JOURNAL OF ECONOMIC DEVELOPMENT 115
Volume 45, Number 2, June 2020

MACROECONOMIC VARIABLES AND STOCK RETURNS IN BANGLADESH: AN EMPIRICAL ANALYSIS IN THE PRESENCE OF STRUCTURAL BREAKS

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This paper examines the long-run relationship between stock market indices in Bangladesh using exchange rate (ER), domestic credit provided by banks (DCB), industrial production index (IPI), and crude oil price (COP) in the presence of structural breaks. The study used time series data from 2009 to 2017 and applied ARDL bounds testing approach. Both conventional unit root and unit root tests in the presence of structural breakpoints are conducted. ARDL bounds testing approach confirms the presence of a long-run relationship among the selected variables and the stock market crash of 2010 and oil price shock of 2011 are found to have a significant effect on the stock price fluctuations in both stock exchanges in Bangladesh. The error correction term suggests that 43.3% of the disequilibrium in Dhaka Stock Exchange (DSE) returns is adjusted monthly to get back to the long-run equilibrium, whereas the value is 34.9% for Chittagong Stock Exchange (CSE). Moreover, ER, DCB, and COP have a significant positive impact on stock prices for both stock exchanges. The policy guideline of this study is that the regulators in foreign exchange market, banking sector, and capital market should work together to make prudential regulatory framework with a view to transforming both stock exchanges into a robust one within the South Asian region.

Keywords: Stock Market, Macroeconomic Variables, Bangladesh, Structural Break, ARDL, Cointegration
JEL Classification: C51, C13, G14, G15

1. INTRODUCTION

South Asia has maintained its top spot as the world’s fastest growing region with growth rate set to reach seven percent in 2019 (The World Bank, 2019). This robust economic growth is one of the main reasons in making the capital markets of this region attractive investment opportunities for both domestic and foreign investors. This favourable outlook of investors is crucial for stock markets in South Asian countries like Bangladesh to be more robust in performance. An efficient stock market plays an important role in industrial and economic development by making intermediate and long-term funds available to businesses, governments, and individuals (Hearn and Piesse, 2010).

The United Nations (UN) has recently granted Bangladesh the “Developing Country” status. On top of that, the government of Bangladesh has set its sight on becoming a “Developed Country” by 2041. Various infrastructural and development projects need to be implemented in order to achieve this objective. Bangladesh must attract both foreign and domestic investors for financing these mega projects. But a robust stock market that Bangladesh is still missing at the moment is a must for channeling the inbound capital funds. The capital market of Bangladesh accounted for not more than 14.5% of its nominal GDP (CEIC Data, 2019). It is very negligible compared to other emerging economies around the world. Therefore, extensive research on the macroeconomic feature of the capital market is required to make better the overall scenario.

In the context of Bangladesh, the stock markets are inefficient and underdeveloped due to lack of knowledge and expertise in stock market operations (Bangladesh Bank, 2016). Moreover, the financial sector has recently been confronted with poor soundness of banks, limited availability of financial products and is currently facing difficulties in raising capital through the stock markets. After the stock market crash in 2010, the savers started to prefer banks to deposit their money and the government’s savings tools as the most attractive alternative investment options rather than investing in highly volatile stock market. Consequently, the stock market is facing severe liquidity problem despite having enough access liquidity with banks and investible surplus with millions of savers.

Bangladesh stock markets confronted two severe stock market crashes in 1996 and 2010. There has been an alarming bubble in stock markets in 1996 followed by a calamitous crash. For instance, the general index of Dhaka Stock Exchange (DSE) soared from about 800 points in June 1996 to around 3600 points in November 1996. Large investors along with some dominant market manipulators as well as insiders with access to asymmetric information left the market with huge profit and that resulted in losing the capital of most of the ill-fated and wretched small investors (Islam and Ahmed, 2015). Before reviving the fragile confidence of the investors, the market witnessed another sharp decline in 2010 that resulted in wiping out even the initial capital investment made by many investors. The market crash of late 2010 continued to be felt with the index point falling 3032 points in 2011 and a further 1038 points in 2012.

The underlying reasons behind these crashes have been identified by Choudhury (2013) who pointed out that lack of proper due diligence in opening beneficiary owner (BO) accounts, wrong placement of IPOs, speculations through omnibus account, violation of banking acts, lack of monitoring, rumor spread by brokers and dealers, and market rigging and manipulation through wrongful application of book building method are crucial factors contemplating these crashes. Therefore, the stock market of

Bangladesh may provide a good example for examining the effects of some macroeconomic factors on the returns of stock market indices in the presence of structural breaks. Moreover, the findings of the paper may provide new insights to the foreign and domestic investors who have little source of information regarding the macroeconomic aspect of Bangladeshi stock markets.

The presence of structural breaks in time series data is a common phenomenon that may arise from a good number of reasons which include, among others, economic or financial crises, policy changes, and regime shifts. Perron (1989) opined that if structural breaks are not dealt with properly, one may obtain spurious results. Therefore, in the present study, we used several structural break point tests to investigate the relationship between stock market indices and selected macroeconomic variables in Bangladesh. We applied both conventional unit root tests which do not consider any structural break in the data followed by more relevant unit root tests which allow one structural break (Zivot and Andrews test) and two structural breaks (Lumsdaine and Papell test) to examine the significance of structural breaks.

These two tests were used to endogenously determine the most significant structural break in the data. Moreover, Bai and Perron (2003) test of multiple structural break points has also been employed in this paper. Banda et al. (2019), Hondroyiannis and Papapetrou (2001) and Chang and Nieh (2004) applied Zivot and Andrews (ZA) test along with other standard unit root tests to explore the dynamic interrelation among macroeconomic variables. On the contrary, Narayan (2005) used both ZA test and Lumsdaine and Papell (LP) test to investigate the saving and investment nexus for China whereas Stylianou (2014) took the help of Bai and Perron (2003) test along with ZA test and other relevant unit root tests to explore the causal effect between debt and economic growth.

The impact of macroeconomic factors on stock exchange returns has been explored by many researchers (Palamalai, 2011; Abugri, 2008; Pradhan et al., 2015; Peiró, 2016). The studies by Shiller (1981) and LeRoy and Porter (1981) showed that the movement of stock prices is subject to change of some macroeconomic variables that may affect many firms' cash flows and influence the risk-adjusted discount rate. Some prior studies have investigated the macroeconomic impact on stock returns in the presence of structural breaks (Kan and Lim, 2015; Pan and Mishra, 2018; Shahbaz et al., 2013).

Palamalai (2011), Abugri (2008) and Pradhan et al. (2015) explored the impact of exchange rate along with other variables on stock prices. The effect of domestic credit provided by the banking sector on index returns has been investigated in these studies (Pradhan et al., 2014; Garcia and Liu, 1999). The impact of industrial production index on stock prices got the focal point in the research conducted by Tiwari et al. (2015) and Peiró (2016). On the other hand, Suleman and Wasim (2016) found a significant positive association between crude oil prices and stock prices. Similarly, Khan and Yousuf (2013) concluded that crude oil price has positive relation with stock prices in the long-run. On the contrary, Nisha (2016) suggested that the world oil price index has insignificant impact on DSE using VAR model.

After reviewing the previous studies on the relationship between selected macroeconomic variables and stock prices in Bangladesh, it is observed that none of previous studies applied a structural break point test in the context of Bangladesh stock market. Although the ARDL bounds testing is widely used to analyze the relationship between macroeconomic variables and stock prices without considering the role of structural breaks in the series, this study has overcome this issue by including dummy variables for structural break points. This may confirm more reliable and consistent findings than the previous ones. More specifically, the aim of this study is to scrutinize the impact of some key domestic macroeconomic variables namely domestic credit provided by banking sector and industrial production index as well as some international macroeconomic variables, such as exchange rate and crude oil prices on index returns of DSE and CSE in Bangladesh in the presence of structural breaks.

The remainder of this paper is organized as follows: Section 2 deals with the literature review. Section 3 describes the selected variables. Section 4 discusses the hypothesized relationship among the selected variables. Section 5 presents the research methodologies of the study. The empirical result is explained in Section 6. Section 7 concludes the study with some policy implications.

2. LITERATURE REVIEW

A good number of studies (Ahmed and Imam, 2007; Kan and Lim, 2015; Palamalai, 2011; Zakaria and Junyang, 2016) have concentrated their attention on the interaction between macroeconomic variables and stock market returns. Some of them (Kan and Lim, 2015; Pan and Mishra, 2018; Shahbaz et al., 2013) explored the relationship addressing the presence of structural breaks whereas others did not consider any structural breaks. Researchers have applied various econometric models in order to explore their intended objectives. Some (Khalid and Khan, 2017; Odhiambo, 2010; Pan and Mishra, 2018; Shahbaz et al., 2013) used ARDL bounds testing approach whereas other methods, such as VAR and VECM, were also considered.

Palamalai (2011) investigated the relationship between macroeconomic variables and stock returns in India by using multivariate cointegration technique. The results suggested that interest rate, money supply, and industrial production index had a significant positive relationship with stock prices in contrast to exchange rate which had a negative impact. Abugri (2008) applied a VAR model to explore the effect of major macroeconomic variables (exchange rate, interest rate, industrial production, and money supply) on stock returns in four Latin American Countries. Pradhan et al. (2015) used a panel VAR model in order to show that a robust long-run interaction existed among exchange rate, economic growth, stock market depth, oil prices, interest rate, and inflation rate in the G-20 countries. Khan and Yousuf (2013) demonstrated that interest rates, money supply, and crude oil prices had positive impact on stock prices while exchange rates affected stock returns negatively in Bangladesh by applying the similar co-integration technique.

Khalid and Khan (2017) found that interest rate had a negative impact on stock market indices while inflation and exchange rate exerted a positive impact on the market in Pakistan with the help of ARDL bounds testing approach. Ahmed and Imam (2007) used VECM to explore the macroeconomic relationship from the context of Bangladesh. They found that GDP growth, industrial production idex, and broad money supply were not co-integrated with stock returns although interest rate change and T-bill growth rate had some influence on the stock market. Nisha (2016) applied VAR model to investigate the impact of macroeconomic indicators on stock returns in Bangladesh. The result depicted that money supply affected stock market performance significantly. Zakaria and Junyang (2016) used structural VAR (SVAR) model and VECM to show that there was a long run relationship among exchange rate, interest rate, inflation, income, and stock returns in Bangladesh, Pakistan, India, and Sri Lanka.

Kan and Lim (2015) explored the influence of macroeconomic factors on stock prices in Malaysia with the help of multivariate co-integration analysis in the presence of structural breaks. They found that CPI contributed positively to stock returns in contrast to industrial production index and money supply which affected the market negatively. Pan and Mishra (2018) also considered structural breaks while investigating the relationship between Chinese real economy and its stock market by applying ARDL model. The results confirmed the presence of a long-run negative association between the Shanghai, a share market and the real sector of Chinese economy. Banda et al. (2019) addressed the relationship between inflation, economic output, interest rates and exchange rates and industrial shares in developing countries after considering any possible structural break. Shahbaz et al. (2013) used ARDL bounds testing approach in the presence of unknown structural breaks to explore the impact of macroeconomic factors on stock market performance in Pakistan. They showed that economic growth, inflation, financial development, and investment improved stock market performance.

Pradhan et al. (2014) tested the Granger causalities between banking sector developemnt, stock market development, economic growth, and four other macroeconomic variables in ASEAN countries with the help of a panel VAR model. The short-run Granger causality results showed the presence of a unidirectional causality from banking sector development (domestic credit sanctioned by the banking sector as one of the defining variables) to stock market development. Garcia and Liu (1999) used pooled data from 1980 to 1995 to explore the macroeconomic determinants of stock market development for 15 countries (Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela, Indonesia, Korea, Malaysia, the Philippines, Taiwan, Thailand, Japan, and the United States) based on regression analysis. The results indicated that domestic credit to the private sector as a percentage of GDP had a significantly positive effect on the capitalization of the stock market under consideration. Odhiambo (2010) applied ARDL model to demonstrate that the developement of banking sector and stock markets had a unique positive interaction among them in South Africa.

Tiwari et al. (2015) took the help of a conditional VAR model and a Granger

Causality test to demonstrate that a long-run unidirectional causality from stock returns to industrial production existed in the economy of India. Maysami et al. (2004) found a cointegrating relationship between stock index, industrial production, exchange rate, price levels, interest rate, and money supply in Singapore by applying the VECM. According to Peiró (2016), the movements in stock prices were caused by industrial production and interest rate in three largest European economies (France, Germany, and the United Kingdom).

On the other hand, Apergis and Miller (2009) investigated the impact of oil price changes on stock returns for eight countries (the United States, Germany, Japan, France, the United Kingdom, Canada, Italy, and Australia). They found that the impact of oil price shocks on stock returns was small in magnitude. Arouri and Fouquau (2009) examined the relationship between oil prices and Gulf Cooperating Council (GCC) stock markets. Their findings indicated that oil price increases affected stock markets in Oman, Qatar, and UAE positively. Suleman and Wasim (2016) also found a significant positive interaction between oil prices and stock indices in Bangladesh and Pakistan. From the perspective of the three BRIC's countries (Russia, India, and China), the results of Fang (2010) suggested that changes in oil price had no significant impact on stock returns in India but for Russia and China, the effects were significantly positive in nature.

Park and Ratti (2008) showed that there was a significant impact of oil price shock on stock returns in the U.S. and 13 European countries. Based on linear and asymmetric models, Arouri (2011) showed that the extent of the interaction between crude oil prices and European stock returns depended on the sector being considered. After studying this type of interdependence for both oil-importing and oil-exporting countries, Creti et al. (2014) found that the degree of interdependence was higher in exporting countries than in importing ones. Filis et al. (2011) investigated this type of interaction for six oil-importing (USA, Germany, Netherlands) and oil-exporting (Canada, Mexico, Brazil) countries. Their findings showed that all stock markets were affected negatively by oil prices. On the other hand, Nasr (2016) studied the influence of oil prices on stock returns in 26 oil-exporting and oil-importing countries with the help of ARDL approach. The study discovered that oil price changes affected stock prices positively in oil-exporting countries while the impact was negative in oil-importing countries.

Based on the empirical literature discussed above, it is apparent that various macroeconomic variables including exchange rate, domestic credit, industrial production index, and crude oil price affect the stock market of a country although the extent of this impact varies across stock markets. Moreover, the inclusion of structural breaks in studying this interaction strengthens the viability of the research. Although this type of research has been conducted on various occasions in different countries, the scenario is quite the opposite in Bangladesh especially in case of incorporating structural breaks. Therefore, it is not known to the policymakers of Bangladesh whether these macroeconomic variables have any impact on the country's stock markets at the presence of structural breaks. In order to fill this research gap, current study attempts to explore the interaction of the macroeconomic variables with stock returns in Bangladesh by considering any possible structural breaks.

3. VARIABLES CONSTRUCTION

Based on financial and economic theories as well as established literature, the following four domestic and foreign macroeconomic factors are treated as the independent variables and stock price indices of DSE and CSE are treated as the dependent variables. The domestic macroeconomic variables are domestic credit sanctioned by banking sector (DCB) and industrial production index (IPI), while exchange rate (ER) and crude oil price (COP) are treated as foreign macroeconomic factors. Monthly time series data over the period from July 2009 to July 2017 (97 observations) are considered for this study due to abnormal stock market behavior during this period. The data have been compiled from the monthly economic trend published by Bangladesh Bank (the central bank of Bangladesh) and the websites of DSE and CSE. The data of IPI have been collected from the website of BBS (Bangladesh Bureau of Statistics). For the proxy of crude oil price index, the crude oil price of Dubai Fateh has been used as United Arab Emirates (UAE) is one of the biggest suppliers of crude oil for Bangladesh.

Table 1. Definition of Selected Variables

Variable	Definition
Exchange Rate (ER)	It refers to the exchange rate of Bangladeshi Taka (BDT) per US dollar (USD).
Domestic Credit by Banking Sector (DCB)	It includes all the credit disbursed to various sectors on a gross basis by the banking system, with the exception of the credit to the central government.
Growth of Industrial Production Index (IPI)	It indicates the monthly growth rate of industrial production index which is considered as a proxy to gross domestic product (GDP).
Crude Oil Price (COP)	It is the spot price of a barrel of benchmark crude oil (Dubai Fateh).
Stock Index of DSE and CSE (SID and SIC)	They refer to the general and board index listed in DSE and all share price index listed in CSE.

Notes: The monetary measure of ER is in BDT/ USD; DCB in BDT (billion); IPI in percentage; COP in USD/Barrel; SID and SIC in points. The natural logarithmic form of all the variables except ER and IPI is used in the model.

4. MACROECONOMIC FACTORS AND STOCK RETURNS: HYPOTHESIZED RELATIONSHIPS

This section deals with the macroeconomic variables chosen for the study and their hypothesized relationships with the stock prices.

4.1. Exchange Rate (ER)

It is hypothesized that the relationship between ER and index reruns is negative. It is due to the cheaper products of Bangladesh given that BDT depreciates against USD. The scenario will translate into greater demand for Bangladeshi products. It will result in higher amount of cash inflows to Bangladeshi firms. Higher amount of cash inflows tends to push up the share price of that particular firm.

4.2. Domestic Credit Provided by Banking Sector (DCB)

Higher credit helps various entities increase the spending in productive resources resulting in higher production and higher GDP growth rate. Consequentially, higher GDP growth rate leads to higher earnings and higher stock prices. Thus, domestic credit provided by the banking sector has a significant positive link with stock prices. Garcia and Liu (1999) demonstrated this type of relationship in their study. In contrast, a negative link with stock prices may also be found. One plausible explanation for this negative relationship is due to the fact that income effect and substitution effect will cause individuals to switch to banks because of higher costs, risk, and time associated with stock markets.

4.3. Industrial Production Index (IPI)

The linkage between IPI and index returns is assumed to be positive. It is because the growing GDP will pave the way for companies to generate more cash inflows. This favourable scenario will push up the share prices of the companies.

4.4. Crude Oil Price (COP)

The relationship between oil prices and stock returns varies from country to country based on whether the country is an oil importer or exporter. Creti et al. (2014) found that oil-exporting countries tended to show stronger interdependency between the oil price and the stock market than oil-importing countries. Filis et al. (2011) showed that stock markets were affected negatively by oil prices. Higher oil prices reduce sales and profits of a company that results in a decline of stock prices. On the contrary, Creti et al. (2014) found a positive impact on stock returns due to the demand-side oil price shock.

Table 2. Hypothesized Relationship between Stock Prices and Macroeconomic Factors

Macroeconomic Variables	Expected Impact
Exchange Rate (ER)	-
Domestic credit sanctioned by banking sector (DCB)	+/-
Industrial Production Index (IPI)	+
Crude Oil Price (COP)	+/-

On the basis of the existing literature, the expected effect of each of the independent variables on stock prices is displayed in the Table 2.

5. DATA AND THE METHODS

All the variables except exchange (ER) and industrial production index (IPI) have been converted into natural logarithms to avoid the scaling problem. It will help in avoiding the sharpness and variations in the data and making a symmetric distribution so that coefficients cannot be influenced by extreme values (Abosedra et al., 2015; Khan and Yousuf, 2013). To examine the dynamic relationship between macroeconomic factors and stock prices, the data have been analyzed using the software packages like EViews 10 and RATS 9.2.

In the present study, the following models have been used:

$$SID_t = \beta_0 + \beta_1 ER_t + \beta_2 DCB_t + \beta_3 IPI_t + \beta_4 COP_t + \varepsilon_t, \quad (1)$$

$$SIC_t = \beta_0 + \beta_1 ER_t + \beta_2 DCB_t + \beta_3 IPI_t + \beta_4 COP_t + \varepsilon_t. \quad (2)$$

Here, β_0 is the intercept term; β_1, β_2, β_3, and β_4 represent the unknown coefficients to be estimated, and ε_t is the error term in the model.

In order to check the time series properties of the data, both the conventional unit root tests, such as Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) and the new testing procedures dealing with structural breaks like Zivot and Andrews (ZA) and Lumsdaine and Papell (LP) unit root tests are applied. ZA and LP test are used to check the stationarity of the data in the presence of structural breaks because of the low power of conventional unit root tests (Perron, 1989). If a time series is stationary at a mix of *I(0)* and *I(1)*, the ARDL bounds testing approach can be considered as VAR and VECM become invalid in this regard.

5.1. Unit Root Test without Structural Breaks

5.1.1. ADF Unit Root Test

To examine the presence of unit roots, ADF test can be used with serial correlation. The ADF test is based on the following equation:

$$\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t. \quad (3)$$

Here, y_t is the time series being tested; t is time trend variable; Δ is the first difference operator, and ε_t denotes white noise error term. The model adds the number of lags (k) to ensure that the residuals are uncorrelated. According to Said and Dickey (1984), the hypothesis for the test is as below:

- H_0: The time series is non-stationary; i.e. H_0: $\alpha = 0$
- H_1: The time series is stationary (or trend-stationary); i.e. H_1: $\alpha \neq 0$.

5.1.2. PP Unit Root Test

According to Phillips and Perron (1988), Phillip-Perron unit root test is also used as its reported statistics are robust to heteroskedasticity and serial correlation by using the Newey–West heteroskedasticity and autocorrelation consistent (HAC) covariance matrix estimator. The test is based on the same hypotheses and has the same asymptotic distributions like the ADF test. The fundamental equation for Phillips and Perron (1988) test is as follows:

$$x_t = \alpha + \delta_t + a x_{t-1} + e_t. \tag{8}$$

Here, α is the drift component; δ_t is the deterministic trend and e_t is the error term

The following hypotheses are assumed in PP test:

- H_0: $a = 1$ (data are not stationary)
- H_1: $a \neq 1$ (data are stationary).

5.2. Unit Root Test with Structural Breaks

According to Perron (1989), if structural changes are present in the data, the results of ADF and PP unit root tests may be biased towards the rejection of the non-stationarity of the data. As the economy of Bangladesh has been subjected to some structural breaks (such as stock market crash in 2010, oil price shock in 2011 and 2014-15), ZA and LP unit root tests are applied to check the stationarity of the data in the presence of structural breaks.

5.2.1. Zivot and Andrews (ZA) Unit Root Test with One Structural Break

ZA unit root test considers one endogenously determined structural break with the null hypothesis of the presence of unit root. The alternative hypothesis is a trend stationary series process that allows for a one-time break in the trend function (Zivot and Andrews, 1992).

The three basic models of ZA test are as follows:

Model A: $\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta t + \theta_1 DU_t + \sum_{j=1}^{k} d_j \, \Delta y_{t-j} + \varepsilon_t.$ (4)

Model B: $\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta t + \gamma_1 DT_t + \sum_{j=1}^{k} d_j \, \Delta y_{t-j} + \varepsilon_t.$ (5)

Model C: $\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta t + \theta_1 DU_t + \gamma_1 DT_t + \sum_{j=1}^{k} d_j \, \Delta y_{t-j} + \varepsilon_t.$ (6)

Model A allows for a one-time change only in the intercept whereas *Model B* does the same only in the trend. *Model C* facilitates a change in both the intercept and trend. In the mentioned equations, DU_t and DU_t represent two sustained dummy variables that capture a shift in the intercept and a shift in the trend respectively occurring at time break (*TB)*. In this study, Model C is applied to minimize the loss of information.

5.2.2. Lumsdaine and Papell (LP) Unit Root Test with Two Structural Breaks

According to Lumsdaine and Papell (1997), if there exists more than one structural break in the data, considering only one break may not be sufficient and it could lead to a loss of information. Taking the fact into consideration, LP test is applied to capture two unknown structural breaks, which is more powerful than ZA test. The equation used in LP test that allows two potential structural breaks is as follows:

$$\Delta y_t = \mu + \alpha_1 y_{t-1} + \beta t + \theta DU_{1_t} + \omega DU_{2_t} + \gamma DT_{1_t} + \psi DT_{2_t} + \sum_{i=1}^{k} c_i \, \Delta y_{t-i} + \varepsilon_t. \quad (7)$$

In the above equation, DU_{1_t} and DU_{2_t} are two dummy variables that capture structural changes in the intercept at time break 1 (TB_1) and time break 2 (TB_2) respectively, while DT_{1_t} and DT_{2_t} are two dummy variables that capture shifts in the trend variable at time TB_1 and TB_2 respectively.

5.2.3. Multiple Breakpoint Tests

If there are several shifts in the data set, it is required to scrutinize the case of regime shifts. The reason is that structural breaks could affect both the short-run and long-run relationship among the variables. Brown et al. (1975) suggested that the stability tests of CUSUM and CUSUM of squares show the preliminary evidence of parameter instability in the error correction model (ECM) equation. After applying CUSUM and CUSUM of squares tests, it is observed that there is an instability in the parameters of the model that necessitates the determination of the structural breaks. The reason is that the implied long-run coefficients may also be affected because of the dependency on the ECM and thereby Bai and Perron (2003) test procedure for multiple unknown breakpoints is applied due to the poor power of CUSUM approach to detect the breakpoints. Bai and Perron (BP) multiple breakpoint test determines the number of breaks and break dates endogenously. This approach displays substantial power in locating multiple unknown structural breaks. BP test treats the breakpoints as unknown and estimates them by using a standard linear regression model with *T* periods and *m* potential breaks. The applied regression model is as follows:

$$y_t = X_t \beta + Z_t \delta_j + \epsilon_t, \quad (8)$$

for the observations $T_j,\ T_{j-1} \ldots\ldots\ T_{j+1} - 1$ in regime *j* ($\mathrm{j} = 0, \ldots, \mathrm{m}$).

Here, X variables are those whose coefficients do not vary across regimes, while the parameters of Z variables are regime specific. β and δ_j denote vectors of coefficients associated with X and Z variables respectively. The break dates are denoted by ($T_1, \ldots, T_m$) and ϵ_t represents the white noise error term. Following Bai and Perron (2003), the quadratic spectral kernel with an *AR(1)* approximation is used to construct the optimal bandwidth, which is referred to as heteroskedasticity and autocorrelation consistent (HAC) estimator in the linear regression model. Additionally, the regressors are allowed to have heterogeneous distributions across segments.

There are three types of tests developed by Bai and Perron (2003) to detect the number of structural breaks namely sequential testing procedures, global breaks vs. none, and global information criteria. Among them, first one is used for single added breakpoint that most reduces the sum-of-squares and for an additional breakpoint in each of the $l+1$ segments for given l breakpoints. The Global breaks vs. none test implements the Bai-Perron tests of l globally optimized breaks against no structural breaks along with the corresponding double maximum statistics (UD_{max} and WD_{max}) tests. Global information criteria test uses the information criteria computed from the global optimizers to determine the number of breaks. Additionally, $l+1$ breaks vs. global l test method combines the global and sequential testing procedures.

According to Bai and Perron (2003), in order to select the number of breaks, at first, UD_{max} and WD_{max} tests should be exploited to check if at least one break is present. If the double maximum statistics (UD_{max} and WD_{max}) are significant, then the number of breakpoints should be determined by the sequential application of the Sup $F(l+1|l)$ statistic and the Sup $F(1|0)$ statistic is ignored. In this test, the null hypothesis refers to l number of breakpoints, while the alternative hypothesis indicates $l+1$ number of breakpoints. The estimated break dates from the global and sequential testing procedures are obtained from a global minimization of the sum of squared residuals.

5.3. ARDL Bounds Testing Approach

ARDL approach, introduced by Pesaran et al. (2001), has several advantages over conventional cointegration techniques. ARDL is a more statistically significant approach for small or finite samples. It provides the option of selecting different optimal number of lags for different variables. It is applicable for regressors of mixed order or same order of integration and regressors with structural breaks. ARDL bounds test is applied in this study to explore the relationship between the selected macroeconomic variables and stock returns in the presence of structural breaks. The ARDL representation of the equation (1) and (2) can be specified as follows:

$$\begin{aligned}\Delta SID_t = \; & \alpha_0 + \textstyle\sum_{i=1}^{n_1} \eta_{1i} \Delta SID_{t-i} + \sum_{i=0}^{n_2} \eta_{2i} \Delta ER_{t-i} + \sum_{i=0}^{n_3} \eta_{3i} \Delta DCB_{t-i} \\ & + \textstyle\sum_{i=0}^{n_4} \eta_{4i} \Delta IPI_{t-i} + \sum_{i=0}^{n_5} \eta_{5i} \Delta COP_{t-i} + \theta_1 D_{1_t} + \theta_2 D_{2_t} + \theta_3 D_{3_t} \\ & + \lambda_1 SID_{t-1} + \lambda_2 ER_{t-1} + \lambda_3 DCB_{t-1} + \lambda_4 IPI_{t-1} + \lambda_5 COP_{t-1} + e_t, \qquad (9)\end{aligned}$$

$$\begin{aligned}\Delta SIC_t = {} & \alpha_0 + \textstyle\sum_{i=1}^{n_1} \eta_{1i} \Delta SIC_{t-i} + \sum_{i=0}^{n_2} \eta_{2i} \Delta ER_{t-i} + \sum_{i=0}^{n_3} \eta_{3i} \Delta DCB_{t-i} \\ & + \textstyle\sum_{i=0}^{n_4} \eta_{4i} \Delta IPI_{t-i} + \sum_{i=0}^{n_5} \eta_{5i} \Delta COP_{t-i} + \theta_1 D_{1_t} + \theta_2 D_{2_t} + \theta_3 D_{3_t} \\ & + \lambda_1 SIC_{t-1} + \lambda_2 ER_{t-1} + \lambda_3 DCB_{t-1} + \lambda_4 IPI_{t-1} + \lambda_5 COP_{t-1} + e_t. \qquad (10)\end{aligned}$$

Here, Δ, α_0 and e_t designate the first difference operator, the intercept, and the white noise error term respectively. η_{1i} *to* η_{5i} and λ_1 *to* λ_5 denote the coefficients for the short-run and long-run relationship respectively in the model. θ_1 *to* θ_3 represent the coefficients for dummy variables. Dummy variables are included in both short run and long-run models to know whether the determined structural breaks have any impact in the long run or only in the short-run.

The bounds testing approach applies the F-statistic to investigate the presence of a long-run relationship among the variables. This actually tests the null hypothesis of no cointegration among the variables against the alternative hypothesis of the existence of cointegration among the variables. This is denoted as:

- $H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$
- $H_1: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq 0$.

As exact critical values for the F-statistic are not available for an arbitrary mix of *I(0)* and *I(1)* variables, Pesaran et al. (2001) provided the bounds on the critical values for the asymptotic distribution of the F-statistic. If the computed value of F-statistic is smaller than the lower bound, no co-integration is possible, by definition. The higher value of F-statistic than the upper bound suggests the presence of a co-integrating relationship while the F-statistic between the lower and upper bounds indicates the inconclusive result.

After conducting the bounds test, unrestricted error correction model (ECM) will be used to determine the speed of adjustment for the long-run equilibrium. The error correction version of ARDL models pertaining to the equations (9) and (10) are as follows:

$$\begin{aligned}\Delta SID_t = {} & \alpha_0 + \textstyle\sum_{i=1}^{n_1} \eta_{1i} \Delta SID_{t-i} + \sum_{i=0}^{n_2} \eta_{2i} \Delta ER_{t-i} + \sum_{i=0}^{n_3} \eta_{3i} \Delta DCB_{t-i} \\ & + \textstyle\sum_{i=0}^{n_4} \eta_{4i} \Delta IPI_{t-i} + \sum_{i=0}^{n_5} \eta_{5i} \Delta COP_{t-i} + \theta_1 D_{1_t} + \theta_2 D_{2_t} + \theta_3 D_{3_t} \\ & + \gamma EC_{t-1} + \varepsilon_t, \qquad (11)\end{aligned}$$

$$\begin{aligned}\Delta SIC_t = {} & \alpha_0 + \textstyle\sum_{i=1}^{n_1} \eta_{1i} \Delta SIC_{t-i} + \sum_{i=0}^{n_2} \eta_{2i} \Delta ER_{t-i} + \sum_{i=0}^{n_3} \eta_{3i} \Delta DCB_{t-i} \\ & + \textstyle\sum_{i=0}^{n_4} \eta_{4i} \Delta IPI_{t-i} + \sum_{i=0}^{n_5} \eta_{5i} \Delta COP_{t-i} + \theta_1 D_{1_t} + \theta_2 D_{2_t} + \theta_3 D_{3_t} \\ & + \gamma EC_{t-1} + \varepsilon_t. \qquad (12)\end{aligned}$$

Here, γ denotes the coefficient for measuring the speed of adjustment and error correction (EC) is the residual obtained from the equations (9) and (10).

Finally, relevant post-estimation diagnostic tests, such as normality test, serial correlation test, heteroskedasticity test, functional form test, and parameter stability test, are performed to check the goodness of fit of the estimated ARDL models for SID and SIC over the selected time period.

6. RESULTS AND DISCUSSIONS

Some descriptive statistics of the variables, namely mean value, median, maximum value, minimum value, and standard deviation over the period from July, 2009 to July, 2017 are presented in Table 3.

Table 3. Descriptive Statistics of the Variables

Statistic	SID	SIC	ER*	DCB	IPI**	COP
Mean	8.488	9.590	0.013	13.034	0.011	4.327
Median	8.454	9.557	0.013	13.054	0.013	4.419
Maximum	9.060	10.066	0.015	13.587	0.205	4.806
Minimum	7.978	9.238	0.012	12.356	-0.208	3.305
Std. Dev.	0.195	0.165	0.001	0.333	0.081	0.381
Observations	112	112	112	112	112	112

Notes: All the variables except ER and IPI are in natural logarithmic form.
*ER is kept in USD/BDT, **IPI is in percentage form.

The results from Table 3 show that on average, the log values of the stock index of DSE and CSE are 8.488 and 9.590 representing the average index value of about 4952.990 points and 14823.330 points respectively. The average log values of DCB and COP are 13.034 and 4.327 representing the average original values of about BDT 4825.211 billion and US$ 80.790 per barrel respectively. The monthly average value of ER is 0.013 USD/BDT and IPI grows at an average rate of 1.130%. The standard deviations indicate lower dispersion in data for all included variables.

Before applying the ARDL bounds testing approach, we need to determine the degree of integration of each variable. Unit root tests were conducted using Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test without considering structural breaks. Conventional unit root tests do not take the possibility of structural breaks into account and thereby we reexamined the integration of order using Zivot and Andrews (ZA) and Lumsdaine and Papell (LP) unit root test. ZA unit root test considers only one-time break in the model, while LP unit root test allows two unknown breaks in the model. As the ZA test may lose power in checking the stationarity in case of more than one single break in the data, LP unit root test along with ZA test is used following Narayan and Narayan (2005). The results of ADF, PP, ZA and LP unit root test are reported in Table 4.

Table 4. Results of Unit Root Tests without and with Structural Breaks

Variables	ADF		PP		ZA		LP	
	Intercept	Trend & intercept	Intercept	Trend & intercept	t-Statistic	TB	t-Statistic	TB
SID	-2.841	-3.023	-2.890	-3.041	-3.840	2010:12	-5.410	2010:12; 2013:04
ΔSID	-9.356***	-9.356***	-9.356***	-9.356***	-11.080***	2010:11	-11.330***	2010:11; 2014:10
SIC	-2.375	-2.426	-2.495	-2.522	-3.890	2010:12	-5.150	2010:12; 2013:04
ΔSIC	-8.363***	-8.331***	-8.337***	-8.303***	-9.650***	2010:11	-9.980***	2010:11; 2014:10
ER	-1.799	-1.666	-1.674	-1.465	-4.180	2012:11	-7.650***	2011:11; 2013:10
ΔER	-6.093***	-6.140***	-6.132***	-6.181***	-10.040***	2012:01	-11.050***	2010:11; 2012:01
DCB	-0.549	-2.968	-2.951**	-2.946	-3.660	2010:10	-4.860	2010:10; 2012:12
ΔDCB	-1.638	-1.074	-9.290***	-9.776***	-11.530***	2012:06	-12.400***	2010:12; 2012:06
IPI	-3.957***	-4.631***	-29.590***	-43.579***	-10.070***	2011:06	-10.190***	2013:07; 2014:09
COP	-1.125	-2.065	-0.892	-2.047	-3.760	2014:09	-4.980	2013:11; 2015:10
ΔCOP	-7.214***	-7.236***	-7.120***	-7.129***	-8.610***	2016:01	-8.970***	2014:06; 2016:01

Notes: Lag length for ADF was chosen by Schwarz information criterion (SIC). Newey-West Bandwidth for PP using Bartlett Kernel estimation method. ***, **, and * denote significance at 1%, 5%, and 10% respectively. Lag length for ZA and LP unit root test is chosen by Bayesian information criterion (BIC).

From the results of ADF and PP unit root tests shown in Table 4, it is observed that the *t*-statistics of all variables except IPI is significant at first difference and the t-statistic of IPI is significant at level. It indicates that only IPI is stationary at level *I(0)* while all other variables are stationary at first difference *I(1)*. The results make sure that none of the variables is integrated at second difference *I(2)* or above. On the other hand, the results of ZA unit root test also show that all included variables except IPI are stationary at first difference, while IPI is stationary at level in the presence of one structural break in the data. Like ZA test, the empirical results of LP unit root test also suggest the same in the presence of two structural breaks except ER. ZA test shows that ER is stationary at level. As all the variables are stationary either at *I(0)* or *I(1)*, ARDL bounds testing approach can be applied in this study. Since all variables except IPI are integrated of order one *I(1)* with structural breaks, the analysis proceeds to identify further possible breakpoints in their long run relationship.

The results of Bai and Perron (BP) multiple breakpoint tests are shown in Table 5. The results of the double maximum statistics (*UDMax* and *WDMax*) of both models are significant at 5% significance level. It points out the strong evidence of at least one structural break in the long run relationship between macroeconomic factors and stock price indices. Here, Sup $F(1|0)$ represents the null hypothesis of no structural breaks against the alternative hypothesis of one structural break. Thus, Sup $F(2|1)$ and Sup $F(3|2)$ can be interpreted in the same way. After confirming the presence of at least one structural break in the long run relationship between macroeconomic factors and stock price indices, the sequential testing procedure is applied to detect more than one break.

Table 5. Results of Bai and Perron (BP) Multiple Breakpoint Tests

Statistic(s)	Model 1		Model 2	
	Test statistics	Critical value**	Test statistics	Critical value**
UDMax statistic	255.785*	18.420	276.227*	18.420
WDMax statistic	290.379*	19.960	276.227*	19.960
Sup $F(1\|0)$	255.785*	18.230	276.227*	18.230
Sup $F(2\|1)$	54.078*	19.910	32.194*	19.910
Sup $F(3\|2)$	14.079	20.990	18.702	20.990
Corresponding estimated break dates	2011M02, 2014M01		2011M02, 2013M11	

Notes: Structural breaks are allowed for in the intercept and coefficients. UDmax and WDmax denote the BP double maximum test statistics for the null hypothesis of no structural breaks versus the alternative of an unknown number of breaks given some upper bound (M). Sup $F(l+1|\ l)$ denotes the BP test for l versus $l+1$ breaks. Estimation allows heterogeneous error distributions across breaks. A trimming parameter of 0.15 and the maximum structural breaks of 5 are applied. ** and * denote Bai and Perron (2003) critical values and statistical significance at 5% level respectively.

In both models, the statistics of Sup $F(1|0)$ and Sup $F(2|1)$ are significant at 5% level of significance while the statistic of Sup $F(3|2)$ is not significant suggesting the presence of two structural breaks. The first breakpoint took place in 2011M02 for both models and it seems to coincide with the resultant effect of the stock market crash of 2010-11. The stock markets of Bangladesh were unstable from 2010 to 2011. According to the reports of two stock exchanges of Bangladesh, the index value went up by 62% in 2009 and 83% in 2010. It went down by 10% in January 2011 and a further decline of 30% in February 2011. The Bangladesh Bank (BB) took corrective measures to stabilize the market and control inflation by putting a leash on the liquidity.

The second breakpoints took place in 2014M01 for DSE and 2013M11 for CSE which are closely related to the oil price shocks of 2014-15. The oil price shock of 2014-15 was a supply shock because of the surge in oil supply and the reduction in global demand of it at the same time. The oil price shock of 2014-15 had direct effects through trade and indirect effects through investment, consumption, and changes in inflation rate.

The results of the estimated ARDL model for both Model 1 (DSE) and Model 2 (CSE) are depicted in Table 6. Akaike information criterion (AIC) is used to select the optimal lag length. The result shows that ARDL (1, 1, 3, 0, 4) is the best model for DSE whereas ARDL (3, 1, 4, 0, 4) best describes the variables for CSE. Table 6 includes both short run and long run parameters.

Table 6. ARDL Bounds Testing Model

Model 1 Dependent variable: D(SID) Selected model: ARDL (1, 1, 3, 0, 4) based on restricted constant and no trend				Model 2 Dependent variable: D(SIC) Selected model: ARDL (3, 1, 4, 0, 4) based on restricted constant and no trend			
Variable	Coefficient	t-Statistic	Prob.	Variable	Coefficient	t-Statistic	Prob.
C	-0.846	-0.723	0.472	C	-0.989	-1.081	0.283
SID(-1)	-0.433	-5.832	0.000	SIC(-1)	-0.349	-5.156	0.000
ER(-1)	66.874	2.722	0.008	ER(-1)	50.605	2.538	0.013
DCB(-1)	0.220	2.673	0.009	DCB(-1)	0.234	3.411	0.001
IPI*	-0.111	-1.225	0.224	IPI*	-0.132	-1.789	0.078
COP(-1)	0.165	2.448	0.017	COP(-1)	0.134	2.411	0.018
D(ER)	180.722	2.331	0.022	D(SIC(-1))	0.114	1.233	0.222
D(DCB)	3.170	3.035	0.003	D(SIC(-2))	-0.139	-1.400	0.166
D(DCB(-1))	2.074	2.107	0.038	D(ER)	185.681	3.047	0.003
D(DCB(-2))	1.509	1.522	0.132	D(DCB)	1.688	1.969	0.053
D(COP)	0.144	1.430	0.157	D(DCB(-1))	1.768	2.207	0.031
D(COP(-1))	0.018	0.181	0.857	D(DCB(-2))	1.677	2.099	0.039
D(COP(-2))	-0.236	-2.418	0.018	D(DCB(-3))	1.259	1.632	0.107
D(COP(-3))	0.186	1.974	0.052	D(COP)	0.138	1.742	0.086
D_1	0.102	2.883	0.005	D(COP(-1))	0.006	0.074	0.941
				D(COP(-2))	-0.154	-1.942	0.056
D_2	-0.078	-2.347	0.022	D(COP(-3))	0.170	2.208	0.030
				D_1	0.074	2.764	0.007
D_3	0.021	0.390	0.697	D_2	-0.079	-2.804	0.007
				D_3	-0.013	-0.295	0.769

Notes: * Variable interpreted as Z = Z(-1) + D(Z). D_1, D_2, and D_3 denote outlier dummy variables which take value one for unusual values and zero otherwise.

On the other hand, the coefficients of D_1 and D_2 are significant at 1% significance level for both models. So, both the stock market crash of 2010 and the oil price shock of 2011 had significant positive and negative effects respectively on the stock price fluctuations in both stock markets of Bangladesh. It suggests that the index value of DSE and CSE surged excessively due to the initial bubble of the stock market crash of 2010 and dropped because of the oil price shock of 2011. However, D_3 is not significant for DSE and CSE. Therefore, the oil price shock in 2014-15 had no significant effect on stock returns in DSE and CSE.

The results of the ARDL bounds test are reported in Table 7. As the calculated F-statistic values of both models are higher than the critical value of the upper bound at the 1% significance level, it can be concluded that there is a long-run relationship among the selected variables in the presence of structural breaks for both models.

Table 7. Bounds Test Results

Null hypothesis: No existence of long-run relationships			
		F-statistic	k
Model 1		6.978	4
Model 2		6.400	4
Critical value	Significance	I(0)	I(1)
	10%	2.303	3.220
	5%	2.688	3.698
	1%	3.602	4.787

The long run coefficients of the variables at level are included in Table 8. The estimated coefficients of ER, DCB, and COP show a positive link with stock prices and they are statistically significant for both DSE and CSE. It suggests that if the exchange rate of BDT against USD appreciates, the index returns of both stock exchanges move up as ER affects index returns positively. Although the hypothesized relationship was negative, some explanation can be provided in favor of the positive linkage. Tiryaki and Tiryaki (2018) also posited that the effect of exchange rate on stock returns could be positive or negative depending on whether the country is export-oriented or import-oriented. The economy of Bangladesh is largely dependent on the ready-made garments (RMG) industry. Majority of the raw materials required to produce the end products of this industry are imported from various countries. Therefore, the appreciation of BDT gives the importers more buying power.

Table 8. Estimated Level Long-run Coefficients of ARDL Model

Model 1				Model 2			
Variable	Coefficient	t-Statistic	Prob.	Variable	Coefficient	t-Statistic	Prob.
ER	154.287	3.148	0.002	ER	144.830	3.033	0.003
DCB	0.507	3.217	0.002	DCB	0.669	4.385	0.000
IPI	-0.255	-1.223	0.225	IPI	-0.377	-1.684	0.096
COP	0.380	2.543	0.013	COP	0.382	2.580	0.012
C	-1.951	-0.737	0.464	C	-2.831	-1.099	0.275
$\mathrm{EC} = \mathrm{SID} - (154.287 * \mathrm{ER} + 0.507 * \mathrm{DCB} - 0.255 * \mathrm{IPI} + 0.380 * \mathrm{COP} - 1.951)$				$\mathrm{EC} = \mathrm{SIC} - (144.830 * \mathrm{ER} + 0.669 * \mathrm{DCB} - 0.377 * \mathrm{IPI} + 0.382 * \mathrm{COP} - 2.831)$			

The positive relationship of DCB with SID and SIC indicates that higher domestic credit in Bangladesh allows companies to spend more in productive resources which in turn ensures more earnings and higher stock prices for them. This relationship is consistent with the evidence in the existing literature (Garcia and Liu, 1999). Although the positive sign of COP with stock returns of both DSE and CSE was not hypothesized, this type of disagreeing empirical result is not uncommon according to Suleman and Wasim (2016) and Khan and Yousuf (2013). They have suggested a significant positive relationship of oil prices with stock returns. One possible explanation could be the higher dependency of developing countries like Bangladesh on oil exporting countries in terms of the inflow of remittances. As a result, falling oil prices in those countries may cause lower remittances for Bangladesh. Moreover, according to Creti et al. (2014), demand-side oil price shock is one of the reasons behind the positive impact on stock returns. Table 8 also shows that the relationship of IPI with stock returns is negative in both models and it is not statistically significant. This finding is similar to the one found by Tiryaki et al. (2017) in Turkey for Borsa Istanbul Financial Index.

The results presented in Table 9 below confirm that the ECTs are negative and significant at 1% level of significance. The ECT coefficients denote that around 43% of the disequilibrium in DSE returns is adjusted monthly to regain the long run equilibrium.

Table 9. Error Correction Version of ARDL Model

Model 1				Model 2			
Dependent variable: D(SID)				Dependent variable: D(SIC)			
Selected model: ARDL (1, 2, 4, 2, 0)				Selected model: ARDL (3, 1, 4, 0, 4)			
Variable	Coefficient	t-Statistic	Prob.	Variable	Coefficient	t-Statistic	Prob.
D(ER)	180.722	2.615	0.011	D(SIC(-1))	0.114	1.334	0.187
D(DCB)	3.170	4.400	0.000	D(SIC(-2))	-0.139	-1.634	0.107
D(DCB(-1))	2.074	2.742	0.008	D(ER)	185.681	3.380	0.001
D(DCB(-2))	1.509	1.913	0.060	D(DCB)	1.688	2.683	0.009
D(COP)	0.144	1.624	0.109	D(DCB(-1))	1.768	2.980	0.004
D(COP(-1))	0.018	0.192	0.849	D(DCB(-2))	1.677	2.647	0.010
D(COP(-2))	-0.236	-2.647	0.010	D(DCB(-3))	1.259	1.818	0.073
D(COP(-3))	0.186	2.129	0.037	D(COP)	0.138	1.964	0.053
D_1	0.102	3.655	0.001	D(COP(-1))	0.006	0.078	0.938
				D(COP(-2))	-0.154	-2.103	0.039
D_2	-0.078	-5.551	0.000	D(COP(-3))	0.170	2.467	0.016
				D_1	0.074	3.406	0.001
D_3	0.021	1.166	0.247	D_2	-0.079	-6.037	0.000
				D_3	-0.013	-0.929	0.356
ECT(-1)	-0.433	-6.368	0.000	ECT(-1)	-0.349	-6.155	0.000
R-squared		0.479		*R*-squared		0.507	
Adjusted *R*-squared		0.408		Adjusted *R*-squared		0.419	
S.E. of regression		0.062		S.E. of regression		0.049	
Durbin-Watson stat		1.941		Durbin-Watson stat		1.934	
Akaike info criterion		-2.603		Akaike info criterion		-3.067	
Schwarz criterion		-2.277		Schwarz criterion		-2.658	
Hannan-Quinn criteria		-2.471		Hannan-Quinn criteria		-2.902	

In case of CSE, the adjustment rate of disequilibrium is around 35%. The results imply that DSE needs approximately two and a half months on average to reach the long run equilibrium whereas CSE requires around three months for this purpose.

Table 10 shows the summarized result of the diagnostic tests. All conducted tests except normality test for Model 1 find no problems in the collected data of the selected variables. The residuals aren't normally distributed for DSE as Jarque-Bera statistic is statistically significant. As the sample size is higher than 30 and there exists the central limit theorem in the data, the normality issue may be ignored (Arshed, 2014).

Table 10. Diagnostic Tests

Diagnostic test(s)	Statistic(s)	Model 1		Model 2	
		Test statistic	*p* value	Test statistic	*p* value
Normality	Jarque-Bera	53.758	0.000	0.345	0.842
Breusch-Godfrey serial correlation LM	*F*-statistic	0.263	0.769	0.204	0.816
Breusch-Pagan-Godfrey heteroskedasticity	*F*-statistic	1.419	0.156	1.020	0.451
Ramsey RESET	*F*-statistic	0.586	0.446	0.200	0.656

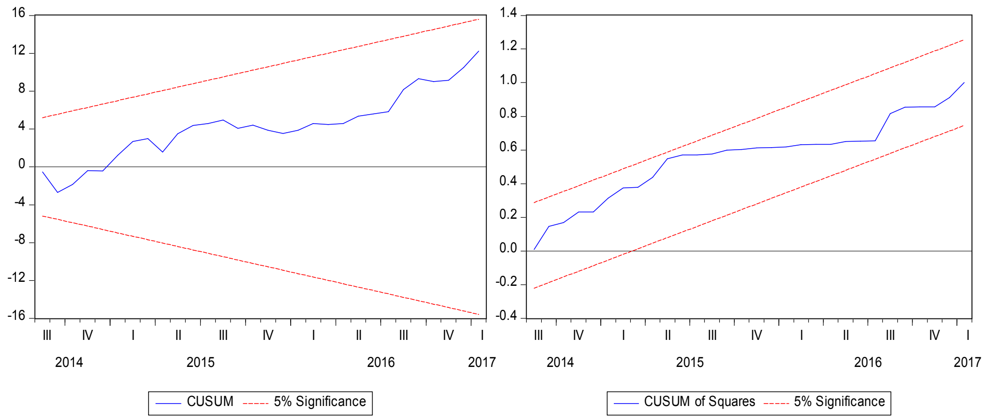

Figure 1. CUSUM and CUSUMSQ test for stability of long-run coefficients of Model 1

On the other hand, the *F*-statistic value in serial correlation test, heteroskedasticity test and Ramsey RESET test are not statistically significant. It indicates that there are no autocorrelation, heteroskedasticity or specification errors in the selected ARDL models.

Both the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) tests are applied to check the stability of models and residuals respectively. Figure 1 shows that the long run coefficients of Model 1 are stable as the CUSUM and CUSUMSQ lines remain within the 5% critical range of stability.

On the other hand, Figure 2 indicates that the long run coefficients of Model 2 are stable in accordance with the CUSUM test. Although the CUSUMSQ line goes beyond the upper critical line initially, it comes back within the critical band to justify the stability of the residuals.

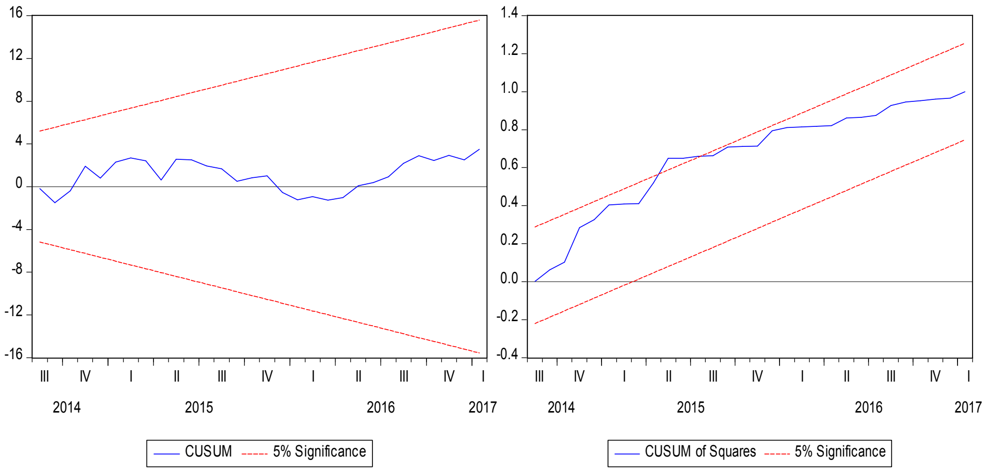

Figure 2. CUSUM and CUSUMSQ test for stability of long-run coefficients of Model 2

According to Brown et al. (1975), if the statistics fall within the theoretical bound lines (dashed) at 5% level of significance, it indicates the stability of the estimated coefficients in the ECM based ARDL models over the sample period. As the figure of both models confirms the stability of models and residuals, it can be suggested that the estimated coefficients of this specification are valid for interpretation and can be used for practical policy-making purposes.

7. CONCLUSION

The study examines the long-run relationship between macroeconomic indicators and stock prices fluctuations in Bangladesh in the presence of structural breaks using monthly time series data for the period 2009:07 to 2017:07. Two domestic macroeconomic variables, namely domestic credit provided by banking sector (DCB) and industrial production index (IPI) and two international macroeconomic factors, such as exchange rate (ER) and crude oil price (COP) are treated as independent variables. On the other hand, stock price indices of DSE and CSE are considered as dependent variables.

To scrutinize the aforementioned relationship among the variables concerned, unit root tests, Bai-Perron multiple breakpoint tests, and ARDL bounds testing approach are used in this study. Firstly, conventional unit root tests (ADF and PP) are applied to analyze the time series properties of the data. The results suggest that only IPI is stationary at level *I(0)* while all other variables are stationary at first difference *I(1)*. As conventional unit root tests have low power to check the stationarity of the variables in the presence of structural breaks, ZA and LP unit root tests that allow for one and two unknown structural breaks respectively in the model have also been applied. The results of ZA and LP tests are alike the conventional unit root tests. After confirming the presence of structural breaks in the data, multiple breakpoint test developed by Bai and Perron (2003) is used to identify unknown multiple breakpoints. It showed the presence of three breakpoints in both models. The determined breaks coincide with important phenomena in Bangladesh and global economy, including the stock market crash of 2010 and the oil price shocks of 2011 and 2014-2015.

The empirical results of ARDL bounds test suggest a long run relationship among the variables in both models. The estimated long run coefficients of both models show that ER, DCB and COP have a significant positive impact on stock prices while IPI exerts a negative impact which is not significant for any model. The coefficients of dummy variables indicate that both the stock market crash of 2010 (D_1) and the oil price shock of 2011 (D_2) had a significant effect on the stock prices fluctuations of DSE and CSE while the oil price shock of 2014-15 (D_3) had no effect on either stock exchanges. Furthermore, the values of ECM terms show that around 43% and 35% of the disequilibrium in DSE and CSE returns respectively are adjusted monthly to get back to the long run equilibrium.

Based on the findings, the influence of the macroeconomic variables on the stock markets provides some important implications for the policy-making bodies, like Bangladesh Bank (BB) and Bangladesh Securities and Exchange Commission (BSEC) for developing stock markets in Bangladesh. Due to the significant positive impact of exchange rate on stock returns, BB which works as the regulator of foreign exchange market should take into consideration this significant relationship at the time of formulating monetary policy in order to prevent any abrupt changes in the exchange rate. As DCB has a significant positive impact on stock prices fluctuations, the concerned policymakers should focus on banking sector development to monitor the credit sanctioning process very cautiously. On the contrary, due to the positive link of crude oil prices with stock prices, the government should be conscious of crude oil prices fluctuations and should take actions against any shock in crude oil prices. For example, firstly the supply shortage risk of crude oil can be minimized by increasing the strategic oil reserves. Secondly, heavy dependency on crude oil can be reduced by ensuring the availability of alternative fuels like coal, natural gas, and renewable energy. Moreover, the government can minimize the adverse effect of oil price fluctuations on the economy of Bangladesh by improving dialogue with oil exporting countries.

However, this study is limited to a small sample size and few macroeconomic variables are considered due to the unavailability of data. As this study has focused on a particular country only, future studies may be based on several developing countries by considering the structural breaks. Furthermore, different analytical methods can be applied depending on the circumstances.

APPENDIX

Table A1. Basic ARDL Model

Model 1 Dependent Variable: SID Selected Model: ARDL (1, 1, 3, 0, 4)				Model 2 Dependent Variable: SIC Selected Model: ARDL (3, 1, 4, 0, 4)			
Variables	Coefficient	*t*-Statistic	Prob.	Variables	Coefficient	t-Statistic	Prob.
SID(-1)	0.567	7.623	0.000	SIC(-1)	0.764	7.246	0.000
ER	180.722	2.331	0.022	SIC(-2)	-0.253	-1.907	0.060
ER(-1)	-113.849	-1.510	0.135	SIC(-3)	0.139	1.400	0.166
DCB	3.170	3.035	0.003	ER	185.681	3.047	0.003
DCB(-1)	-0.876	-0.733	0.466	ER(-1)	-135.076	-2.280	0.026
DCB(-2)	-0.565	-0.479	0.633	DCB	1.688	1.969	0.053
DCB(-3)	-1.509	-1.522	0.132	DCB(-1)	0.313	0.318	0.751
IPI	-0.111	-1.225	0.224	DCB(-2)	-0.090	-0.097	0.923
COP	0.144	1.430	0.157	DCB(-3)	-0.418	-0.422	0.674
COP(-1)	0.039	0.255	0.799	DCB(-4)	-1.259	-1.632	0.107
COP(-2)	-0.253	-1.691	0.095	IPI	-0.132	-1.789	0.078
COP(-3)	0.421	2.915	0.005	COP	0.138	1.742	0.086
COP(-4)	-0.186	-1.974	0.052	COP(-1)	0.001	0.008	0.993
D_1	0.102	2.883	0.005	COP(-2)	-0.160	-1.328	0.188
				COP(-3)	0.324	2.746	0.008
D_2	-0.078	-2.347	0.022	COP(-4)	-0.170	-2.208	0.030
				D_1	0.074	2.764	0.007
D_3	0.021	0.390	0.697	D_2	-0.079	-2.804	0.007
				D_3	-0.013	-0.295	0.769
C	-0.846	-0.723	0.472	C	-0.989	-1.081	0.283
R-squared		0.888		R-squared		0.916	
Adjusted R-squared		0.864		Adjusted R-squared		0.894	
S.E. of regression		0.064		S.E. of regression		0.050	
F-statistic		37.567		*F*-statistic		41.670	
Prob(F-statistic)		0.000		Prob (*F*-statistic)		0.000	
Akaike info criterion		-2.496		Akaike info criterion		-2.959	
Schwarz criterion		-2.033		Schwarz criterion		-2.415	
Hannan-Quinn criter.		-2.309		Hannan-Quinn criter.		-2.740	
Durbin-Watson stat		1.941		Durbin-Watson stat		1.934	

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Received February 19, 2019, Revised September 4, 2019, Accepted December 5, 2019.