Financial Development and Economic Growth in Bangladesh: Empirical Evidence from ARDLCointegration and Granger Causality Analysis

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Abstract

The main objective of this study is to examine the empirical cointegration, long and short run dynamics and causal relationships between financial development and economic growth in Bangladesh over the period 1973 to 2015. Employing three different indicators for financial development 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 as well as additional cross-checking test convincingly confirmed long run cointegration between economic growth and financial development indicators in Bangladesh. The estimated long run and short run results indicate that, growth in the total trade ratio has insignificant impact on economic growth. However, growth in broad money to 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 in the long run, while the latter has significant negative impact in the short run but positive in the long run on economic growth. On the whole, Granger causality analysis indicated a bidirectional, co-evolutionary process between financial development and economic growth in the context of Bangladesh.

Keywords: Financial Development, Economic Growth, Bounds Testing, ARDL, Co-integration, Error Correction Model, Granger Causality, Bangladesh

JEL Classification: E44, E51, O1, O4, O11, O16, G18, G28

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1.0 Introduction

Since 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), Public Finance, Financial Liberalization, Foreign Direct Investment, etc. (Islam, M. F., 1999). The efficacy of these reform programs is better reflected in the economic growth and financial development situation of the country.

There is ample theoretical and empirical evidence of correlation, cointegration and causality between financial development and economic growth. The existence of correlation had been initially articulated by Gurley and Shaw (1955) followed by Goldsmith (1969), McKinnon (1973) and Shaw (1973). In their paper, Gurley and Shaw (1955) gave substantial proof of co-evolution of the real and the financial sectors but without indicating direction of causation. In his cross-country study Goldsmith (1969) also finds evidence of strong correlation 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 are dependent mainly on country specific economic fundamentals and data.

In recent times economic growth in Bangladesh has been quite impressive. It is, therefore, inspiring for researchers to identify and assess various contributing factors helping to consolidate and sustain this growth. This study motivated us to mainly focus on the contribution of the financial development towards this achievement.

Against this backdrop, this study makes an effort to investigate the empirical cointegration, long and short run dynamics and causal relationships between financial development and economic growth in Bangladesh. The main objectives of the study are as follows:

1) To find out if Financial Development and Economic Growth in Bangladesh are cointegrated or not;
2) To unfold the long-run and short-run dynamics between Financial Development and Economic Growth in Bangladesh;
3) To assess the form 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 rest of the research is organized as follows: section 2 gives a brief overview of financial development and economic growth in Bangladesh; Section 3 reviews the literatures; data and methodology are described in section 4; section 5 presents Estimation, Analysis and Findings; and finally, section 6 concludes and provides policy implication of the study.

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). As 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 have been suggested in the literature. In the absence of any precise definition of "financial development", following the practice of existing literature (King and Levine, 1993a & 1993b; Levine, 1997&1999; and Levine and Zervos, 1998) some indicators of financial development may be used to examine the long and short run dynamics and causal relationships of financial development and economic growth in Bangladesh. Accordingly, three alternative indicators of financial development have been used that are representative of developments in the three key sectors such as Monetary Sector, Banking System and External Sector for Bangladesh economy. 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 as a ratio of GDP (M2GDP) is basically the liquid liabilities of the financial system in Bangladesh that includes currency plus demand and interest-bearing liabilities of financial intermediaries. This is the broadest and most common measure of financial development and is considered to be a typical measure of financial "depth". It also indicates the degree of monetization with respect to the real economy.

The second indicator of financial development, following Demetriades and Hussein (1996), Khan et al. (2005), and Boulila and Trabelsi (2002 and 2004) among others, is total deposit (demand plus time) liabilities as a ratio of GDP (denoted by DLGDP) which is a relatively broader measure of financial development aiming to gauge the overall size of the financial intermediary sector. An increase in this ratio can be explained as a development in financial deepening in the economy (Garcia and Liu, 1999; Boulila and Trabelsi, 2004 and Naceur et al., 2007). It also shows the level of liquidity provided to the economy as it includes all the liquid liabilities of the financial system excluding currency in circulation and hence is a key measure of financial depth. Recent studies by King and Levine (1993, a, b), Levine and Zervos (1998), Rousseau and Wachtel (2002) and Chaudhuri and Smiles (2004) used this variable to measure the impact of financial sector on economic growth, and other studies used this variable as a measure of financial deepening.

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 supposed that this variable could also have an impact on economic growth. The omission of this variable could therefore bias the direction of causality between financial

development and economic growth. In view of this, following Jalil.A, and Ma, Y. (2008), Al-Malkawi, et al. (2012), Kiprop, et al. (2015), Sunde, T.(2012) and Nyasha, S., & Odhiambo, N.M. (2015), we employ trade openness as an indicator of financial development. Besides being a measure of financial development and economic growth, this variable can also be considered to contain other information to control for other factors associated with either economic growth or financial development.

Many studies also include capital market data in defining financial development of a country. However, capital market data for Bangladesh is not available for the whole period of 1973-2015; therefore, it is not possible to examine the impact of capital market in financial development of Bangladesh under the current study.

The data as presented in Table 1 below show that the five-year periodic averages of almost all the indicators of financial development used in the study display mostly a steady increasing trend, indicating widening and deepening of the financial system in Bangladesh over time.

Table 1

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

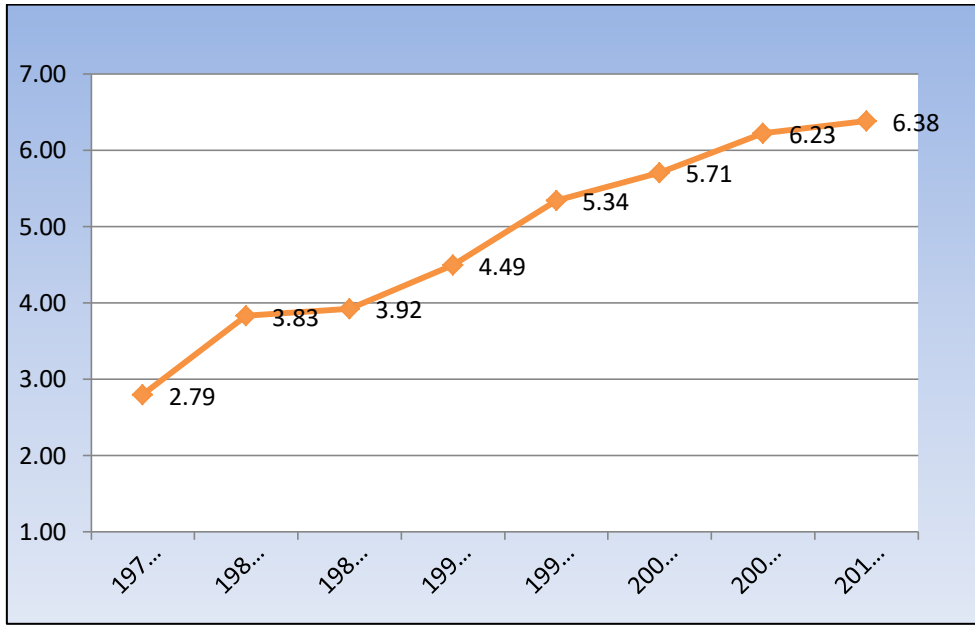
Period	M2GDP	DLGDP	TRGDP	GR_avg*
1976-80	3.11	86.21	152.15	2.79
1981-85	8.02	89.09	120.73	3.83
1986-90	15.63	96.09	81.01	3.92
1991-95	24.05	96.01	83.63	4.49
1996-00	33.73	97.27	96.56	5.34
2001-05	52.71	96.49	84.92	5.71
2006-10	89.86	94.54	89.71	6.23
2011-15	150.68	94.84	78.39	6.38

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

In addition, as can be seen from the Figure1 and Table 1, the five-year periodic averages of the economic growth in Bangladesh also maintained impressive and steady progress, displaying a somewhat similar pattern and moving approximately together with financial development indicators revealing a close association. As seen, 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



3.0 Literature Review

The first empirical study to investigate the finance-growth link is Goldsmith's (1969) paper which 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 survey of the literature on finance-growth relationship was provided by Levine (1997) and presented a convincing argument as to how financial development helps reduce market frictions and contributes toward economic growth.

In general, studies that are based on cross-country observations seem to find evidence in favor of the Schumpeterian (1911) view: "*financial development promotes economic growth*" (King and Levine, 1993a and 1993b; Fry, 1978 and 1997; Levine and Zervos, 1998; Levine, 1997 and 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*".

Studies based on time series techniques are dominated with the evidence of bi-directional causality (Demetriades and Hussein, 1996; Hansson and Jonung, 1997; Luintel and Khan, 1999; and Shan et al., 2001). 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 evidence where financial development causes economic growth. On the other hand, some studies such as Al-Malkawi, H. N. et al (2012) on UAE found statistically significant negative relationship and a bi-directional causality between financial development and economic growth.

In the context of Bangladesh economy, financial development and economic growth has continued to be a topic of interest among the researchers, as evident by the growing number of literatures employing different methods and techniques and exploring various aspects of interactions between the two. Rahman, M.H. (2004) investigated the causal relationship between financial development and economic growth in Bangladesh using a Structural Vector Autoregression (SVAR) framework and found that various indicators of financial development and investment had long-run and short run impact on per capita income of Bangladesh. Islam, M.R., Habib, M.W., & Khan, M.H. (2004) also conducted a time series analysis of finance and growth in Bangladesh over the period from 1975 to 2002. Employing a Granger Causality test, their study found causality running from economic growth to financial development in Bangladesh. Kabir, S.H., & Hoque, H.A. A. B. (2007), within the OLS model framework, focused on the impact of financial liberalization upon economic growth of Bangladesh considering three proxies of financial development, such as real interest rate, volume of intermediation, and efficiency of intermediation and observed financial and monetary variables not fully contributing to growth. Uddin, M. G. S., and Chakraborty, L. (2009) employed the co-integration and Granger causality tests to investigate long-run relationship and the direction of causality between financial development, international trade and real income growth in Bangladesh and found no long-run relationship between economic growth and financial development as scaled by money supply and domestic credits. Hye, Q. M. A., & Islam, F. (2013) constructed financial development index (FDI) for Bangladesh using Principal Component Method and used it to explore the existence of a long run relationship between FDI and economic growth employing Autoregressive Distributed Lag (ARDL) approach to cointegration. They found negative impact of real interest rate (RIR) and FDI on economic growth. Bristy, H.J. (2014) used Ordinary Least Squares technique to unfold interaction between financial development and exchange rate volatility in Bangladesh and found exchange rate variability to adversely affect growth due to poorly developed financial market, which discourages innovation and hence in turn lowers the growth.

Shahbaz, M., Rehman, I. U., & Muzaffar, A. T. (2014) revisited the relationship between financial development and economic growth in Bangladesh by incorporating trade openness in production function using quarterly data over the period of 1976-2012. Using combined Bayer-Hanck cointegration in the presence of structural breaks, they showed financial development to facilitate economic growth but capitalization to impede it, while the causality analysis revealed feedback effect between financial development and economic growth. Sikder, M.Z.I., Wadud, M.A., & Hasan, M.A. (2017) employed Johansen's multivariate cointegration to test the long run relationship and vector error correction model to test causality of financial development and economic growth in Bangladesh and India involving time series data of GDP, domestic credit provided by financial sector, domestic credit to private sector, and broad money from 1974 to 2015 and found long term relationship between financial development and economic growth in Bangladesh and India, while at the same time bidirectional causality was confirmed between financial development and economic growth in both the countries. Hossain, A., Biswas, S., Hossain, M.N., & Poddar, A.K. (217) performed Factor Analysis on some selected indicators of Bangladesh financial sector during the period 1988-2013 and then used Granger – Causality test to conclude no financial factor significantly causing economic growth, but rather economic growth causes "depth/stability" factor of financial sector. Kabir, M.N. & Halder, P. (2018) empirically examined the relationship between financial development and economic growth in Bangladesh using time series data over the period of 1977-2016. Applying Johansen Co-integration and Granger-causality test in Vector Error Correction Model (VECM) they found long-run causality from financial development to economic growth.

4.0 Data and Methodology

4.1. Variables and Data

In order to gain valuable insights into the long-run and short-run dynamics as well as the causal relationships between financial development and economic growth in Bangladesh, four variables have been used in the growth form. Using a variable in growth form conveys information regarding the direction of movements of the variable in the current period with respect to the previous period, which can be used to gain valuable intuition regarding future movement of the variable as well. On the other hand, a variable in simple ratio form gives information on the variable for the current period only. Therefore, we can gain more information by using a variable in the growth form rather than using it in simple ratio form.

In this study, we use real GDP growth as proxy for economic development. Remaining

three variables represent financial development indicators in the economy from three sectors: monetary system, banking system, and external economy. The description of all the variables is as follows-

GR: Real GDP Growth
BM: Growth in Broad Money (M2) to GDP Ratio
DL: Growth in Total Deposit Liability to GDP Ratio
TR: Growth in Total Trade (Import plus export) to GDP Ratio

We have used the time series data of Bangladesh economy for the period starting from 1973-74 to 2015-16. The data source is the various issues of the Economic Trends and other publications of Bangladesh Bank, the central bank of Bangladesh. Keeping view with the prime objective of the study, the functional form of the model is as follows:

Economic Growth = f (Financial Development)

The econometric form of the above model is as follows:

$$GR_t = \boldsymbol{\alpha} + \boldsymbol{\beta}_1 BM_t + \boldsymbol{\beta}_2 DL_t + \boldsymbol{\beta}_3 TR_t + \boldsymbol{\varepsilon}_t$$

Where all the variables are same as described above, is the intercept and β_1-β_3 are coefficients of explanatory variables.

4.2 Unit Root Testing

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).

Although in ARDL approach of cointegration unit root pre-testing is not essential, the ARDL/Bound Testing methodology of Pesaran and Shin (1999) and Pesaran *et al*. (2001) requires that no variable should be integrated of order 2 or I(2), as such data will invalidate the methodology. It is therefore, justified to test the stationarity of each variable before proceeding to the next level of analysis and inference. The Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root testing methods will be used for the Unit Roots Testing of the variables under study.

4.3 Cointegration Testing Using ARDL Bounds Testing Approach

The ARDL (Auto Regressive Distributed Lag) bound testing technique developed by Pesaran and Shin (1999) and Pesaran *et al.* (2001) will be employed to investigate the possible existence of cointegration among the variables under study or whether they possess long run equilibrium relationship as well as extracting both the long-run and short-run dynamics.

The ARDL / Bounds Testing methodology of Pesaran and Shin (1999) and Pesaran *et al.* (2001) has a number of advantages over traditional cointegration testing as enumerated below:

- It is very flexible and allows analysis with a mixture of I (0) and I (1) data.
- It involves just a single-equation set-up, making it simple to implement and interpret.
- Unlike the conventional method, different variables can be assigned different lag-lengths in the model.
- It is very much suitable for small samples.
- It provides unbiased estimation of long run relationship and long run parameters (Harris and Sollis, 2005).
- The endogeneity problem is adequately addressed. In this approach Pesaran and Shin (1999) maintain that modeling ARDL with the appropriate number of lags will address autocorrelation and endogeneity problems. According to Jalil *et al.* (2008), endogeneity is less of a problem if the estimated ARDL model is free of autocorrelation.

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

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

where GR, BM, DL and TR are variables of the study 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:

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

The model in equation (2) is a particular type of Error Correction Model (ECM), where the coefficients *are not restricted*. Pesaran *et al*. (2001) term it as a "conditional ECM". The appropriate values for the maximum lags, p, q_1, q_2 and q_3 will be determined by using one or more of the "information criteria" - AIC, SC (BIC), HQ, *etc*.
Under the above equation the null and alternative hypotheses are as follows:

H_0 : No cointegration exist

H_1: cointegration exists.

The null hypothesis is tested by conducting F-test for the joint significance of the coefficients of the lagged levels of the variables. Thus

H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = 0$

H_1:$\theta_0 \neq 0, \theta_1 \neq 0, \theta_2 \neq 0, \theta_3 \neq 0$

The distribution of the test statistic is purely non-standard and exact critical values for the F-test are not available for an arbitrary mix of I(0) and I(1) variables. However, Pesaran *et al*. (2001) developed *bounds* on the critical values for the *asymptotic* distribution of the F-statistic. For various situations (*e.g*., different numbers of variables, (k + 1)), they supply lower and upper bounds on the critical values. However, since the study is based on a relatively smaller sample size, we shall also compare the computed F-test value with the bounds critical value tables provided by Narayan (2005) as these are more suitable for small samples.

In each case, the lower bound is based on the assumption that all of the variables are I (0), and the upper bound is based on the assumption 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 is possible, by definition. If the F-statistic exceeds the upper bound, we conclude that we have cointegration. Finally, if the F-statistic falls between the bounds, the test is in conclusive & we will have to resort to other techniques of cointegration.

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

$$H_0 : \theta_0 = 0, \text{ against } H_1 : \theta_0 < 0.$$

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" tabulated by Pesaran *et al.* (2001; pp.303-304), this would support the conclusion that there is a long-run relationship between the variables. If the t-statistic is less than the "I (0) bound", we would conclude that the data are all stationary.

Short run parameters are estimated using the regular error correction mechanism (ECM) as depicted is equation (3) below:

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

The error correction model results indicate the speed of adjustment back to long run equilibria after a short run shock. The ECM integrates the short-run coefficient with the long-run coefficient without losing long-run information. Under ECM technique, the long run causality is depicted by the negative and significant value of the error correction term (ECT) coefficient α and the short run causality is shown by the significant value of other regressor variables.

4.4 Diagnostic Tests of the Model

One of the most important and crucial assumptions in the ARDL / Bounds Testing methodology of Pesaran *et al.* (2001) is that the errors of equation (2) must be serially independent and normally distributed. Therefore, both 'Q-Statistics' and 'Breusch-Godfrey Serial Correlation LM test' will be used for testing Serial Independence and 'Jarque-Bera' test will be used for testing Normality of the errors of the model. The heteroskedasticity will also be checked using 'Breusch-Pagan-Godfrey' test.

4.5 Stability Test of the Model

It is indispensable to ensure the 'dynamic stability' of any model having autoregressive structure. The stability of the model will be checked by using Recursive CUSUM and CUSUM of squares (Brown, Durbin, and Evans, 1975) estimates. These tests are also suggested by Pesaran and Pesaran (1997) for measuring the parameter stability.

4.6 Granger Causality Test

According to Granger (1969), measuring the *correlation* between variables is not enough

to construct a complete understanding about the relationship between two or more time series. This is because some correlations may be spurious and not useful, as there might be a hint of existence of a third variable that cannot be accounted for. This is the core idea of performing the causality test.

Following Toda-Yamamoto (1995) procedure[2], the Granger Causality among the variables under an augmented Vector Autoregression (VAR) framework will be estimated.

5.0 Estimation, Analysis and Findings

The 'Unit Root Testing' of the variables, appropriate maximum lag lengths selection of the model &the ARDL model estimation, and Granger Causality along with all the diagnostics and stability testing of the model were done using E-Views 9.0 software**.** E-Views version 9.0 contains a full-functioning ARDL estimation option, together with bounds testing and an analysis of the long-run relationship between the variables being modeled.

5.1 Unit Root Testing

The Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root testing results are displayed in the following table:

Table 2

Results of Unit Root Test

	ADF	KPSS
	H_0: Variable has a unit root	H_0: Variable is Stationary
Variables	LEVEL	LEVEL

[2]For a detailed discussion with example of the procedure, see Dave Giles (2011)

	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 at the10%, 5%and 1% levels respectively; p-values in the parentheses (.))

It can be inferred from the above estimates that under KPSS test all variables are 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 other variables are stationary at the levels. Therefore, the true order of integration of the variables GR and DL are inconclusive. This mix and uncertain order of integration of the variables justifies using the ARDL approach of cointegration. However, as required by the ARDL bound testing technique developed by Pesaran and Shin (1999) procedure[3], and Pesaran *et al.* (2001), the results of the ADF and KPSS unit root testing confirm that no variable is I(2).

5.2 ARDL model estimation

The 'Akaike Information Criterion (AIC)' has been used to determine the optimum lag length of the model. 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. The trend variable has been used to cover for a variable which is not directly observable

[3]For a detailed discussion with example of the procedure, see Dave Giles (2011)

but impacts the dependent variable, and is highly correlated with time. This also ensured stability of the model.

5.3 Diagnostic Tests of the Model

As far as the diagnostic checks are concerned, this model is good fit and it passes all the diagnostic tests. The R-squared is 0.874092 (Adj-R^2:0.800645), implying that almost 87.5 percent variations in the dependent variable are explained by the model and the rest by the error term. The DW statistics is 2.012823, which confirms that the model is not spurious. Moreover, the computed F-statistic (11.90106) clearly rejects the null hypothesis that the regressors have zero coefficients (p-Value: 0.00). As illustrated in the table below, the model passes the test regarding serial correlation (Q-Statistics and Breusch-Godfrey Serial Correlation LM tests), Normality (Jarque-Bera test) and Heteroscedasticity ('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 shows that all the spikes are within range in both the cases, therefore, re-affirming that the errors of the model is serially independent.

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

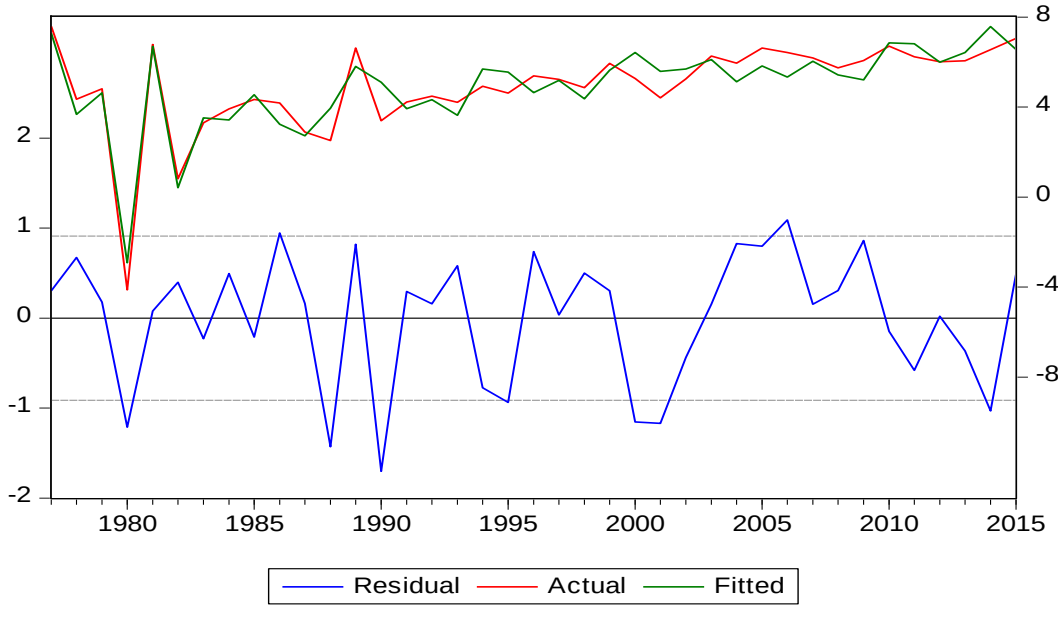
*Probabilities may not be valid for this equation specification.

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).

Figure3

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



5.5 ARDL Bounds Test

Since the model passed all the diagnostics tests, we now move to the next level of analysis, i.e., bounds test for cointegration. The associated F-test obtained is as follows:

Table 4

Result of ARDL Bounds Testing

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

(***significant at 1% significance level**)**

For k=3 (number of independent variables) the relevant critical values with unrestricted intercept and linear trend from table CI(v) on p.301 of *Pesaran et al. (2001),* and for k=3, n≈40 the table for case (v) on p.1990 of *Narayan (2005)* is given below:

Table 5

Bounds Testing Critical Values from Pesaran and Narayan

	Pesaran	Narayan

Critical Values	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

As the value of the computed F-statistic exceeds the upper bound even at the 1% significance level in both the Pesaran and Narayan relevant table of critical values, we can conclude that *there is evidence of a long-run relationship between the time-series of our model* (at this level of significance or greater).

Cross Checking for cointegration:
In addition, the t-statistic on GR_{t-1} is -7.232627. When we look at Table CII (v) on p.304 of Pesaran *et al*. (2001), we find that 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, even at the 1% significance level, the computed t-statistic on GR_{t-1} far exceeds the corresponding value for I(1), thus reinforcing our conclusion that there is a long-run relationship among the variables.

5.6 Long Run and Short Run Relationships

5.6.1 Long Run Dynamics

The long run equilibrium relationship among the variables estimated using the ARDL approach is given in the table below:

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 the 1%, 5%and 10% 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 which is confirmed by the sign and statistical significance of their coefficients as shown in the Table6 above. 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 to this study alone. Several other studies have shown evidence of negative association between the two (see also De Gregorio and Guidotti, 1995; Adu *et al*., 2013; Nyasha, S. and Odhiambo, N.M., 2015; Al-Malkawi, H.N. *et al*., 2012).

5.6.2 Short Run Dynamics

The following OLS equation is tested for the short run causality in ARDL (2,4,4,0) framework:

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 the 10%, 5% and 1% levels respectively)

The results corresponding to equation (3) are shown by the Table 7 above. We conclude that short-run dynamics is in conjunction with the long-run relationships as shown by the value and sign of lagged error correction term (ECT) coefficient α [CointEq(-1)]. As required, ECT has a negative sign and it is very significant even at 1% level. This represents that there exists long term relationship between the dependent variable and the regressors. In addition, the value of ECT coefficient is-0.961107, which signifies strong and a faster speed of adjustment to equilibrium. Thus nearly 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 which is confirmed by the sign and statistical significance 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 confirmed by the sign and statistical significance 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 argument that monetary and bank-based financial development, rather than openness propel the real sector in Bangladesh.

5.7 Stability of the Model

To ensure the robustness of our results we employ structural stability tests on the parameters of the long-run results based on the cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals of squares (CUSUMSQ) tests as suggested by Pesaran and Pesaran (1997). A graphical representation of CUSUM and CUSUMSQ statistics are provided in Figure 4 and Figure 5 below. If the plots of the CUSUM and CUSUMSQ remain within the 5 per cent critical bound, it would signify the parameter constancy and the model stability. Both the plots indicate that none of the straight lines (drawn at the 5 percent level) are crossed by CUSUM and CUSUMSQ. i.e., the plots of both the CUSUM and CUSUMSQ are within the boundaries (shown by the dotted red lines) and therefore these statistics confirm the model stability and that there is no systematic change identified in the coefficients at 5% significance level over the study period.

Figure4

Plot of CUSUM Tests

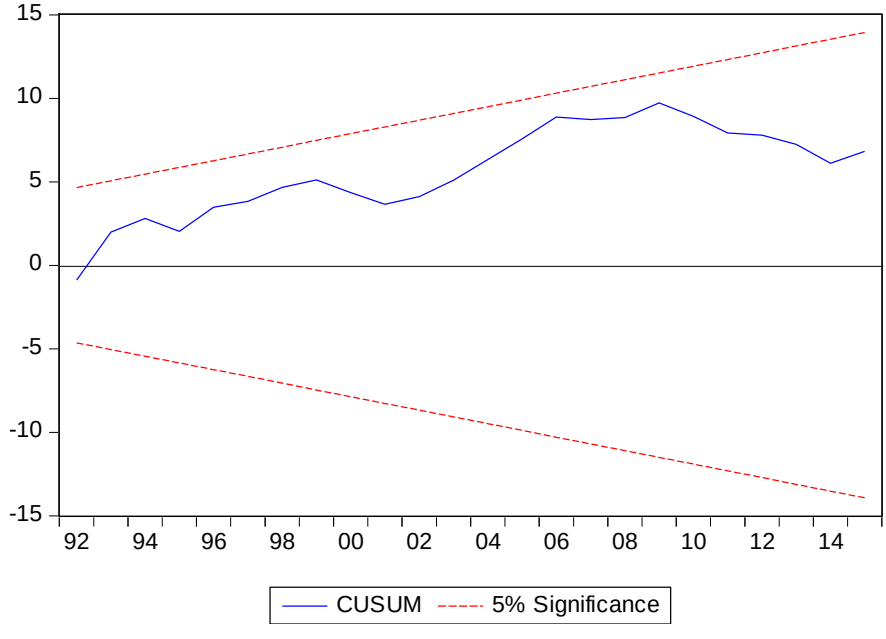
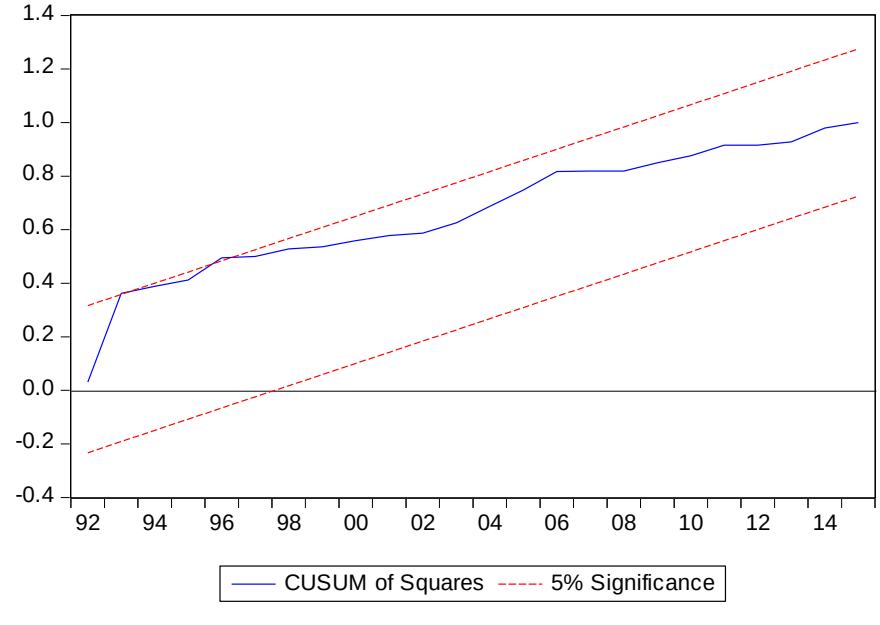


Figure 5

Plot of CUSUM of Squares Tests



5.8 Granger Causality Test

Following Patrick (1966) who postulated the existence of a feedback/interaction relationship between economic growth and financial development, most literature focus on two main diverging theoretical paradigms: the "supply leading hypothesis" and the "demand following hypothesis". While the 'supply-leading' hypothesis posits a unidirectional causation that runs from 'financial deepening to economic growth', the 'demand-following' hypothesis posits an opposite direction of causality, a unidirectional causation from 'economic growth to financial development' (Balago, G.S., 2014).

Some other researchers, however, observe a complex link between financial development and economic growth in the form of both way causality and are in favor of the view of a joint evolution of the real and financial sectors during the growth process (Gurley and Shaw, 1955; Greenwood and Jovanovic, 1990; Galetovic, 1996; Greenwood and Smith, 1997; and Bencivenga and Smith, 1998).

After examining the long run relationship between the variables, we use the Granger causality test to determine the causality between the variables. As we found cointegration among the variables, we may expect uni or bidirectional causality among the series. We examine the causal relationships between financial development and economic growth in Bangladesh within an augmented VAR framework following Toda-Yamamoto (1995) procedure. The Table 8 and the arrow diagram for causal channels in Figure 6 below show the short run granger causality among the variables.

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

Table 8

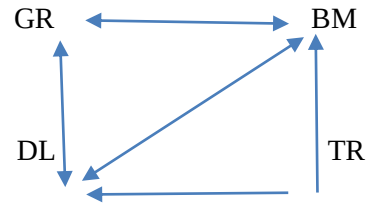
Granger Causality/Block Exogeneity Wald Tests

	Dependent Variable				Direction ofCausality
	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 the10%, 5% and 1% levels respectively)

Figure 6

Causal Channels



economic growth (GR & BM and GR & DL), but total trade growth (TR) as a financial development indicator 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 TR, but not the other way around.

However, although TR does not have any direct causal link with GR, since TR causes BM and DL while both BM and DL have bidirectional causality with GR, 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, 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, we do not find any strong and conclusive evidence for either 'supply-leading' or 'demand-following' 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 above (Demetriades and Hussein, 1996; Hansson and Jonung, 1997; Luintel and Khan, 1999; and Shan et al., 2001, Al-Malkawi, H. N. et al., 2012)

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.

6.0 Conclusion and Policy Implications

This paper has examined the empirical cointegration, long and short run dynamics and causal relationships between financial development and economic growth for the case of Bangladesh over the period 1973 to 2015. Accordingly, we applied the ARDL/Bounds

Testing methodology developed by Pesaran and Shin (1999) and Pesaran *et al*. (2001) to investigate cointegaration, Unrestricted Error Correction Model (UECM) of Pesaran and Shin (1999) and Pesaran *et al*. (2001) for long and short run dynamics and the Toda-Yamamoto Procedure of Granger Causality in a VAR framework.

The analysis was performed employing three different indicators for financial development 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 as well as additional cross-checking confirmed long run cointegration between economic growth and financial development indicators in Bangladesh. The coefficient of the error correction term is statistically significant at 1% levels of significance and has the expected negative sign with a value of (-0.961107), which signifies a very strong and faster speed of adjustment to equilibrium. Thus nearly 96% of the disequilibrium converges back to the long term equilibrium within one period (one year). The estimated model passed all the diagnostics tests and was also found to be stable.

The estimated long run and short run results indicate that, growth in the total trade ratio (TR) has insignificant impact, both in the short and long-run, on economic growth (GR). However, 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 appear 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. This result implies that it is the monetary and bank-based indicators, rather than openness are better financial development indicators for economic growth in Bangladesh.

The results of the short run granger causality analysis indicate existence of mostly bi-directional causality channels between financial development and economic growth: GR & BM, GR & DL, except TR which has no direct causal link with economic growth in the short run. Among the financial indicators, BM and DL also show bi-direction causality between themselves while unidirectional causality exists between TR & BM and TR & 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.

As the foregoing arguments imply, Bangladesh should continue with its efforts for economy wide reform and liberalization programs. The results of the study imply that 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 help mustering savings and promote investment and thus contribute toward greater economic growth. The long run negative impact of broad money growth on economic development also posits a caution regarding careful and proper planning and implementation of the monetary policy in Bangladesh and to find an optimum level of money supply in the economy. This study also suggests improvements in the external sector and openness of the economy because of its perceived influence on economic growth through the monetary and banking sector channels.

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