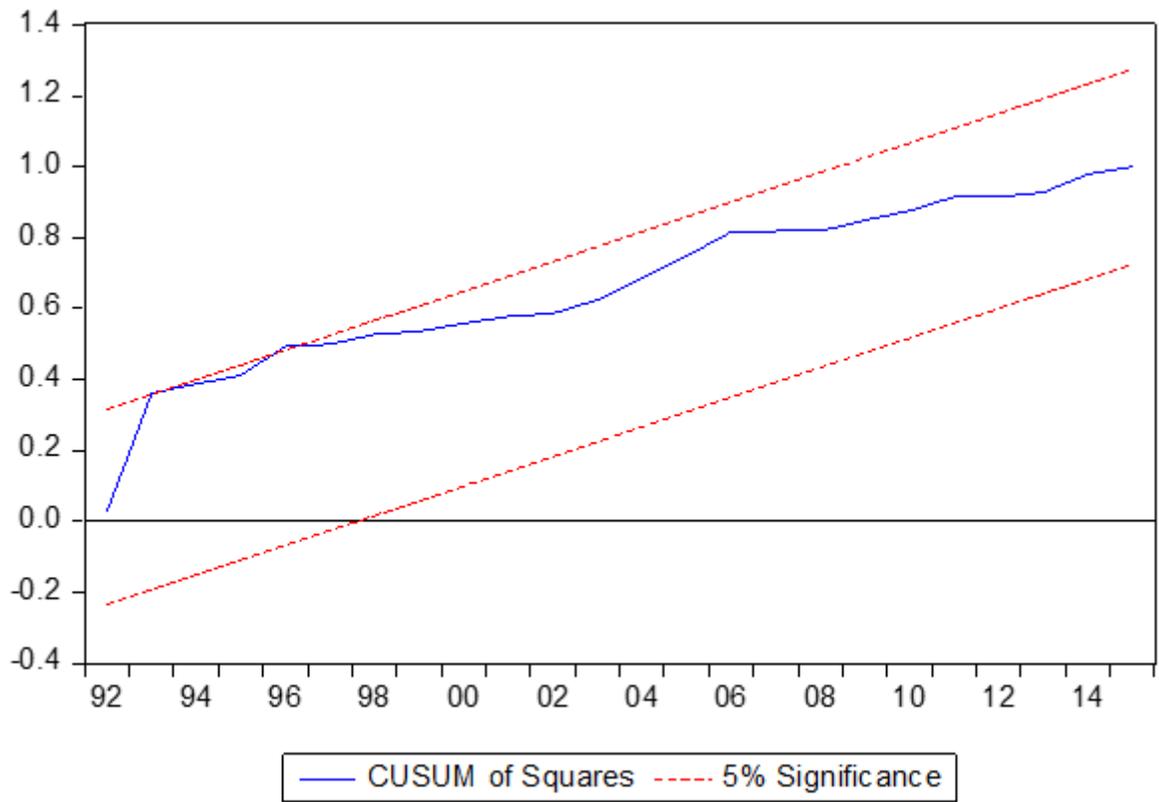


Figure 5

Plot of CUSUM of Squares Tests

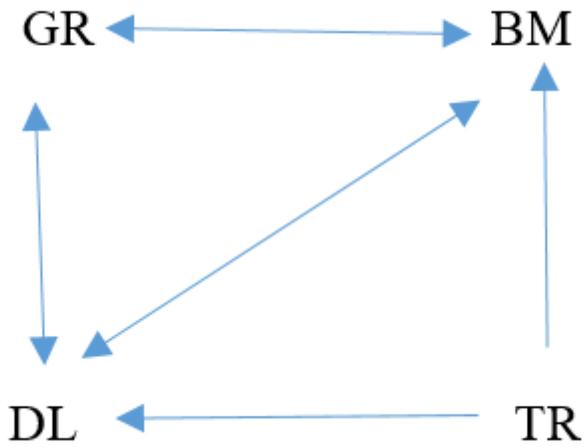


Figure 6

Causal Channels