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THE IMPACT OF MACROECONOMIC VARIABLES ON STOCK PRICES IN SRI LANKA: A BOUNDS TESTING APPROACH

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Abstract

A vibrant stock market is of critical importance if a developing economy is to attain a high growth trajectory. In Sri Lanka stock market performance has been considered a key indicator of its economic as well as business health. This paper intends to examine the causal relationship between stock prices and macroeconomic variables and investigate the effects of macroeconomic variables on the dynamics of stock price movements in the Sri Lankan stock market. To empirically examine the long-run relationships and short-run dynamic interactions among the variables of interest, this study employs the autoregressive distributed lag bound test approach. The study uses monthly statistical data of macroeconomic and political stability variables such as industrial production, inflation rate, money supply, real exchange rate, trade openness, the average weighted prime lending rate, all share price index and war data from January 2007 to December 2019. The results reveal a significant relationship between stock market returns and macroeconomic and political stability variables except all share price index.

Keywords: *macroeconomics, stock prices, bounds test.*
JEL Code: E60, G12

1. Introduction

The stock market plays a vital role in achieving economic prosperity by fostering capital formation and sustaining economic growth (Omoniyi, et.al, 2014). In the present context, researchers, academics and policymakers have identified the vital impact stock markets have as efficient channels of financial intermediation and their role as a major determinant of a country's economic growth. According to the evidence surfacing from cross country analyses, an efficient and vibrant financial system is sine qua non for economic growth and sustainable development (Schumpeter and Redverse, 1949; Fama, 1990; and Caporale et al., 2004). However, investment in the stock market involves risk and uncertainty. An increase in positive stock returns without risk and uncertainty is always challenging. It is well established in the literature that several risks and uncertainties affect the performance of stock markets. In this context macroeconomic variables and the political environment is widely considered better market performance indicators (Perotti and Van Oijen, 2001; Panetta, 2002).

The relationship between macroeconomic variables and the stock market performance can be a model that can be worked backward, viz; stock market performance may influence the macroeconomic variables as found by Smith (1990), or the contrary (Kabeer, 2017). This relationship is an object of on-going interest of investors, academics and policymakers. While the economic literature has been devoted to studies on the relationship between macroeconomic variables and the performance of stock markets in developed economies such as the US and Japan, few attempts have been made at unraveling this linkage in developing economies such as Sri Lanka. Such a distinction is important given the nature of the relationship between macroeconomic variables and stock market performance may differ from developed to developing economies. Further, the impact of various macro-economic and political variables on the stock market prices has significant effects on the stock market performance, which makes investors uncertain about the future performance of companies. Therefore, investors in the Colombo stock exchange need information on the influence of varies macro-economic and political instability variable on the stock market prices.

The aim of this paper is to investigate the causal relationship between macroeconomic and political stability variables and stock prices. It examines the effects of both macroeconomic and political stability variables on the dynamics of stock price movements in the Sri Lankan stock market. From the previous literature (please see Table 3), authors have identified that the following macroeconomic variables have influence on stock market performance in Sri Lanka: industrial production, inflation rate, money supply, real exchange rate, trade openness, average weighted prime lending rate and war data as a dummy variable in the analysis to represent political stability. This study focuses on how these variables lead to changes in stock prices and thus the overall performance of the stock market. At present, investment in Sri Lanka's stock market is through both local and international investors. The Colombo Stock Exchange (CSE) is the only stock market in Sri Lanka which is responsible for providing a transparent and regulated environment where companies and investors can join together (Colombo Stock Exchange, 2014). The CSE enjoys a high level of activity considered necessary for creating a suitable investor friendly environment that encourages foreign investors. However, a number of researchers and policymakers point out that improvement to the regulation of the stock market in Sri Lanka is needed to generate a greater level investor confidence over the sustainability of growth in stock market returns. Hence, information on the performance and influence of the stock market on the Sri Lankan economy can be of great use to prospective investors. The outcome of this paper is therefore designed to provide a tool to predict the future performance of the stock market.

The study is significant in terms of its contribution to economic literature in Sri Lanka and other similar developing countries. It is thought to be the first attempt to examine the impact of macroeconomic variables on stock prices in Sri Lanka by using more appropriate econometric techniques and in particular the ARDL bounds test which has not been applied to this phenomenon in Sri Lanka. Moreover, to the best of our knowledge, no study includes industrial production as one of the independent variables in an empirical analysis of stock market performance in Sri Lanka.

The reminder this article is structured as follows: Section 2 reviews the theoretical and empirical literature on macroeconomic variables and stock prices. Section 3 provides the data sources and a description of variables. Section 4 discusses the econometrics methodology and Section 5 presents the empirical analysis and estimation results. The final section provides the concluding remarks and policy implications.

2. Literature review

2.1 Theoretical literature

There are various asset pricing theories on which a framework for the relationship between macroeconomic variables and stock market performance can be based. Two such theories are the capital asset pricing model (CAPM) and arbitrage pricing model (APM).

Sharpe (1964) and Lintner (1965) proposed the CAPM. Their work based on the portfolio choice theory of Markowitz (1952). It is one of the first asset pricing theories and is a traditional approach to calculating stock returns but is also used to analyze the relationship between macroeconomic variables and stock market performance by using the risk factor known as market risk. The CAPM model is presented in the following linear form;

$$E(R_i) = R_f + \beta(E(R_m) - R_f)$$

where $E(R_i)$ is the expected return on a stock; R_f is the risk-free rate of return; R_m is the expected market return (return on the market portfolio). The key term in the model is β (i.e. beta) which indicates the statistical relationship between the asset's return and the return on the total portfolio of the assets. The CAPM is a one factor model which relies mostly on the measure beta, which emphasizes the sensitivity of asset volatility to the volatility of the whole market.

The APM takes reforms as a linear function of multi factors and this can be consider as an expansion of the CAPM. The APM was developed by Stephen Ross in 1976 (Ross 1976) and assumes that the risk and reform relationship is determined by a host of macroeconomic variables. APM can be represented by the following expression.

$$R_i = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots\ldots + \beta_X X_X + \varepsilon$$

where R_i is the expected return on a stock and X is the systematic risk. The term β is the response to a systematic risk and the beta coefficient is the reaction of the return of equity to a systematic risk. While the beta in the CAPM captures the response of the return of equity to a specific risk factor, for the return on the market portfolio in the APM, the indicate the responsiveness to a given macroeconomic variable. The term ε is the random error and is associated with unsystematic risk.

The most common theory used in research aimed at examines the relationship between macroeconomic variables and stock market performance is the APM. The APM neither provide guidance or rules to select the variables nor are the variables in the APM clearly defined being open in their definition. The model allows the variables and the number employed to be selected freely.

The choice of variables is usually made with respect to the relevance of what is being tested. That is, the variables which are most likely to influence the returns are chosen (Bailey, 2005). Due to the openness of the model, the APM is an explanatory model rather than an empirical one.

2.2 Empirical literature

Extensive literature can be found on the effects of macroeconomic variables on stock prices. Evidence on various categories of economies and periods has confirmed that macroeconomic variables play a significant role in determining of stock prices. Table 1 presents a summary review of literature.

The below summary confirms that though the relationship between macroeconomic variables and stock prices has mostly supported the causal relationship between the selected variables, the evidence on their relationship has produced mixed findings. This inconclusive result arises due to the types of data, time periods under consideration, the differing econometric methods and the characteristics of various countries.

Table 1. A summary of previous studies.

Author/ Year	Country/ies	Period	Methodology	Variables	Conclusion
Fama (1981)	USA	1953 - 1977	Regression analysis	Real GNP, industrial production, money supply, lagged inflation, capital expenditures and interest rates.	A strong positive relationship between common stock returns and real economic variables.
Chen et al. (1986)	USA	Jan.1953 - Nov.1983	Regression analysis	Consumption, the market index, oil prices, industrial production, inflation, interest rate and changes in risk premium.	Industrial production, changes in risk premium and interest rates are highly significant. Unanticipated inflation and changes in expected inflation are also significant.
Mukherjee & Naka (1995)	Japan	Jan.1971 - Dec.1990	WECM	Exchange rate, inflation, money supply, real economic activity, call money rate and long-term government bond rate.	Co-integrating relationship existed between macroeconomic variable and Japanese stock market.
Muradoglu et al. (2000)	19 Emerging Market	Jan.1976 - Dec.1997	Granger causality test	Exchange rates, interest rates, inflation and industrial production.	Bi-directional causality relationship between stock returns and macroeconomic variables.
Bhattacharya & Mukherjee (2001)	India	1990 - 2000	Toda & Yamamoto non-causality test	Exchange rate, foreign exchange reserves and trade balance.	No causal linkage between stock prices and the three variables under consideration.
Wongbangpo & Sharma (2002)	Indonesia, Malaysia, the Philippines, Singapore and Thailand	1985 - 1996	Co-integration and Granger causality test, VECM	Inflation, interest rate and exchange rate.	The stock prices are negatively related to inflation. Interest rate is negatively related with stock prices in the Philippines, Singapore and Thailand, but positively related with stock prices in Indonesia and Malaysia. The exchange rate is positively related to stock prices in Indonesia, Malaysia and the Philippines, but negatively in Singapore and Thailand.
Gunasekarage et al. (2004)	Sri Lanka	Jan.1985 - Dec.2001	Co-integration and VECM	Money supply, treasury bill rate, inflation and exchange rate.	Macroeconomic variables have a significant influence on stock market.

Gan, et al. (2006)	New Zealand	Jan.1990 - Jan.2003	Johansen multivariate, Granger-causality test	Inflation, interest rate, exchange rate, real GDP, money supply, and domestic retail oil prices.	Stock Index is consistently determined by the interest rate, money supply, and real GDP
Adam & Tweneboah (2008)	Ghana	1991 - 2006	Johansen's multivariate co-integration test	FDI inflows, interest rate, inflation and exchange rate.	Interest rate and FDI are the key determinants of the share price movements in Ghana.
Hassan & Nasir (2008)	Pakistan	Jun.1998 - Jun.2008	ARDL method	Interest rates, inflation, exchange rates, money supply, oil prices and industrial production.	The macroeconomic factors that had the main contribution in determining the equity prices in the long run.
Lucey et al. (2008)	Canada, France, Germany, Hong Kong, Italy, Singapore and UK	1999 - 2007	GARCH model	Interest rates and exchange rates.	The unexpected news of macroeconomic factors had significant impact on the returns of stock exchanges.
Tursoy et al. (2008)	Turkey	Jan.2001-Sep.2005	Regression analysis	Crude oil price, inflation, gold price, import, export, exchange rate, GDP, foreign reserve, unemployment, market pressure index, industrial production, interest rate and money supply.	The stock returns had not been affected by these macroeconomic factors.
Mahmood & Dinniah (2009)	Malaysia, Korea, Thailand, Hong Kong, Japan and Australia	Jan.1993 - Dec.2002	Co-integration test	Exchange rates, Inflation and industrial production.	The existence of a long run relationship between stock price and different macro-economic variables for Japan, Korea, Hong Kong and Australia. Short run relationship exists in all countries except for Hong Kong and Thailand.
Humpe & Macmillan (2009)	USA and Japan	Jan.1965 - Jun.2005	Co-integration analysis	Industrial production, inflation, interest rate and money supply.	USA: Stock prices are positively related to industrial production, negatively related to both inflation and interest rate. Insignificant relationship between stock prices and the money supply

					Japan: Stock prices are positively related to industrial production and negatively related to money supply.
Sohail & Hussain (2009)	Pakistan	2002 - 2008	VECM	Money supply, exchange rate and industrial production.	The returns of LSE affected by inflation rate while money supply, exchange rate and industrial production positively impact on returns of LSE.
Asaolu & Ogunmuyiwa (2010)	Nigeria	1986 - 2007	Johansen co-integration test, Granger causality test	External debt, inflation, fiscal deficit, exchange rate, foreign capital inflow, investment and industrial output.	A long run relationship between share price and the macroeconomic variables.
Buyuksalvarci (2010)	Turkey	2003 - 2010	Multi-variable regression model	Inflation, interest rate, gold price, industrial production, oil price, exchange rate and money stock.	Interest rate, industrial productions index, oil price and foreign exchange rate have a positive impact on stock returns.
Alshogeathri (2011)	Saudi Arabia	Jan.1993 - Dec.2009	VAR and generalized auto-regressive conditional heteroscedasticity model	Money supply, interest rates, inflation, bank credit, world crude oil prices and exchange rate.	A positive relationship between the stock price and money supply, interest rate, inflation. Unidirectional causal relationships between stock returns and money supply and inflation.
Izedonmi & Abdullahi (2011)	Nigeria	2000 - 2004	OLS method	Inflation, exchange rate and market capitalization.	No significant effects of the variables on the stocks return.
Karam & Mittal (2011)	India	1995 - 2008	OLS method	Interest rate, inflation, exchange rate and gross domestic saving.	There existed long term relationship between risk factors and returns of Indian Stock Exchange.
Kuwornu & Victor (2011)	Ghana	Jan.1992 - Dec.2008	Maximum likelihood estimation	Inflation, crude oil price, exchange rate and interest rate.	A significant relationship between stock returns and other selected variables. Inflation had a positive effect, while exchange rate and interest rate had negative influence on stock returns. Crude oil prices do not have any effect on stock returns.
Olugbenga (2012)	Nigeria	Jan.1985 - Apr.2009	Pooled or panel model	Money supply, interest rate, exchange rate, inflation, oil price and GDP.	Macroeconomic variables have varying significant impact on stock prices of individual firms in Nigeria.

Naik&Padhi (2012)	India	Apr.1994 - Jun.2011	Johansen's co-integration and VER, Granger causality test	Industrial production, wholesale price index, money supply, treasury bill rates and exchange rates.	All macroeconomic variables and the stock market index are co-integrated and hence, a long-run equilibrium relationship exists between them
Ozcan (2012)	Turkey	2003 - 2010	Johansen's co-integration test	Interest rates, inflation, money supply, exchange rate, gold prices, oil prices, current account deficit and export volume.	Macroeconomic variables exhibit a long run equilibrium relationship with the ISE industry index.
Saeed And Akhter (2012)	Pakistan	June 2000 - June 2010.	OLS method	Money supply, exchange rate, industrial production, interest rate and oil prices.	Oil prices, exchange rate and interest rate have significant impact on banking index while money supply, exchange rate, industrial production and interest rate show a negative relationship with banking index.
Yahyazadehfar& Babaie (2012)	Iran	Mar.2001 - Apr.2011	Johansen-Juselius Co-integration and VAR model	Interest rate, house price and gold price.	Positive relationship between stock price and house price. Interest rate and gold price are negatively related to stock price.
El-Nader &Alraimony (2013)	Jordan	1991 - 2010	ARCH Model	Money supply, inflation, exchange rate and interest rates.	All macroeconomic variables have a negative role on stock returns.
Inyiama&Nwoha (2014)	Nigeria	2000 - 2012	OLS method and Granger causality test	Interest rate, inflation, exchange rate and GDP.	A positive but insignificant relationship between share price and inflationary rate, real GDP and exchange rate. A negative and insignificant relationship is found between share price and interest rate. No causal relationship between share price and interest rate, inflation, GDP and exchange rate.
Kalyanaraman &Tuwajri (2014)	Saudi Arabia	Jan.1994 - Jun. 2013.	Johansen co-integration test, VECM	Inflation, industrial output, money supply, exchange rate and oil prices.	All macroeconomic variables are found to impact stock prices. Long run causality from the explanatory variables to the stock prices. Short run causality finds a two-way causality between stock prices and oil prices.

Chia & Lim (2015)	Malaysia	1980:Q1 - 2011:Q3.	ARDL method	Industrial production, inflation, money supply, interest rate and exchange rate.	Share prices are influenced positively by money supply and interest rates, and negatively by inflation.
Francis & Ganeshamoorthy (2017)	Sri Lanka	1986-2014	Johansen's co-integration, OLS method and Granger causality test	All share price index, inflation rate, money supply, exchange rate and average weighted prime lending rate	The macroeconomics variables have significant long run and short run effects in determining stock prices in Sri Lanka. The average weighted prime lending rate and exchange rate showed a positive relationship with all share price index while narrow money supply and Colombo Consumer price inflation rate showed a negative relationship. The result of Co-integration test also confirmed that there is a long run stable stock price function for Sri Lanka.
Amith & Louis (2018)	ASIAN 3: China, India, & Japan	Jan.2008-Nov. 2016.	Johansen co-integration test, Granger causality test	Exchange rate, inflation (CPI), Nifty, Shanghai stock exchange and Nikkei stock exchange	Exchange rate has a positive and significant long-run effect on stock markets while the inflation has a negative and insignificant long-run effect. In the short run, there is no statistically significant relationship between macroeconomic variables and stock markets.
Jana &Tomáš, (2019)	Brazil, China, France, Germany, Hong Kong, India, Italy, Portugal, Singapore, Switzerland and the U.S	Jan.2000-Dec.2017.	Multifactor model	Stock market development, GDP, unemployment, money supply and IPI.	Positive linkages between automaker's stock return volatility with stock market development, GDP and unemployment.Inverse linkage between the dependent variable with money supply and IPI.

3. Methodology

3.1 Data source and description of variables

Several macroeconomic variables influence stock market returns. One way of linking macroeconomic variables and stock market returns is through arbitrage pricing theory (Ross, 1976) where multiple risk factors can explain stock returns. After reviewing the literature thoroughly, we have selected various macroeconomic variables and a political stability variable (war) for our present study drawing on various previous studies. To accomplish the research objective, we use monthly data on industrial production, inflation rate (consumer price index), money supply, real exchange rate, trade openness, average weighted prime lending rate and all share price index, which cover the period from January 2007 to December 2019. Stock market returns are also affected by different political events and such risk always exists particularly in less developed countries including Sri Lanka due to their unstable political conditions (Bittlingmayer, 1998). In the past decade, several researchers have analyzed the importance of political conditions on volatility of global stock markets (Beaulieu et al., 2006). Therefore, the omission of a political variable could greatly bias the empirical results between macroeconomic variables and stock returns in the case of Sri Lanka since political instability is a significant feature in this country. We use dummy variable (WAR) to capture the effect of political instability during the relevant periods and which takes the value 1 for the war months and 0 otherwise. The choice of the study period is based on the availability of data series. All the data has been gathered from the official database of the World Bank (2019) and various annual reports of Central Bank of Sri Lanka.

All variables were log transformed, hence the problem of heteroskedasticity can be reduced since it compresses the scale in which the variables are measured and thus reducing a tenfold difference between two values to a twofold difference (Gujarati, 1995). Descriptions of variables and data sources are presented in Table 2

Table 2. Descriptions of variables and data sources

Variable	Acronym	Source
Industrial production	IPI	Central Bank of Sri Lanka
Inflation rate	INF	World Bank (2015)
Money supply	MS	World Bank (2015)
Real exchange rate	REXE	World Bank (2015)
Trade openness	OPN	Pen World Table (2016)
Political instability	WAR	SIPRI (2016)
Average weighted prime lending rate	AWPLR	Central Bank of Sri Lanka
All share price index	SP	Central Bank of Sri Lanka

The expected sign of macroeconomic variable on stock returns and macroeconomic variables employed in previous studies are presented in Table 3 in the Appendixes.

3.2 ARDL model specification

In order to empirically examine the long-run relationships and short-run dynamic interactions between the variables of interest, the model has been estimated by using the ARDL bounds testing co-integration procedure of order p, in Z_t, where Z_t is a column vector composed of the eight variables: Z_t = (ASPI, AWPLR, IPI, INF, OPN, MS, REXR, WAR). The ARDL co-integration approach was popularized by Pesaran and Smith (1998), Pesaran and Shin (1999) and Pesaran et al. (2001). The procedure is adopted given the following advantages over conventional cointegration techniques.

- Firstly, the ARDL bounds testing procedure, being a single equation technique, is more robust in small or finite samples consisting of 30 to 80 observations (Pattichis, 1999; Mah, 2000; Ghatak and Siddiki 2001 and Romilly et al. 2001) compared to the conventional methodologies[1]. Therefore, conducting bounds testing will be appropriate for the present study.
- Secondly, the standard Wald or F-statistics used in the bounds test have a non-standard distribution under the null hypothesis of no co-integration relationship between the examined variables. Nor does this methodology require the pre-testing of this methodology does not require to pretest the variables in the model for unit roots - unlike other techniques such as the Johansen approach. The linear ARDL co-integration technique is applicable irrespective of whether the regressors in the model are purely I(0), purely I(1) or mutually co-integrated. However, the technique is not valid in the presence of I(2) or higher order series. If we are not sure about the unit root properties of the data, then applying the ARDL procedure is the more appropriate model for empirical work.
- Thirdly, the procedure for bounds test is not complete. In contrary to other multivariate co-integration techniques such as Johansen and Juselius (1990), the model can be tested by using a simple Ordinary Least Square (OLS) method once the lag order of ARDL has been recognized.
- Fourthly, this technique generally provides unbiased estimates of the long-run model and valid *t*-statistic despite some of the regressors are endogenous (Harris and Sollis 2003).
- Fifthly, the ARDL Model applies a general-to-specific modeling framework by taking a sufficient number of lags to capture the data generating process (Harvey, 1981). It estimates $(p + 1)k$ number of regressions to obtain an optimal lag length for each variable, where p is the maximum lag to be used, and k is the number of variables in the equation.
- Sixthly, the ARDL co-integration estimates the short-run and long-run components of the model simultaneously; removing problems associated with omitted variables and

[1]Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990)

autocorrelation and therefore provides unbiased and efficient estimates.

- Lastly, an error correction model (ECM) can also be drawn from by an ARDL approach (Sezgin and Yildirim, 2003). The ECM allows drawing an outcome for long-run estimates while other traditional co-integration techniques do not provide such types of inferences.

The above advantages of the ARDL technique over other standard co-integration techniques justify the application of ARDL in the present study to analyze the relationship between the variables of interest. Following Pesaran et al (2001) as summarized in Frimpong and Oteng-Abayie in 2006 (Frimpong and Oteng-Abayie, 2006), In this study the bounds test method is applied via modeling the long-run equation as a general vector autoregressive (VAR) model of order *p*, in z_t: This can be presented as:

$$z_t = c_0 + c_1 t + \sum_{i=1}^{p} \varphi_t z_{t-i} + \varepsilon_t \qquad (1)$$

$$t = 1, 2$$

with c_0 representing a $(k+1)$-vector of intercepts (drift), and c_1 denoting a $(k+1)$-vector of trend coefficients. Pesaran et al (2001) further derived the following vector error correction model (VECM) corresponding to (1):

$$\Delta z_t = c_0 + c_1 t + \Pi z_{t-i} + \sum_{i=1}^{p-1} \Gamma_t \Delta z_{t-i} + \varepsilon_t \qquad t = 1, 2 \qquad (2)$$

where the (k+1) × (k+1) matrices

$$\Pi = l_{k+1} + \sum_{i=1}^{p} \psi_i \qquad and$$

$$\Gamma = -\sum_{j=i+1}^{p} \psi_j \qquad i = 1, 2 \ldots\ldots, p-1$$

contain the long-run multipliers and short-run dynamic coefficients of the VECM. Z_t is the vector of variables y_t and x_t respectively. y_t is an I(1) dependent variable defined as SP_t and x_t=[AWPLR, IPI, INF, OPN, MS, REXR,WAR] is a vector matrix of ‘forcing’ I(0) and I(1) regressors with a multivariate identically and independently distributed (*i.i.d*) zero mean error vector $\varepsilon_t = (\varepsilon'_{1t}, \varepsilon'_{2t})'$ and a homoscedastic process. Further, assuming that a unique long-run relationship exists among the variables, the conditional VECM (2) now becomes:

$$\Delta y_t = c_0 + c_1 t + \alpha_{yy} y_{t-1} + \alpha_{xx} x_{t-1} + \sum_{i=1}^{p-1} \lambda_t \Delta y_{t-1} + \sum_{j=1}^{q-1} \xi_t \Delta x_{t-1} + \varepsilon_t \qquad (3)$$

$$t = 1, 2$$

Where α_{yy} and α_{xx} are the long-run multipliers and λ and ξ are the short-run multipliers. Based on Equation (3), the conditional VECM of interest can be specified as:

$$\begin{aligned}\Delta lnSP_t &= c_0 + \alpha_1 lnSP_{t-1} + \alpha_2 lnAWPLR_{t-1} \\ &+ \alpha_3 lnIPI_{t-1} + \alpha_4 lnINF_{t-1} + \alpha_5 lnOPN_{t-1} \\ &+ \alpha_6 lnMS_{t-1} + \alpha_7 lnREXR_{t-1} + \alpha_8 WAR_{t-1} \\ &+ \sum_{i=1}^{p} \phi_i \Delta lnSP_{t-i} + \sum_{j=1}^{q} \varpi_j \Delta lnAWPLR_{t-j} \\ &+ \sum_{l=1}^{q} \varphi_l \Delta lnIPI_{t-l} + \sum_{m=1}^{q} \theta_m \Delta lnINF_{t-m} \\ &+ \sum_{p=1}^{q} \eta_n \Delta lnOPN_{t-} + \sum_{r=1}^{q} \sigma_r \Delta lnMS_{t-r} \\ &+ \sum_{s=1}^{q} \kappa_s \Delta lnREXR_{t-s} + \sum_{u=1}^{q} \tau_u \Delta WAR_{t-u} \\ &+ \psi D_t + \varepsilon_t \qquad (4)\end{aligned}$$

Where α_i are the long run multipliers, c_0 is the drift, and ε_t are white noise errors.

3.3 Bounds testing procedure

First, we estimate the model in Equation (4) using the ordinary least square (OLS) method. Second, we test the absence of a long-run relationship between y_t and x_t by restricting the coefficient of y_{t-1} and x_{t-1} to be zero. To verify whether there exists a long run relationship among the variables, we conduct an F-test to show the joint significance of the coefficients of the lagged levels of the variables, denoted as:

$H_0 = \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = \alpha_8 = 0$ (No co-integration) (a)
against the alternative

H_1: At least one $\alpha_i \neq 0$ (Co-integration exists) (b)

We denote the test which normalizes on *SP* by F_{SP} (SP | AWPLR, IPI, INF, OPN, MS, REXR, WAR)

However, the asymptotic distribution of the bounds test statistic is non-standard under the null hypothesis of no co-integration relationship between y_t and x_t. Two asymptotic critical values bounds provide a test for co-integration when the independent variables are I(d) (where $0 \leq d \leq 1$): a lower value assuming the regressors are I(0), and an upper value assuming purely I(1) regressors. Here, the computed F-statistics (F bounds) is compared with the lower critical bounds (LCBs) and the upper critical bounds (UCBs). Thus:

- If $F_{Bounds} \geq UCB$, y_t is co-integrated with x_t
- If $F_{Bounds} \leq UCB$, y_t is not co-integrated with x_t
- If $LCB \leq F_{Bounds} \leq UCB$, Results is inconclusive

The computed F-statistics under the null hypothesis is compared with the critical values given in Pesaran et al. (2001).

In the next step, once co-integration is established the conditional ARDL (p, q_1, q_2, q_3, q_4, q_5, q_6, q_7) long-run model for SP_t can be estimated as:

$$lnSP_t = c_0 + \sum_{i=1}^{p} \alpha_1\, lnSP_{t-i} + \sum_{j=1}^{q} \alpha_2\, lnAWPLR_{t-i} + \sum_{l=1}^{q} \alpha_3\, lnIPI_{t-i} + \sum_{m=1}^{q} \alpha_4\, lnINF_{t-i} + \sum_{p=1}^{q} \alpha_5\, lnOPN_{t-i} + \sum_{r=1}^{q} \alpha_6\, lnMS_{t-i} + \sum_{s=1}^{q} \alpha_7\, lnREXR_{t-i} + \sum_{u=1}^{q} \alpha_8\, WAR + \psi D_t + \varepsilon_t \qquad (5)$$

where, all variables are as previously defined. This involves selecting the orders of the ARDL (p, q_1, q_2, q_3, q_4, q_5, q_6, q_7) model in the eight variables using the Schwarz Bayesian criterion (SBC). In the next and final step, we obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

$$\Delta lnSP_t = \mu + \sum_{i=1}^{p} \phi_i\, \Delta lnSP_{t-i}$$

$$+\sum_{j=1}^{q} \varpi_j \, \Delta lnAWPLR_{t-j} + \sum_{l=1}^{q} \varphi_l \, \Delta lnIPI_{t-l}$$
$$+\sum_{m=1}^{q} \theta_m \, \Delta lnINF_{t-m} + \sum_{p=1}^{q} \eta_p \, \Delta lnOPN_{t-p}$$
$$+\sum_{r=1}^{q} \sigma_r \, \Delta lnMS_{t-r} + \sum_{s=1}^{q} \kappa_s \, \Delta lnREXR_{t-s}$$
$$+\sum_{u=1}^{q} \tau_u \, \Delta WAR_{t-u} + \vartheta ecm_{t-1} + \varepsilon_t \quad (6)$$

Here ϕ, ϖ, φ, θ, η, σ, κ, and τ are the short-run dynamic coefficients of the model's convergence to equilibrium, and ϑ is the speed of adjustment.

Once the short-run dynamic parameters have been established, usual diagnostic tests such as the Lagrange multiplier test of residual serial correlation, Ramsey's RESET test using the square of the fitted values for correct functional form, the normality test based on skewness and kurtosis of residuals and heteroscedasticity test based on the regression of squared residuals on squared fitted values are performed to test the reliability of parameters. The long-run stability of parameters is tested applying the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) tests. The Microfit 5 is used to perform the ARDL model and the diagnostic tests.

4. Empirical analysis and estimation results

4.1 Unit root test

We first test the stationary status of the selected time series data to determine their order of integration before proceeding to the ARDL bound test. The unit root tests are used to ensure that the variables are not $I(2)$ stationary so as to avoid spurious results. The test of unit root for all variables is done here with the augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) test statistics. Both the tests have the most general form of specification that includes the trend and intercept.

The statistical results of the ADF and PP tests are reported in Table 4. For the log-first difference variables of share price, average weighted prime lending rate, trade openness, money supply and real exchange rate, the obtained test statistics are all greater than the critical value at the 1 per cent level of significance. This implies that the null hypothesis of unit root is rejected; hence, we conclude that these variables are integrated of order one. For the variables of industrial production and inflation, they are stationary at level as the test statistic is greater than the 1 per cent critical value.

4.2 ARDL Bounds test

The computed *F*-test statistics for the co-integration test is displayed in Table 5. The critical value is reported together in the same table based on the critical value suggested by (Pesaran et al., 2001).

The result of the bounds testing approach for co-integration shows that the calculated F-statistic is 5.65 and that it is significant at the 5 per cent level. The critical values of the upper level of bounds are 3.13, 3.50 and 4.26 for 10, 5 and 1 per cent level of significance, respectively. The result confirms that the null hypothesis is rejected at the 5 per cent significance level therefore it is clear that there exists a co-integration relationship among the variables.

The next step requires the ARDL method to estimate the long-run and short-run elasticities. The orders of the ARDL model in the eight variables are selected by using SBC. Equation (5) is estimated using the following ARDL (1, 1, 0, 1, 1, 0, 1) specification. The estimated long-run coefficients of the model given in Equation (5) are reported in Table 6.

The long-run test confirm has the estimated of long-run relationship are significant for all variables with the exception of average weighted prime lending rate (AWPLR). In the long run, industrial production (LIPI) and real exchange rate (LREXR) in Sri Lanka is found to have a positive and significant (at the 5 per cent significance level) impact on the share price (LSP), with an elasticity of 0.64 and 4.59 respectively.

This indicates that industrial production and real exchange rate have an important effect on share price in Sri Lanka. The estimated coefficients of trade openness (LOPN) and money supply (LMS) have a positive significant impact on share price at the 1 per cent level. If we consider the effect of trade openness and money supply on share price, a 1 per cent increase in trade openness and money supply leads to a 2.73 per cent and 6.99 per cent increase respectively in share price. This means that trade openness and money supply have a very significant and important effect on share price. The macroeconomic stability variable (LINF*)* and political stability variable (WAR) have an expected negative sign and are significant at the 1 per cent level in the long-run. The long-run relationship between the variables indicates that there is Granger-causality in at least one direction which is determined by the F-statistic and the lagged error-correction term.

The error correction representation of equation number (6) is obtained after estimate the long-run estimate of coefficient. The optimal lag length for the selected error correction representation of the ARDL (1, 1, 0, 1, 1, 0, 1) model is determined by the SBC. The results of short-run dynamic coefficients associated with the long run relationships obtained from the ARDL-ECM equation (6) are presented in Table 7. The estimated lagged error correction term ECT (-1) is negative and highly significant. The negative and significant error correction term also confirms the existence of a stable long-run relationship between the significant regressors and the dependent variable in Sri Lanka. The feedback coefficient is -0.17. It suggests that about 17 per cent disequilibrium is corrected in the current year.

The results of this analysis found strong support for the short-run relationship between the share price and its selected determinants excluding average weighted prime lending rate. All variables except average weighted prime lending rate are statistically significant. Industrial production, trade openness and money supply have a positive sign and significant at the 1 percent confident Level in the short run. The real exchange rate coefficient is positive impact on share price and significant at the 95 per cent confident level with an elasticity of 1.16. Finally, the macroeconomic stability and political stability variables have a negative sign and are significant at the 5 per cent level.

4.3 Diagnostic and stability tests

Lastly, to check for the estimated ARDL (1, 1, 0, 1, 1, 0, 1) model, the diagnostic tests such as serial correlation, functional form, normality, heteroscedasticity and structural stability of the model are considered. The results of the diagnostic tests are reported in Table 8. The diagnostic tests of the estimated ARDL model suggest that the model passes the tests of serial correlation, functional form misspecification, non-normal errors and the heteroscedasticity. The diagnostic tests confirm that there is no evidence of serial correlation and heteroskedasticity.

Finally, when analyzing the stability of the long-run coefficients together with the short-run dynamics, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) are applied. CUSUM and CUSUMSQ statistics are plotted against the critical bound of 5per cent significance. A graphical representation of CUSUM and CUSUMQ statistics is shown in Figure 1 and 2 which indicate the stability of the parameters remained within its critical bounds of parameter stability.

Figure 1: Plot of CUSUM test

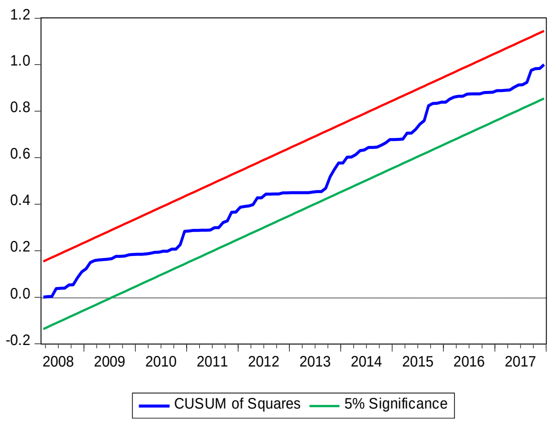
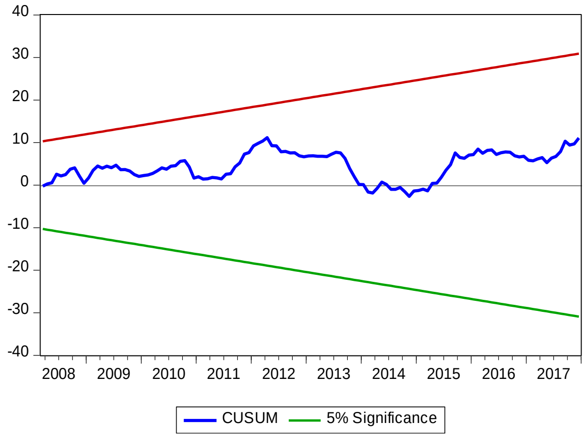


Figure 2: Plot of CUSUM test



5. Conclusion and policy implications

There are numerous studies which have examined the impact of macroeconomic variables on stock prices, but their results are questionable. The reasons for their inconsistencies include sample bias, selection of inappropriate variables, methodological deficiencies and poor quality of data. This paper overcomes most of these shortcomings by estimating a model that controls a number of domestic and international factors using the ARDL bounds test. To empirically examine the long-run relationships and short-run dynamic interactions among the variables of interest, the paper uses data from January 2007 to December 2017. The findings confirm a significant relationship between the selected macroeconomic variables and stock market returns. In the long run, industrial production, real exchange rate, trade openness and money supply have a positive significant impact on share price in Sri Lanka. It is also found that macroeconomic stability and political stability have an expected negative sign and are significant. Further, the findings also indicate a short-run relationship between selected macroeconomics variables except average weighted prime lending rate and the share price.

The findings of this study are consistent with previous studies as discussed in the empirical literature. Thus, policymakers can develop policies to stabilize the selected macroeconomic variables through measures which enhance political stability. Further, policymakers can implement policies and programs to attract more investors to the stock market.

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Appendices

Table 3. The expected sign of the variables and the variables employed in previous tests

Variables	Expected sign	Previous studies which employ indicated variables
Industrial production	+	Fama (1981), Chen et al. (1986), Muradoglu et al. (2000), Hassan & Nasir (2008), Tursoy et al. (2008), Humpe & Macmillan (2009), Mahmood & Dinniah (2009), Sohail & Hussain (2009), Asaolu & Ogunmuyiwa (2010), Buyuksalvarci (2010), Naik & Padhi (2012), Saeed And Akhter (2012), Kalyanaraman & Tuwajri (2014), Chia & Lim (2015)
Inflation	-	Fama (1981), Chen et al. (1986), Mukherjee & Naka (1995), Muradoglu et al. (2000), Wongbangpo & Sharma (2002), Gunasekarage et al. (2004), Gan, et al. (2006), Adam & Tweneboath (2007), Anokye & Tweneboah (2008), Hassan & Nasir (2008), Tursoy et al. (2008), Humpe & Macmillan (2009), Mahmood & Dinniah (2009), Karam & Mittal (2011), Asaolu & Ogunmuyiwa (2010), Buyuksalvarci (2010), Alshogeathri (2011), Kuwornu & Victor (2011), Olugbenga (2011), Ozcan (2012), El-Nader & Alraimony (2013), Inyiama & Nwoha (2014), Kalyanaraman & Tuwajri (2014), Chia & Lim (2015)
Money supply	+	Fama (1981), Mukherjee & Naka (1995), Gunasekarage et al. (2004), Gan, et al. (2006), Hassan & Nasir (2008), Tursoy et al. (2008), Humpe & Macmillan (2009), Buyuksalvarci (2010), Alshogeathri (2011), Olugbenga (2011), Naik & Padhi (2012), Ozcan (2012), Saeed And Akhter (2012), El-Nader & Alraimony (2013), Kalyanaraman & Tuwajri (2014), Chia & Lim (2015)
Real exchange rate	-	Mukherjee & Naka (1995), Muradoglu et al. (2000), Bhattacharya & Mukherjee (2001), Wongbangpo & Sharma (2002), Gunasekarage et al. (2004), Gan, et al. (2006), Adam & Tweneboath (2008), Anokye & Tweneboah (2008), Hassan & Nasir (2008), Lucey et al. (2008), Tursoy et al. (2008), Mahmood & Dinniah (2009), Karam & Mittal (2009), Sohail & Hussain (2009), Asaolu & Ogunmuyiwa (2010), Buyuksalvarci (2010), Alshogeathri (2011), Izedonmi & Abdullahi (2011), Kuwornu & Victor(2011), Olugbenga (2011), Naik & Padhi (2012), Ozcan (2012), Saeed And Akhter (2012), El-Nader & Alraimony (2013), Inyiama & Nwoha (2014), Kalyanaraman & Tuwajri (2014), Chia & Lim (2015)
Trade openness	+	Kawakatsu and Morey (1999a, 1999b), Kim and Singal (2000a, 2000b), Basu and Morey (2005), Alajekwu et al., (2013).
Political instability	-	Simon (1982), Chen & John (1996), Tan &Gannon, (2002), Khalid & Rajaguru (2010), Gul et al (2013), Manzoor (2013), Nguthi (2013)
Average weighted prime lending rate/ Interest rate	-	Fama (1981), Chen et al. (1986), Mukherjee & Naka (1995), Muradoglu et al. (2000), Wongbangpo & Sharma (2002), Gan, et al. (2006), Adam & Tweneboath (2008), Anokye & Tweneboah (2008), Hassan & Nasir (2008), Lucey et al. (2008), Tursoy et al. (2008), Humpe & Macmillan (2009), Karam & Mittal (2011), Buyuksalvarci (2010), Alshogeathri (2011), Kuwornu & Victor(2011), Olugbenga (2011), Ozcan (2012), Saeed And Akhter (2012), Yahyazadehfar & Babaie (2012), El-Nader & Alraimony (2013), Inyiama & Nwoha (2014), Chia & Lim (2015)

Table 4. Results of ADF and PP tests

Variables	Augmented Dickey-Fuller		Phillips-Perron	
	Level	First differenced	Level	First differenced
LSP	-1.21	-9.74	-1.29	-9.97
	(0.67)	(0.00)	(0.63)	(0.00)
LAWPLR	-2.21	-7.12	-0.88	-9.40
	(0.20)	(0.00)	(0.79)	(0.00)
LIPI	-5.98	--	-6.20	--
	(0.00)		(0.00)	
LINF	-3.01	--	-6.09	--
	(0.03)		(0.00)	
LOPN	-1.76	-3.88	-1.73	-4.25
	(0.40)	(0.01)	(0.42)	(0.00)
LMS	-1.42	-3.84	-1.04	-3.97
	(0.57)	(0.02)	(0.74)	(0.01)
LREXR	-1.91	-15.87	-1.69	-19.00
	(0.33)	(0.00)	(0.43)	(0.00)

Source: World Bank (2018).
Note: Values in parentheses are p-value.

Table 5. Results of ARDL bounds test

Computed F-statistic	Critical Values		Significance level
	Lower bound	Upper bound	
	2.96	4.26	1%
5.64*	2.32	3.50	5%
	2.03	3.13	10%

Source: World Bank (2018).
Note:Computed F-statistics = 5.64. The upper and lower bounds were obtained using unrestricted intercept with no trend. The critical values are obtained from Pesaran et al. (2001), table CI (iii) Case III.

TABLE 6. Estimated long run coefficients using ARDL model selected based on SBC

Variable	Coefficient	τ-statistics	probability
C	7.43**	1.63	0.01
LAWPLR	-0.03	-0.09	0.12
LIPI	0.64**	1.32	0.02
LINF	-1.06*	-3.17	0.00
LOPN	2.73*	5.82	0.00
LMS	6.99*	4.85	0.00
LREXR	4.59**	2.32	0.02
WAR	-0.60*	-3.64	0.00

Source: World Bank (2018).
Note: *, **, *** indicates significance at the 1 per cent, 5 per cent and 10 per cent respectively.

TABLE 7: Error correction representation for ARDL model based on the SBC

Variable	Coefficient	t-statistics	probability
ΔLAWPLR	-0.05	-0.09	0.23
Δ LIPI	0.11**	1.64	0.01
ΔLINF	-0.18**	-2.39	0.02
ΔLOPN	2.18*	4.38	0.00
ΔLMS	1.19*	3.77	0.00
ΔLEXR	1.16**	3.75	0.03
ΔWAR	-0.10**	-1.97	0.05
ECT (-1)	-0.17*	-3.49	0.00
R^2	0.68		
$\overline{R}^2$	0.63		
F-statistics	5.41		0.00
DW - statistics	1.87		

Source: World Bank (2018).
Note: *, **, *** indicates significance at the 1 per cent, 5 per cent and 10 per cent respectively.

Table 8. Diagnostic test

	Test statistics		LM version		F version	
A:	Serial correlation	CHSQ (1)	= 10.24	(0.59)	F (12,110)	= 0.78 (0.67)
B:	Functional form	CHSQ (1)	= 0.89	(0.35)	F (1,121)	= 0.81 (0.37)
C:	Normality	CHSQ (2)	= 7.26	(0.13)		Not applicable
D:	Heteroscedasticity	CHSQ (1)	= 1.74	(0.19)	F (1,186)	= 1.74 (0.19)