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Uttam Chandra Paul*

Abstract: This paper examines the causal relationship between private sector credit growth and economic growth in Bangladesh by using annual time series data over the period of 1976-2017. To investigate this relationship, the Autoregressive Distributed Lag (ARDL) Approach has been used. In addition, this paper examines the direction of causality by adopting the Toda-Yamamoto procedure of Granger Causality test in the VAR model. The empirical results show that the annual growth rate of private sector credit (PC) and industrial production index (IPI) have a positive and significant effect on annual growth rate of GDP in both long-run and short-run. But there is only a short-run positive effect of export (X) and a negative effect of broad money (BM) on GDP growth rate. Finally, the results of the Toda-Yamamoto Granger Causality test show that there is unidirectional causality from GDP growth rate to private sector credit growth rate.

Keywords: Bangladesh, GDP growth, Private sector credit growth, Autoregressive Distributed Lag (ARDL) Approach, Toda-Yamamoto Granger Causality test.

JEL Classification: C22, E51, O47.

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Chapter-I: Introduction

For centuries, there is a debate among the researchers about the nature and direction of the relationship between financial market development and economic growth. In light of this existing debate, this paper aims to examine the relationship between private sector credit growth and economic growth in Bangladesh by using annual time series data over the period of 1976-2017. For the last 42 years, the economy of Bangladesh has been growing by 5% per annum. However, Bangladesh is enjoying high GDP growth in recent years. In the FY2016-17, the real GDP grows by 7.28%. As a result, in the FY2016-17 Bangladesh's GDP increases to 19.76 trillion Bangladeshi Taka (BDT), equivalent to 249.7 billion USD in nominal terms. In terms of purchasing power parity (PPP), Bangladesh's GDP reaches $687.1 billion USD and become the worlds' 30th largest economy.

At the same time, the number of banks, the amount of bank credit as well as private sector credit in Bangladesh also gradually increasing. In the FY2016-17, the total amount of credit by 57 scheduled banks in Bangladesh increases to 7.22 trillion Bangladeshi Taka. Out of this total bank credit, 7.13 trillion Bangladeshi Taka disburses to the private sector, which is 98.8% of total bank credit. That means, almost all of the bank credit in Bangladesh goes to the private sector. In the FY2016-17, private sector credit grows by 15.7%. It has been growing by 19% per annum for the last 42 years. Past economic growth rates and private sector credit growth rates indicates a positive relationship with each other. But does any systematic causal relationship exist between these two variables or is it merely a case of "spurious" correlation?

Previous studies by McKinnon's (1973), Shaw (1973), Fry (1988), Levine, R. (1999), Beck et al. (2003), Adeniyi (2006), Loayza and Rancière (2006), Cappiello et al. (2010), Hossain et al. (2015) etc. suggest that financial sector development can increase economic growth by raising saving, improving efficiency of loanable funds, and promoting capital accumulation. They argue that, in less developed and developing countries, financial market development is important for economic development. They conclude that financial market development and economic growth are positively related to each other. But the channel and direction of causality remain unresolved (Fitzgerald, 2006). Empirical works show that in some countries financial market development causes economic development. While economic development is the driving force for financial market development in other countries.

In light of these conflicting views, this paper attempts to examine whether the previous consensus on the causal relationship between economic development and financial market development holds for Bangladesh. In addition, this paper aims to find out the direction of causality considering some other variables.

From the perspective of the present economic condition of Bangladesh, it is important to know about the nature and direction of the relationship between economic growth and private sector credit growth in Bangladesh. The ruling government of Bangladesh has set the "Vision 2021" and "Vision 2041". The ultimate goal of the "Vision 2021" is to improve the quality of people's life by achieving higher economic growth. The government of Bangladesh aims to increase economic growth under the 7th Five-Year plan in order to make Bangladesh a middle-income country by 2021. The target of the "Vision 2041" is to make Bangladesh a developed country, which also requires higher economic growth. Hence, the specific objectives of this study are as follows:

- To investigate the short-run and long-run relationship between private sector credit growth and economic growth in Bangladesh considering some other variables; and
- To find out the causality and direction of causality between private sector credit growth and economic growth in Bangladesh considering some other variables.

To achieve these objectives, the rest of the paper is organized as follows. *Section-II* briefly reviews the existing literature on this ground. *Section-III* describes the data and methodology of the study. *Section-IV* reports and discusses the empirical results. Finally, *Section-V* shows the conclusion of this study.

Chapter-II: Literature Review

Economists differ regarding the nature of the relationship between economic growth and credit growth or financial market development. There are three different opinions in the existing literature. The findings of the first group of researchers show that financial development has a significant positive impact on GDP growth. According to Schumpeter (1911), banks facilitate technological innovation by their role of channelizing resources from surplus sector to deficit sector and thus play an important role in promoting economic development. King and Levine (1993a) analyze the data for 80 countries over the period of 1960–1989 and their empirical results suggest that the financial market development is strongly correlated with real per capita GDP growth, which is consistent with Schumpeter's view. King and Levine (1993b) conduct another study on the data of 77 countries over the period of 1960-1989 and find that financial systems allow investors to diversify the risk associated with innovative works, which accelerate technological change and economic growth. By analyzing existing theories and empirical evidence, Levine, R. (1997) finds a positive link between the financial system and long-run economic growth. Cappiello et al. (2010) conduct a study on the data of 11 counties in Euro area and find that a change in the amount of credit and/or standard of credit has a positive and statistically significant effect on real economic activities. Other studies such as Shaw (1973), Fry (1988) and Adeniyi (2006) also find a significant positive relationship between credit growth and economic growth. McKinnon's (1973) study on the relationship between the financial system and economic development in seven countries (Argentina, Brazil, Chile, Germany, Korea, Indonesia, and Taiwan) in the post-World War I1 period suggests that better functioning financial systems support for faster economic growth. Loayza and Ranciere (2006) use an annual dataset of 75 countries over the period of 1960-2000. By using a panel error correction model and a general Autoregressive Distributed Lags (ARDL) model, they find that the relationship between economic growth and financial variables is positive and significant in the long-run. Rahman (2004) conducts a study on Bangladesh by using data from 1976 to 2005 in a long-run Structural Vector Autoregression (SVARs) model and finds a positive impact of financial market development on per capita income and investment-GDP ratio in Bangladesh. Hossain et al. (2015) examine the finance-growth relationship in Bangladesh by using the data from 1990 to 2013. They find that the banking sector positively and significantly affects per capita GDP. At the same time, they find that the stock market does not affect per capita GDP in Bangladesh.

The findings of the second group of researchers indicate that the finance-growth relationship is not very important. According to Robinson (1952), enterprise leads, finance follows. He proposes that economic development creates demands for different types of financial arrangements and the financial system automatically responds to these demands. Lucas (1988) indicates that economists are putting over-stress on the role of financial factors in economic growth. He thinks physical capital, human capital and technological change are important factors for economic growth. Dey & Flaherty (2005) conduct a study with monthly data of 48-member stock exchanges of Federation of International Stock Exchanges on market capitalization and dollar value of equity trading for the period of 1995 to 2001. To identify the impact of bank credit and stock market liquidity on GDP growth, they use a two-stage regression model and find that the bank credit and stock market liquidity are not consistent determinants of GDP growth. By using annual data of China over the period of 1978-2001 and adopting a Vector Autoregression (VAR) model, Shan & Jianhong (2006) finds that financial development comes as the second force after labor input for leading GDP growth in China.

The third group of economists argues that financial development has a negative impact on economic growth. Van Wijnbergen (1982) and Buffie (1984) find that financial development has none or a negative impact on economic growth. Mauro (1995) states that the introduction of specific financial tools that permit individuals to hedge against risks, i.e., allowing portfolio diversification may decrease the precautionary saving and thus impede economic growth. Hye's (2011) study on the relationship between economic growth and financial development in India over the period of 1973-2008 shows that the Financial Development Index (FDI) has negative impacts on economic growth both in long-run and short-run. He also finds that the real interest rate also negatively effects the economic growth in the long-run. Hye and Islam (2013) conduct another study to investigate the relationship between financial development and economic growth in Bangladesh with the annual time series data from 1975 to 2009. By using ARDL approach, they find that the financial development index (FDI) and real interest rate have a negative impact on economic growth.

Moreover, economists have different types of opinions regarding the direction of causality. The findings of the first group of researchers suggest that economic growth causes financial development. By employing a Vector Error Correction Model (VECM), Vazakidis & Adamopoulos (2009) investigate the relationship between economic growth and credit market development in Italy for the period of 1965-2007. Their empirical results show that economic growth has a positive effect on credit market development, while the inflation rate has a negative effect. Muhsin & Eric's (2000) study on the data of Turkey lends further credence to this postulation. From the empirical results, they find that when bank deposit, domestic credit or private sector credit ratios alternatively use as a proxy for financial development; then economic growth causes financial development. Hence, they conclude that economic growth seems to lead financial sector development. Akpansung et al. (2011) conduct a study with annual data of Nigeria from 1970 to 2008. By using a Two-Stage Least Squares (TSLS) regression analysis and a Granger causality test for the causal direction they find that, private sector credit positively affects the GDP growth in Nigeria and there is a unidirectional causal relationship from GDP to private sector credit.

But the second group of researchers argues that the financial market development or credit growth causes economic growth. Demirguc-Kunt & Levine (2008) use a dataset of 44 countries and 36 industries in the manufacturing sector. After reviewing various analytical methods uses in the finance literature, they find that financial development enhances economic growth by repealing growth constraints on the small firms. Global Financial Stability Report of IMF (2008) identifies a positive and statistically significant impact of credit growth on GDP growth. Specifically, it finds that a credit crunch and a credit squeeze spread evenly over three quarters in the USA will reduce GDP growth by about 1.4% and 0.8% points year-on-year respectively, assuming no other supply shocks to the system.

While Favara (2003) uses an unbalanced panel dataset of 87 countries over the period of 1960-1998 and finds that the economic growth and financial development are correlated but financial development does not cause economic growth. His study also shows that relationship between economic growth and financial development is quite heterogeneous across the countries. Hassan and Islam (2005) examine the causal relationship between financial development and growth, and trade openness and growth in Bangladesh by using annual data over the period of 1974-2003. By employing a VAR approach and Granger Causality test, they find no causal relationship between financial development and economic growth; and trade openness and economic growth.

The findings of the last group of researchers show a bi-directional relationship between finance and growth. Greenwood and Jovanovic's (1990) theoretical study suggest a two-way causal relationship between financial development and economic growth. They find that financial intermediation promotes growth for a potential chance of earning a higher rate of return on capital. In turn, growth facilitates to implement costly financial structures. Demetriades & Hussein (1996) conduct a study with time series dataset of 16 less developed countries over the period of 1960-1990. They find a long-run relationship between financial development indicators and per capita GDP in 13 countries. Among these 13 countries, six show bi-directional causality and six other countries show reverse causality. Luintel and Khan (1999) examine this causal relationship for ten less developed countries of Asia, Africa, Europe, and South America. Their study shows a positive effect of financial depth on real income and real interest rate. Their findings also indicate a bi-directional causality between economic growth and financial development. Bayoumi & Melander's (2008) study with US data identifies that a 2.5% reduction in total credit reduces the whole GDP by around 1.5%. Their findings also reveal that economic growth can also be a causal factor for financial development. Mishra et al. (2009) examine the direction of causality in India by using annual data over the period of 1980-2008. They apply the Granger Causality Test in VAR framework and find that credit market development spurs economic growth. The empirical results also indicate a positive effect of economic growth on credit market development in India. Perera, N. & Paudel, R. (2009) conduct a study to investigate this direction of causality in Sri Lanka by considering data from 1955 to 2005. After using Johansen cointegration and VECM approach they find a bi-directional causality between broad money and economic growth in Sri Lanka.

Existing literature shows that economists have different opinion regarding the nature of the relationship between economic growth and financial development or credit growth. But a major portion of the economists finds a positive relationship between these two. In addition, the direction of this relationship differs from country to country. Therefore, the study of the causal relationship between financial development and economic growth is still a debating issue in the empirical literature.

Chapter-III: Data and Methodology

3.1. Data

This study uses annual time series data of Bangladesh over the period of 1976 to 2017 (42 years). Based on the experience from reviewing existing literature, this paper uses the following time series variables in this study:

GDP : Annual growth rate of Gross Domestic Product (GDP) as the dependent variable;

PC : Annual growth rate of Private sector Credit provided by all commercial banks, which is the main regressor and represents financial development;

X : Exports of goods and services as a percentage of GDP, which represents trade openness;

IPI : Industrial Production Index (the base year 2005), which measures the changes of value addition in manufacturing, construction, and utilities; and

BM : Broad Money (% of GDP), which includes currency outside banks, time and demand deposits, foreign currency deposit other than the central bank, travelers check, commercial paper etc.

The source of the private sector credit growth data is annual publications of Bangladesh Bank, which are available in Bangladesh Bank web site (from the year 2000) and Bangladesh Bank library. The source of all other data is the world development indicators database of the World Bank.

3.2. Methodology

At first, Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test examine the stationarity properties of all the time series variables. In order to investigate the short-run and long-run relationship between economic growth and private sector credit growth, this study apply the Autoregressive Distributed Lag (ARDL) approach. Specifically, the Long Run Form and Bound test check the long-run relationship and the Error Correction Form checks the short-run relationship among the variables. Then the LM test and Heteroscedasticity Tests examine the residual diagnostic, and CUSUM test and CUSUM of square test check the stability of the model. Finally, to find out the causality and direction of causality among the variables, this paper uses the Toda and Yamamoto (1995) procedure of Granger Causality test in standard VAR approach.

In this study, private sector credit growth (PC), export of goods and services (X), the natural logarithm of industrial production index (LnIPI), and broad money (BM) determine the GDP growth rate. Hence, the specific economic model is as follows:

$$\mathbf{GDP} = f\,\mathbf{(PC, X, LnIPI, BM)} \qquad (1)$$

From equation (1), following preliminary econometric model can be derived:

$$\mathbf{GDP_t = \beta_0 + \beta_1\, PC_t + \beta_2\, X_t + \beta_3\, LnIPI_t + \beta_4\, BM_t + \mu_t} \qquad (2)$$

Where, μ_t is the random error term; β_0 is the constant term; β_1, β_2, β_3 and β_4 are the coefficients.

3.2.1. Stationarity Test (Unit Root Test)

In time series analysis, it is very important to use a stationary time series to avoid spurious causality. Spurious causality refers to a strong relationship between two non-stationary time series variables, while no causality exists between them. If mean, variance and auto-covariance of a time series do not depend on time, then the series is known as stationary (i.e. no unit root). Otherwise, it is known as non-stationary time series (i.e. unit root) (Gujarati, 2009).

If the stationarity test shows a time series as stationary at level (without differencing, i.e., Y_t), then the series will be integrated of order 0 or I (0). On the other hand, if the test shows a series as stationary at first difference (i.e., Y_t - Y_{t-1}), then the series will be integrated of order 1 or I (1).

3.2.1.1. Augmented Dickey-Fuller (ADF) Test

ADF test is based on the following regression equation:

$$\Delta Y_t = \alpha_1 + \alpha_2 t + \delta Y_{t-1} + \sum_{i=1}^{n} d_i \Delta Y_{t-i} + \varepsilon_t \qquad (3)$$

Where, $\Delta Y_t = Y_t - Y_{t-1}$, α_1 is the constant term, t is the time trend, Δ is the first difference operator, n is the optimum number of lags and ε_t is the pure white noise term.

The null hypothesis of the ADF test is H_O: $\delta = 0$, i.e., the time series is non-stationary (has a unit root).

3.2.1.2. Phillips-Perron (PP) Test

In addition to the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test cross-checks the stationarity properties of every time series variables. PP test does not require to select the level of serial correlation as like ADF, i.e., no need to add lagged difference term. Hence, the PP test is based on the following regression equation:

$$\Delta Y_t = \alpha_0 + \gamma t + \delta Y_{t-1} + \varepsilon_t \qquad (4)$$

Like the ADF test, the null hypothesis of the PP test is H_O: $\delta = 0$, i.e., the time series is non-stationary (has a unit root).

3.2.2. Autoregressive Distributed Lag (ARDL) Approach

This study applies the Autoregressive Distributed Lag (ARDL) approach to test cointegration among the variables. ARDL approach is preferable to other conventional techniques, e.g., Engle and Granger (1987), Johansen (1991), and Gregory and Hansen's (1996). Because, the ARDL approach is applicable irrespective of whether the regressors are I (0), I (1) or mutually integrated (Pesaran et al. 2001).

Based on the ARDL model specification by Pesaran et al. (2001), following ARDL model can be derived from the preliminary econometric model of equation (2):

$$\Delta GDP_t = c_0 + c_1t + \pi_1 GDP_{t-1} + \pi_2 PC_{t-1} + \pi_3 X_{t-1} + \pi_4 LnIPI_{t-1} + \pi_5 BM_{t-1} + \sum_{i=1}^{n} \alpha i \Delta GDP_{t-i}$$

$$+ \sum_{i=0}^{n} \theta i \Delta PC_{t-i} + \sum_{i=0}^{n} \delta i \Delta X_{t-i} + \sum_{i=0}^{n} \rho i \Delta LnIPI_{t-i} + \sum_{i=0}^{n} \omega i \Delta BM_{t-i} + \mu_t \qquad (5)$$

Where, c_0 is the intercept, c_1t is deterministic time trend, π_i represent the long-run coefficients; α_i, θ_i, δ_i, ρ_i, ω_i are the short-run coefficients, n is the optimum lag, μ_t is the white noise error term.

There are two steps in the ARDL approach to estimate the long-run relationship (Pesaran et al., 2001, Hye and Islam, 2013). The first step is to examine the existence of a long-run relationship among the variables. The second step involves the estimation of long-run coefficients of the model.

At first, the ARDL Long Run Form and Bound test investigate the existence of a long-run relationship among the variables. Familiar F-statistic examines the null hypothesis of the non-existence of the long-run relationship among the coefficients of lagged variables, π_i.

H_0: $\pi_1 = \pi_2 = \pi_3 = \pi_4 = \pi_5 = 0$ (no cointegration i.e., no long-run relationship)

Against alternative hypothesis,

H_1: $\pi_1 \neq 0, \pi_2 \neq 0, \pi_3 \neq 0, \pi_4 \neq 0$ $\pi_5 \neq 0$ (Cointegration)

Pesaran et al. (2001) suggest two sets of asymptotic critical values. The first set assumes that all underlying variables are integrated at the level, i.e., I (0), while the second set assumes that all underlying variables are integrated of order one, i.e., I (1). If the computed F-statistic is higher than the upper critical bound, then the null hypothesis of no cointegration can be rejected, i.e., a long run relationship exists among variables. If the F-statistics falls between the lower and upper critical bounds, then no conclusion can be drawn from the result. If the F-statistics is less than the lower critical bound, then the null hypothesis cannot be rejected.

If the long-run relationship exists among the variables, then the long-run and short-run coefficients of the model can be estimate. This study identifies the short-run dynamic parameters by estimating the following Error Correction Model (ECM) based on reduced ARDL specification from equation (5):

$$\Delta GDP_t = \sum_{i=1}^{n} \alpha i \Delta GDP_{t-i} + \sum_{i=0}^{n} \theta i \Delta PC_{t-i} + \sum_{i=0}^{n} \delta i \Delta X_{t-i} + \sum_{i=0}^{n} \rho i \Delta LnIPI_{t-i} + \sum_{i=0}^{n} \omega i \Delta BM_{t-i} + ecm_{t-1} + \mu_t \quad (6)$$

Where, α_i, θ_i, δ_i, ρ_i, ω_i are the short-run coefficients, ecm_{t-1} is the error correction coefficient, which indicates the speed of adjustment required to restore equilibrium in the long-run.

3.2.3. Toda-Yamamoto Granger Causality test in VAR Approach

Modified Wald test in the VAR approach propose by Toda and Yamamoto (1995) investigate the causality. This relatively new approach can overcome the problems of traditional Granger Causality test by avoiding any possible non-stationary or cointegration among the variables during the causality test. Toda and Yamamoto (1995) suggest this approach to estimate VAR model formulated in the levels of the data and test causality among variables on the parameter matrices even if the variables are integrated or cointegrated in a different order.

The Toda and Yamamoto procedure of Granger Causality test starts with the determination of optimal lag length *k* by applying usual lag selection procedure. Then the maximal order of integration, d_{max}, need to find out. If the stationarity test (unit root test) shows that the variables are stationary at I (0), I (1) and I (2), the d_{max} will be 2. To make a valid model, *k* should be greater than or equal to d_{max}, i.e., $k \geq d_{max}$. Finally, it is necessary to estimate a $(k + d_{max})^{th}$ order of VAR and check Block Exogeneity Wald test for the direction of causality.

To apply the Toda-Yamamoto procedure of Granger Causality test, the preliminary econometric model of equation (2) requires to convert into the following VAR system:

$$GDP_t = \alpha_0 + M + \Upsilon_{1t} \quad (7)$$

$$PC_t = \theta_0 + M + \Upsilon_{2t} \quad (8)$$

$$X_t = \delta_0 + M + \Upsilon_{3t} \quad (9)$$

$$LnIPI_t = \rho_0 + M + \Upsilon_{4t} \quad (10)$$

$$BM_t = \omega_0 + M + \Upsilon_{5t} \quad (11)$$

Where, $M \equiv \sum_{i=1}^{k} \alpha_{1i}\, GDP_{t-I} + \sum_{i=k+1}^{dmax} \alpha_{2i}\, GDP_{t-i} + \sum_{i=1}^{k} \theta_{1i}\, PC_{t-I} + \sum_{i=k+1}^{dmax} \theta_{2i}\, PC_{t-i} + \sum_{i=1}^{k} \delta_{1i}\, X_{t-I} + \sum_{i=k+1}^{dmax} \delta_{2i}\, X_{t-i} + \sum_{i=1}^{k} \rho_{1i}\, LnIPI_{t-I} + \sum_{i=k+1}^{dmax} \rho_{2i} LnIPI_{t-i} + \sum_{i=1}^{k} \omega_{1i}\, BM_{t-I} + \sum_{i=k+1}^{dmax} \omega_{2i}\, BM_{t-I}$;

Υ_{it} = Residual of the model; and

Variables are defined as equation (2).

From equation (7), PC causes GDP if $\theta_{1i} \neq 0$, $\forall i = 1,2,\ldots,k$. This rule of causality is applicable for all other variables and equations. The Toda-Yamamoto procedure ignores the coefficient matrices of the last d_{max} lagged vectors in the model and test the linear or nonlinear restrictions on the first *k* coefficient matrices using the standard asymptotic theory.

Chapter-IV: Empirical Results and Discussion

4.1. Descriptive Statistics

There are five variables in this study. Table-1 shows the descriptive statistics for all of the research variables. Table-1 indicates that there is no missing observation. Mean, Median and standard deviation value indicate that all of the variables are normally distributed. All the variables except GDP are positively skewed.

Table 1. Descriptive Statistics for the variables

	GDP	PC	X	LnIPI	BM
Mean	4.996	19.333	10.814	4.096	34.699
Median	5.099	18.640	10.693	4.048	27.059
Maximum	7.284	33.000	20.162	5.630	65.848
Minimum	0.819	10.800	3.396	2.950	11.418
Std. Dev.	1.517	5.580	5.186	0.818	17.952
Skewness	-0.550	0.523	0.324	0.239	0.459
Kurtosis	2.973	2.688	1.733	1.833	1.737
Jarque-Bera	2.116	2.082	3.543	2.784	4.266
Probability	0.347	0.353	0.170	0.249	0.118
Observations	42	42	42	42	42

4.2. Stationarity Test (Unit Root Test)

To identify the order of integration, this study uses different unit root tests. Table-2 shows the unit root test results in Augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) method by using the time trend with constant.

Table-2, unit root results of both ADF and PP test, reveals that GDP and PC are stationary at the level, i.e., they are integrated in 0. While X, LnIPI, and BM are stationary at first difference, i.e. they are integrated in 1. Hence, all the variables are integrated at I (0) and I (1).

Table 2. Results of unit root tests

Variables	At Levels		At 1st Difference		Remarks
	ADF	PP	ADF	PP	I(d)
GDP	-3.7791 (0.0311)**	-8.2307 (0.0000)***	-	-	I(0)
PC	-5.3870 (0.0004)***	-5.5260 (0.0003)***	-	-	I(0)
X	-1.9571 (0.6066)	-1.9571 (0.6066)	-6.4768 (0.0000)***	-6.4768 (0.0000)***	I(1)
LnIPI	-1.1914 (0.8977)	-1.7875 (0.6925)	-4.4860 (0.0052)***	-5.3128 (0.0005)***	I(1)
BM	-1.6833 (0.7406)	-1.7849 (0.6938)	-5.0240 (0.0011)***	-4.9508 (0.0014)***	I(1)

Note 1: *** Rejection of null hypothesis (series is non-stationary) at the 1% level.
Note 2: ** Rejection of null hypothesis (series is non-stationary) at the 5% level.
Note 3: P-values are in parenthesis.
Note 4: I(d) denote the order of integration.
Note 5: For ADF the lag lengths selection is based on AIC (Akaike, 1974). For PP the bandwidth selection is based on Newey and West (1994) method using Bartlett Kernel.

4.3. Autoregressive Distributed Lag (ARDL) Approach

Since the variables are integrated at I (0) and I (1), this study proceeds for the bounds testing procedure in the ARDL approach (Pesaran et al. (2001)). Bound testing involves two steps. At first, estimation of the F-statistic and then compare this F-statistic with the critical values. By applying the ADRL approach for equation (5) with automatic lag selection in Akaike Information Criterion (AIC), F-statistic can be estimate under three different options. Table-3 shows that F-statistic in all three options is significant at 1% level, but ‘Only Intercept’ option provides the highest F-statistic (9.1978). In addition, data shows that ‘Intercept’ is significant, but ‘Trend’ is insignificant. Hence, this study selects ‘Only Intercept’ option for bound testing and compare this F-statistic with critical values, and report the results in Table-4.

Table-3 and Table-4 show that, calculated F-statistic (9.1978) is much bigger than the upper bound critical value (4.37) at 1% significant level. Therefore, the null hypothesis (no cointegration) can be rejected at 1% significant level and conclude that there is a long-run relationship among the variables.

Table 3. Bound test for a long-run relationship

Particulars	No Intercept, no Trend	Only Intercept	Both Intercept and Trend
Computed F-Statistic	4.8042***	9.1978***	7.4068***

Note: *** Rejection of null hypothesis (no levels relationship) at the 1% level.

Table 4. Critical Value Bounds for the only Intercept

Level of significance	Lower Bound, I(0)	Upper Bound, I(1)
1%	3.29	4.37
5%	2.56	3.49
10%	2.20	3.09

Since there is a long-run relationship among the variables, the study examines the significance of long-run coefficients and report the estimated results in Table-5. The results of Table-5 suggest that the annual growth rate of private sector credit (PC) and industrial production index (LnIPI) have a positive and significant effect on annual growth rate of GDP (GDP) at 5% and 10% level of significance respectively. The results also indicate that a 1% increase in PC will increase the GDP by 0.1484%. While a 1% increase in IPI will increase the GDP by 0.0636%. Coefficients of Export (X) and Broad Money (BM) are negative but insignificant.

Table 5. Estimated Long-run Coefficients

ARDL(4, 4, 3, 4, 2) automatically selected based on the AIC Dependent Variable: GDP (Annual growth rate of GDP)				
Regressor	Coefficient	Std. Error	t-Statistic	Prob.
PC	0.1484	0.0694	2.1376	0.0483
X	-0.4329	0.2909	-1.4878	0.1563
LnIPI	6.3610	3.1193	2.0393	0.0583
BM	-0.0355	0.0391	-0.9070	0.3779
C	-15.2209	8.6845	-1.7527	0.0988
EC = GDP - (0.1484PC - 0.4329X + 6.3610LnIPI - 0.0355BM - 15.2209)				

Table-6 reports the results of short-run dynamic coefficients obtained from the error correction model (ECM). The results of Table-6 suggest that private sector credit growth (PC), Export (X) and industrial production index (IPI) have a positive and statistically significant effect on the annual growth rate of GDP (GDP) in short-run. While broad money (BM) negatively affects the GDP growth rate. The estimated error correction term (ecm_{t-1}) is -0.9061. It is very large but negative and statistically significant at 1% significance level, which indicates a high speed of adjustment rate to restore equilibrium in long-run.

In addition, the bottom part of Table-6 shows some diagnostic result of the model. Computed R^2 is 0.9691, which is high and implies that the regression fits reasonably well. Durbin-Watson stat of the model is 2.40, which indicates the probability that the model is free from autocorrelation.

Table 6. Estimated Short-run Error Correction Coefficients

ARDL Error Correction Regression Dependent Variable: ΔGDP_t				
Regressor	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.4012	0.1185	-3.3860	0.0038
D(GDP(-2))	0.0777	0.1295	0.5997	0.5571
D(GDP(-3))	0.4389	0.1112	3.9480	0.0012
D(PC)	0.0851	0.0219	3.8885	0.0013
D(PC(-1))	-0.0170	0.0213	-0.7983	0.4364
D(PC(-2))	-0.0833	0.0211	-3.9436	0.0012
D(PC(-3))	-0.1029	0.0209	-4.9254	0.0002
D(X)	0.2011	0.0751	2.6770	0.0165
D(X(-1))	0.2867	0.0834	3.4373	0.0034
D(X(-2))	0.3267	0.0742	4.4017	0.0004
D(LNIPI)	9.5085	5.4389	1.7483	0.0996
D(LNIPI(-1))	-8.8004	5.9961	-1.4677	0.1616
D(LNIPI(-2))	-26.5650	5.3623	-4.9541	0.0001
D(LNIPI(-3))	-13.6806	5.8268	-2.3479	0.0321
D(BM)	-0.1589	0.0409	-3.8801	0.0013
D(BM(-1))	-0.1006	0.0426	-2.3614	0.0312
ECM_{t-1} [CointEq(-1)*]	-0.9061	0.1065	-8.5107	0.0000
R-squared	0.9691			
Adjusted R-squared	0.9456			
Akaike info criterion	1.4092			
Schwarz criterion	2.1418			
Hannan-Quinn criter.	1.6698			
Durbin-Watson stat	2.4024			

Table-7 reports the estimated long-run coefficients, where all of the variables are in growth term. The result of Table-7 is compatible with Table-5. Table-7 indicates that the annual growth rate of private sector credit (PC_G) and annual growth rate of industrial production index (IPI_G) have a positive and significant effect on annual growth rate of GDP (GDP_G) at 1% and 5% level of significance. Coefficients of Export (X) and Broad Money (BM) are negative but insignificant.

Table 7. Estimated Long-run Coefficients for variables in growth term

ARDL(1, 0, 1, 2, 0) automatically selected based on the AIC Dependent Variable: GDP_G (Annual growth rate of GDP)				
Regressor	Coefficient	Std. Error	t-Statistic	Prob.
PC_G	0.0856	0.0239	3.5762	0.0012
X_G	0.0048	0.0076	0.6336	0.5312
IPI_G	13.8826	5.7111	2.4308	0.0213
BM_G	-0.0094	0.0137	-0.6835	0.4995
@TREND	0.0791	0.0107	7.3699	0.0000
EC = GDP_G - (0.0856 PC_G + 0.0048 X_G + 13.8826 IPI_G - 0.0094 BM_G + 0.0790*@TREND)				

4.4. Residual Diagnostic and Stability Test

Durbin-Watson stat (2.40) from Table-6 indicates that the model is probably free from autocorrelation problem. For confirmation, this study uses the Breusch-Godfrey Serial Correlation LM Test with different lags and present the result in Table-8. Since the maximum lag length is 4 in the ARDL model, the LM test considered up to 4 lags. In every lag, lower F-statistics and high probabilities suggest that the null hypothesis of no serial auto-correlation cannot be rejected. Therefore, the estimated model is free from serial auto-correlation.

Table 8. Breusch-Godfrey Serial Correlation LM Test

Number of lags	F-statistic	Prob.
0	1.2098	F(1,15) = 0.2887
1	1.2098	F(1,15) = 0.2887
2	1.2928	F(2,14) = 0.3053
3	1.4169	F(3,13) = 0.2825
4	1.1009	F(4,12) = 0.4001

Table-9 reports the result of Heteroskedasticity test. The results indicate that all of the three probabilities are more than 5%. Therefore, the null hypothesis of Homoskedasticity fail to reject, which means the estimated model is free from Heteroskedasticity.

Table 9. Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.215284	Prob. F(21,16)	0.0546
Obs*R-squared	28.27526	Prob. Chi-Square(21)	0.1325
Scaled explained SS	2.731125	Prob. Chi-Square(21)	1.0000

The estimated coefficients from the ARDL long-run form and error correction model do not necessarily imply that they are stable. In this case, Pesaran et al. (2001) suggest conducting stability test for estimated coefficients. Regression of time series data is based on the assumption that the regression relationship is constant over time. To examine the stability of the regression relationship, Brown et al. (1975) introduce recursive residuals and test them, which are generally known as cumulative sum (CUSUM) of recursive residuals test and cumulative square sum (CUSUMSQ) of recursive residuals test. Figure-1 and Figure-2 represent the CUSUM and CUSUMSQ statistics plotted at a 5% level of significance for the estimated coefficients of the model. The blue line of Figure-1 and Figure-2 represent the test results and both blue lines lay within the critical boundaries at a 5% level of significance, which implies that the estimated coefficients of the model are stable.

Figure-1. CUSUM test

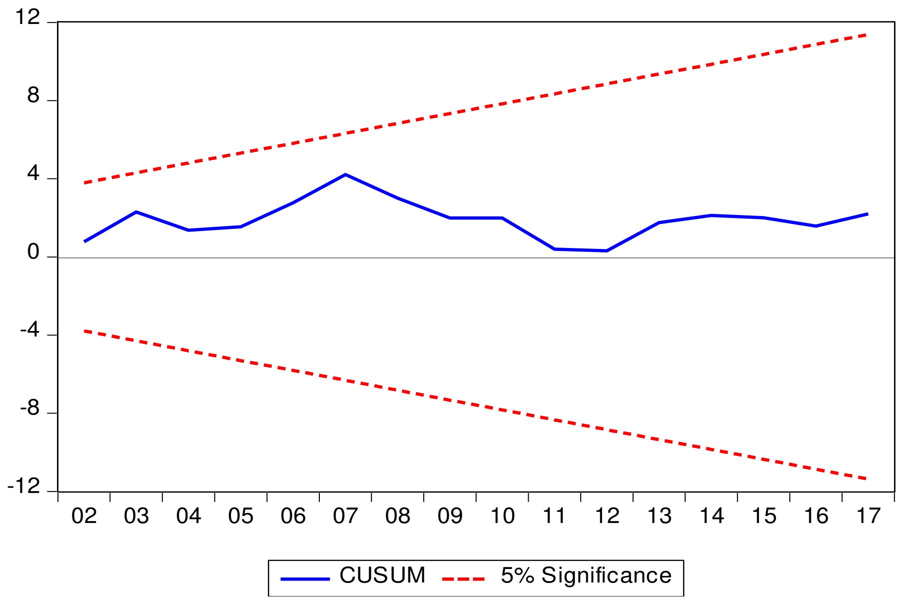
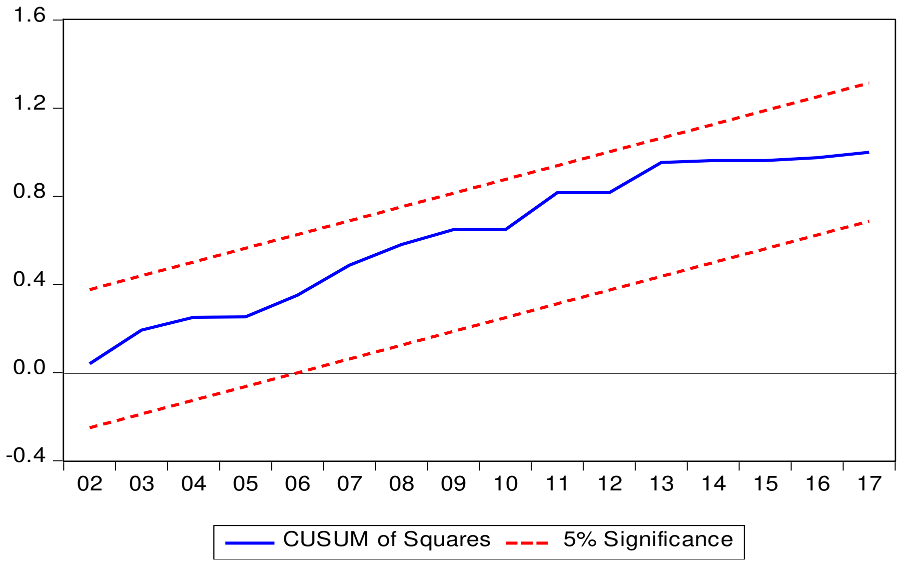


Figure-2. CUSUM square test



4.5. Toda-Yamamoto Tests of Granger Causality

Finally, to investigate the direction of causality, this study estimates a VAR model using the Toda-Yamamoto procedure. For the VAR model, the optimum lag length (k) determined by using likelihood ratio (LR), FPE, Akaike Information Criterion (AIC), Schwarz Criterion (SC) and HQ criterion. Table-8 shows the results for all of these criterions. Based on the minimum value of AIC, FPE and HQ criterions, the optimum lag length (k) is 5.

Table 10. VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-367.0690	NA	373.3502	20.11184	20.32953	20.18858
1	-177.6316	317.4356	0.052255	11.22333	12.52948*	11.68381
2	-159.9715	24.81959	0.084016	11.62008	14.01469	12.46429
3	-121.3998	43.78413*	0.049867	10.88647	14.36954	12.11442
4	-93.03063	24.53549	0.065781	10.70436	15.27588	12.31603
5	-37.03227	33.29632	0.031384*	9.028771*	14.68875	11.02418*

The unit root test result of Table-2 already indicates that the maximum order of integration is I (1), which implies that the d_{max} is 1. Therefore, the $(k+d_{max})^{th}$ order, i.e., 6^{th} order VAR need to run in Toda-Yamamoto procedure and present the Granger Causality or Block Exogeneity Wald test result in Table-9. The result of Table-9 shows that the GDP growth rate positively causes Private sector credit growth rate (PC). But PC does not cause GDP. Hence, it implies that there is a strong positive unidirectional causality from GDP to PC.

Table-9 also indicates that export (X) and Broad money (BM) also cause PC. GDP, PC, IPI and BM positively cause the export of goods and services (X). Hence, private sector credit growth (PC) and export (X) cause each other. But there is no evidence that GDP growth rate, Industrial production index (IPI) and Broad money (BM) are significantly caused by any of the regressor variables.

Table 11.Toda-Yamamoto Causality (Block Exogeneity Wald) test result

Null Hypothesis	Chi-sq	Prob.	Direction of causality
PC does not cause GDP	3.5057	0.6225	No causality
X does not cause GDP	5.0905	0.4049	No causality
IPI does not cause GDP	1.2346	0.9415	No causality
BM does not cause GDP	0.5650	0.9895	No causality
GDP does not cause PC	19.2946	0.0017	GDP → PC
X does not cause PC	12.8390	0.0249	X → PC
IPI does not cause PC	4.5188	0.4774	No causality
BM does not cause PC	9.5781	0.0881	BM → PC
GDP does not cause X	23.3608	0.0003	GDP → X
PC does not cause X	26.1317	0.0001	PC → X
IPI does not cause X	17.9592	0.0030	IPI → X
BM does not cause X	17.2372	0.0041	BM → X
GDP does not cause IPI	1.133428	0.9511	No causality
PC does not cause IPI	2.629324	0.7569	No causality
X does not cause IPI	5.554526	0.3520	No causality
BM does not cause IPI	2.538936	0.7706	No causality
GDP does not cause BM	3.195606	0.6699	No causality
PC does not cause BM	4.496776	0.4803	No causality
X does not cause BM	4.245908	0.5146	No causality
IPI does not cause BM	7.862891	0.1640	No causality

Chapter-V: Conclusion

Economists have a different opinion regarding the nature and direction of the relationship between economic growth and financial development. One group think financial development causes economic growth, another group think that economic growth causes financial development, while some others think that this relationship is not important at all. In light of this conflicting view, this paper investigates the nature and direction of the relationship between financial development and economic growth in Bangladesh. Annual growth rate of GDP represents economic growth, while private sector credit growth (PC) and broad money (BM) represent financial market development. In addition, this paper uses the export of goods and services (X) and industrial production index (IPI) to examine their effect on economic growth. The Augmented Dickey-Fuller (ADF) and the Phillip-Perron (PP) unit root tests show that all of these annual time series are integrated in level, I (0) and first order, I (1). Therefore, the Autoregressive Distributed Lag (ARDL) approach has been used to investigate the long-run and short-run relationship among the variables.

The empirical results show that private sector credit growth (PC) and industrial production index (IPI) positively affect the annual growth rate of GDP both in long-run and short-run. While the export of goods and services (X) and broad money (BM) have a short-run effect on GDP. Export of goods and services (X) affects positively but broad money (BM) affects negatively. These results imply that there is a positive relationship between financial market development and economic growth. This result is consistent with the theories and findings of Schumpeter (1911), McKinnon's (1973), King and Levine’s (1993), Rahman (2004), Loayza and Ranciere (2006), Cappiello et al. (2010), Hossain et al. (2015) etc.

To examine the direction of causality, this paper applies Granger-Causality test in the VAR model using the Toda-Yamamoto procedure. The result shows that annual growth rate of GDP (GDP) causes private sector credit growth (PC), but there is no evidence that PC causes GDP. In addition, export (X) and broad money (BM) also cause PC. Results also show that GDP, PC, IPI and BM cause export (X). Hence, the result implies that the economic growth fosters financial market development. This result is consistent with Vazakidis & Adamopoulos (2009), Muhsin & Eric (2000), and Akpansung, A. O., & Babalola, S. J. (2011).

This paper investigates the relationship between private sector credit growth and economic growth by using annual time series data of Bangladesh. Therefore, the finding of this paper holds true specifically for Bangladesh. There is a scope of further study in this field by using cross sectional data of other countries.

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