Factors Determining the Predictability of Stock Prices in Emerging Capital Markets: Evidence from Colombo Stock Exchange

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Received: 5 July 2012
Accepted: 12 March 2013

Abstract:
Empirical evidence on predictability of stock returns in advanced and emerging capital markets is seemingly mixed. Stock returns in emerging capital markets appear to display weak-form inefficiency. Empirical evidence on the Colombo Stock Exchange (CSE), which is one of the emerging capital markets, has also shown that stock returns tend to display weak-form inefficiency, though factors determining such inefficiency are not well-recognized. This paper, therefore, empirically examines factors determining inefficiency of stock prices focusing on macroeconomic and socio political variables. This study uses time series econometric methods for monthly data from 1985(1) to 2011(5). Results show that there is a long-run relationship between stock returns and macroeconomic variables. Results of Error Correction Model (ECM) and Granger causality tests reveal that there are no such casual links in the short-run. Socio-political variables all together tend to affect stock price movements. These findings suggest that public information on macroeconomic and socio-political conditions tend to determine stock price movements in the CSE. The empirical results, therefore, indicate that macroeconomic and socio-political variables can, to a considerable extent, be used to predict price movements in emerging capital markets.

Keywords: Efficient market hypothesis, Colombo Stock Exchange, Co-integration, Error Correction Model, Granger Causality test

1. Introduction

The Efficient Market Hypothesis (EMH) gained its reputation ever since the 'theory of random walk' and the 'theory of rational expectations' increasingly received acceptance by academia in the mid-twentieth century. A capital market is considered to be efficient if it can fully and precisely reflect all relevant information in determining prices of capital assets and if those prices can quickly adjust in response to new information. Such efficiency also means that the future movements of stock prices cannot be predicted. A seminal work by Fama (1970) divides the degree of market efficiency into three groups depending on information availability. First, weak-form of efficient market hypothesis (WFEMH) states that current prices fully reflect all relevant past price patterns. Second, semi-strong form of the EMH stresses that current prices reflect past price patterns as well as all publicly available relevant information. Third, strong form of EMH highlights the idea that any information available to any market participant is reflected by the current prices.

The weak-form and semi-strong form efficiencies have been tested extensively for capital markets in developed countries. However, two forms are not tested extensively with respect to emerging capital markets. Lack of data, cost of acquiring new information, inadequate regulations and supervision, underdeveloped clearing and settlement systems and lack of efficient data recording process in capital markets in many developing countries tend to confine the research efforts on the weak-form and semi-strong form efficiencies for capital markets in developing countries. In addition, the existing empirical evidence on testing the strong form of the EMH is limited.

The Colombo Stock Exchange (CSE) in Sri Lanka established in 1985 is one of the fastest growing capital markets, an emerging market, in South Asia. 234 listed companies trade their stocks in the primary share market of the CSE. Two price indices mainly record the share trading, namely All Share

Price Index (ASPI) and Milanka Price Index (MPI).[1] In a comprehensive empirical study, Vidanage and Dayaratna-Banda (2012)[2] found that the CSE is basically weak-form inefficient revealing that future price changes can partially be predicted by using past patterns of stock returns in the CSE. This means one needs to empirically examine the sources of this inefficiency in emerging capital markets. In this respect, macroeconomic environment appears to play a crucial role. The important macroeconomic variables that might affect the price movements in the emerging capital markets are interest rates, Foreign Direct Investment (FDI) inflows, economic growth, money supply, and inflation rate. In order to test sources of stock price movements, one needs to test the possible long-run and short-run relationships between these macroeconomic variables and stock returns. So, the purpose of this paper is to investigate whether the macroeconomic environment and socio-political conditions of the country could explain the stock price movements in emerging capital markets.

Testing for the sources of stock price movements other than the past prices can in one way be interpreted as testing the semi-strong form of the EMH which has been widely explored in the existing market efficiency literature by using macro and micro data.[3] Previous studies on the semi-strong form on Colombo stock market (Wickramasinghe, 2006) and Gunasekarage *et al.*, 2004)[4] have been limited to identifying the possible causal relationships between selected macroeconomic variables and stock prices up to 2004. The

[1] ASPI (1985=100) is the oldest share price index at the CSE, and MPI (1998=100) replaces the Sensitive Share Index (SSI).
[2] Vidanage, T and Dayaratna-Banda, O.G. (2012) 'Does past information help predict future price movements in emerging capital markets?: evidence from the Colombo Stock Exchange', South *Asia Economic Journal*, vol. 13, no. 2, pp 241-264.
[3] For example, anticipated events are events such as company announcements on merging and unanticipated events are events such as impacts of terrorist attacks or natural disaster, etc.
[4] A detailed discussion on previous studies on CSE will be carried out in Section 2.

macroeconomic environment of Sri Lankan economy has changed significantly after 2005 with a new government coming onto power. The annual rate of inflation and money supply can be mentioned as few macroeconomic indicators which have changed significantly during the last five years. Moreover, previous studies did not focus on the prevailing economic and political situation though they provide important information.

In this context, it is an interesting and valid empirical question to investigate whether and to what extent socio-political factors and macroeconomic conditions help predict price movements in emerging capital markets, such as the CSE. The remainder of the paper is organized as follows. Section 2 summarizes existing key empirical evidence, and section 3 briefly outlines the econometric methodology and data used in the current study. Results and conclusions are discussed in section 4 and 5, respectively.

2. Existing Empirical Evidence

There is an extensive amount of studies on the relationship between macroeconomic variables and stock returns in advanced countries. Several studies have focused on the relationship between macroeconomic data and stock prices of capital markets in both developed and developing countries. Groenewold and Kang (1993) looked at weak and semi-strong forms of the EMH using data on the Australian share market from 1982 (August) to 1988 (June). They found that the data was consistent with the EMH. Among the studies focused on macroeconomic data on emerging capital market, Balaban and Kunter (1996) looked at the informational efficiency of the Turkish financial market.[5] In 2006, Griffin *et al.* attempted to measure the short-term international stock market efficiency by examining 56 markets in the world in which Sri Lanka was not included. Another attempt on testing semi-strong form of stock market in Ghana has been carried out by Adam & Tweneboah

[5] The financial market is an integration of three capital markets, namely stock market, foreign exchange market and inter-bank money market in Turkey.

(2008). Maysami *et al.* (2004) examined the long-term relationships between selected macroeconomic variables and various stock market indices in Singapore capital market. Maysami *et al.* (2004) employed tests of cointegration to examine the semi-strong form of the efficiency. The short and long-term interest rates, industrial production, price levels, exchange rate and money supply were included as the macroeconomic variables in their study. On one hand, Griffin *et al.* (2006) used drifts on post-earnings announcements, and on the other hand, they used the Morck, Yeung, and Yu (2000) R^2 efficiency measure as an informational efficiency measure to examine the semi-strong form efficiency.[6] Balaban and Kunter (1996) employed the Granger causality tests to determine the semi-strong form efficiency.

However, the above studies generated mixed results. For example, Balaban and Kunter (1996) found significant deviations from EMH with respect to changes in market liquidity. Griffin *et al.* (2006) found similar abnormal returns in emerging and developed markets. A cointegration between macroeconomic variables and stock prices in Ghana was found in Adam and Twenboah (2008) study, signaling a long-run relationship between those variables. Maysami *et al.* (2004) concluded that Singapore's stock market and the property index have a cointegration relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply.

A more recent study by Guttler *et al.* (2008) focused on the semi–strong form efficiency in Brazilian Stock Market. To employ cointegration tests and various Granger causality tests, Guttler *et al.* (2008) considered the following selected macro variables; GDP, inflation rate, the base interest rate

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[6] Morck, Yeung and Yu (2000) proposed the average market model R^2 across firms in a country as a measure of firm-specific information production, with higher average R^2 indicating lower firm-specific information and, thus, less efficient pricing (Griffin *et al.*,2006 : 04). This is used as an informational efficiency measure. See Griffin *et al.* (2006) for an extensive discussion.

and country risk, for the period from January 1995 to December 2005. They found a long-run relationship between selected macroeconomic variables in the Brazilian stock market indices based on the results.

Wickramasinghe (2006) and Gunasekarage *et al.* (2004) empirically tested the semi-strong form of the EMH. Both studies mainly focused on the causal relationship between selected macroeconomic variables and the ASPI on monthly data. Wickramasinghe (2006) used Colombo Consumers' Price Index (CCPI), Money Supply– M1, GDP of Sri Lanka, New York Stock market index and U.S. dollar and Sri Lanka rupee exchange rate for the period of 1985-2004. Gunasekarage *et al.* (2004) utilized money supply, Treasury bill rate, consumer price index, U.S. dollar and Sri Lanka rupee exchange rate and the New York Share price index for the period from 1985 to 2001.

By employing recently developed Ng-Perron unit root tests, Johansen's multivariate cointegration test and error correction model, Wickramasinghe (2006) concluded that the stock prices of Colombo stock market violate the validity of the semi-strong form of the EMH. Gunasekarage *et al.* (2004) also concluded that lagged values of consumer price index, money supply and Treasury bill rate have a significant influence on the stock returns. However, these studies do not explain the sources of capital market inefficiency.

These findings imply that relatively few studies have focused on the effects of macroeconomic variables on stock returns in emerging markets. When the emerging stock markets show weak form inefficiency indicating that variables other than past prices can be used to explain and predict stock price movements, it is advisable to test the relationships between various macroeconomic and socio-political variables and stock returns in emerging markets. As noted earlier, Vidanage and Dayaratna-Banda (2012) found that Colombo Stock Exchange is weak form inefficient indicating that variables other than past securities prices tend to determine the movements in stock prices. This finding provides the basis for empirically examining the macroeconomic and socio-political sources of stock price movements with a view to explaining the sources of information inefficiencies in emerging stock markets which could eventually be used to predict the future movements in prices.

This study differs from the existing studies of Wickramasinghe (2006) and Gunasekarage *et al.* (2004)[7] by the following respects. First, in this study our aim is to empirically test the macroeconomic and socio-political sources of market inefficiency in emerging capital markets focusing on the CSE. Second, the study focuses on the effects of the changes in macroeconomic variables, a few economic and political variables to examine as to how macroeconomic and socio-political variables tend to affect the stock returns in the CSE as against the earlier studies which attempt to test the semi-strong form of EMH. Third, while the existing studies have used the level of stock price indexes in the CSE, this study utilizes the returns calculated using ASPI in the CSE. Fourth, our research uses broad money supply (M2) instead of previously used narrow money supply (M1) since the financial markets in Sri Lanka have developed so that M2 is a better measure of the total amount of money in circulation than M1. Finally, we used monthly data from 1985 (1) to 2011 (5) for our empirical tests as none of the previous studies covered data for this period of time on monthly basis.

3. Methodology and Data

To accomplish the present research objectives, this study employed several quantitative techniques to test the long run relationship, causality, short run relationships, and persistence of short run impacts. These tests include the JJMCT, the ECM, Granger Causality Test, Impulse Response Function (IRF) Test and Variance Decomposition Test for empirical analysis.

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[7] Only these two studies were selected as they directly tested the relationship between macroeconomic variables and stock returns. Some other studies, which investigated the relationship between stock returns and one or two macroeconomic variables, are excluded from the present study. [For example, Samarakoon (1996) examined the relationship between stock returns and inflation in Sri Lanka].

Unit Root Tests

The Augmented Dickey-Fuller (ADF) unit root test is utilized to check the stationarity which may be an important time series property of monthly time series data. The JJMCT and the Granger causality test require that variables tend to be stationary.

Cointegration Test

The cointegration test is used to detect the long-run relationship between stock returns denoted by ASPI and the selected macroeconomic variables. For the empirical study, we adopt the cointegration test developed by Johansen and Juselius (1990), which involves the following steps. First, the order of the integration of the variables needs to be identified. Since the results of the test may be sensitive to the lag length, the appropriate lag length needs to be used in the test. A vector autoregression (VAR) model is used to determine the lag length based on the Akaike Information Criteria (AIC).

The order of integration is important in cointegration analysis since it requires the variables to be integrated in the same order. The order of integration can be determined by the results of the ADF test.[8] However, the procedure of the JJMCT allows us to perform the cointegration test, even if the variables are integrated of different orders (*i.e.* mixed order of integration). The original specification of cointegration test states that a set of *I (1)* variables is cointegrated if there exists *I (0)* linear combination.[9] However, According to Lutkepohl (2002), it is convenient to consider systems with both *I (1)* and *I (0)* variables. In this case the concept of cointegration is extended by interpreting

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[8] A time series is stationary (*i.e.*, no unit roots) in its level form, the order of integration said to be zero [*I (0)* process]. Next, if a time series is non-stationary in its level form, and becomes stationary with the first difference form, the order of integration is said to be one. That is *I (1)* process. In the general case, if a time series has to be differenced d times, the order of integration is *I (d).*

[9] See seminal contributions by Granger and Engle (1987) and Johansen and Juselius (1990).

any linear combination which is *I (0)* as a cointegration relationship. Moreover, Charemza and Deadman (1997) argued that:

> " … If variables in a long run relationship are of a different order of integration and the order of integration of the dependent variable is lower than the highest order of integration of the explanatory variables, there must be at least two explanatory variables integrated of this higher order if the necessary condition for stationarity of the error term is to be met…" (Charemza and Deadman, 1997: 127).

The JJMCT is based on the following VAR equation:

$$y_t = \alpha_1 y_{t-1} + ... + \alpha_n y_{t-n} + \beta x_1 + \varepsilon_t \qquad (1)$$

where y_t and x_1 are k-vector of non stationary [*I (1)* or *I(2)*] variables and a vector of deterministic variables, respectively, and ε_t is a vector of innovations. Using standard vector presentations, the above equation (1) can be illustrated as follows: Let $\mathbf{Y}_t = (Y_{1t}, \ldots, Y_{nt})'$ denote an (n×1) vector of *I(1)* time series. $\mathbf{Y}_t$ is cointegrated if there exists an (n×1) vector $\mathbf{ß} = (ß_1, \ldots, ß_n)'$ such that

$$\mathbf{ß'Y}_t = ß_1 y_{1t} + \ldots + ß_n y_{nt} \sim I(0) \qquad (2)$$

That is, the nonstationary time series in Y_t are cointegrated if there is a linear combination of them that is stationary [*I(0)]*[10].

Based on equation (1), the following model will be estimated;

$$R_t = \alpha_1 R_{t-1} + ... + \alpha_n R_{t-n} + \beta_1 B_t + \beta_2 M2_t + \beta_3 USD_t + \beta_4 INF_t + \varepsilon_t \qquad (3)$$

where R_t is returns on ASPI at time t and R_{t-1} is returns on ASPI at time t-1. B is bank rate and M2 is broad money supply, while USD is US Dollar and Sri Lanka rupee exchange rate, INF denotes the rate of inflation. Two likelihood

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[10] See Eric Zivot tutorials on cointegration (http://faculty.washington.edu/ezivot/econ584/notes/cointegration.pdf) for more detailed discussion.

estimation statistics, known as the trace value (λ trace) and maximum Eigen value (λ max) will be used to make inferences about the number of cointegrating relations.

For trace statistics, the null hypothesis of no cointegration relationship [H_0: r=0] between stock prices and macroeconomic variables can be rejected if the computed trace value exceeds the critical value [if λ_{trace} (r) >critical value] at any given significance level and accept the alternative [H_a: r≥1] hypothesis. Similarly, for the maximum Eigen value, the null hypothesis of no cointegration relationship [H_0: r=0] between the stock prices and macroeconomic variables can be rejected if the computed Eigen value exceeds the critical value [if λ_{max} (r) >critical value] at any given significance level and accept the alternative [H_a: r=1] hypothesis. However, one percent and five percent level of significance are important.[11] Final step is to analyze the normalized cointegrating vectors and speed of adjustment coefficients.

Error Correction Model

If variables are cointegrated, an ECM will be developed based on Engle & Granger (1987) seminal work. In an ECM, the short-run dynamics of the variables in the system are influenced by the deviation from long run equilibrium (Enders, 2004). According to Enders (2004), if two variables are cointegrated, the following equations can be used to build the ECM[12]

$$\Delta Y_t = a_1 + a_y z_{t-1} + \sum_{i=1}^{m} a_{11}\Delta Y_{t-i} + \sum_{i=1}^{n} a_{12}\Delta X_{t-i} + \varepsilon_{1t} \tag{4}$$

$$\Delta X_t = a_2 + a_z z_{t-1} + \sum_{i=1}^{m} a_{21}\Delta Y_{t-i} + \sum_{i=1}^{n} a_{22}\Delta X_{t-i} + \varepsilon_{2t}$$

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[11] The critical values for 10 percent level of significance is not used in the analysis since narrowing the confidence interval might lead to have incorrect conclusions in the analysis.

[12] See Enders (2004: 337-338) for more details.

where, $a_1, a_y, a_{11}, a_{12}, a_2, a_z, a_{21}$ and a_{22} are all parameters; x and y are the variables which exhibit cointegration relationship; Δ is the difference operator; z_{t-1} is the error correction term; and ε_{1t} and ε_{2t} denote the white-noise disturbances.

Granger Causality Test

For identifying the causal relationship between variables, the Granger (1969) causality test will be used. The Granger's (1969) method tests the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. The null hypothesis is, therefore, that ''The returns on ASPI does not cause inflation in the first regression and that inflation does not cause returns on ASPI in the second regression.'' Hence, pair-wise Granger causality tests will be employed to check the short-run impact of the selected macroeconomic variables. The optimal lag length will be decided based on AIC value.

$$\begin{aligned} y_t &= \alpha_1 + \alpha_2 y_{t-1} + \ldots + \alpha_n y_{t-n} + \beta_1 x_{t-1} + \ldots + \beta_n x_{t-n} \\ x_t &= \alpha_1 + \alpha_2 x_{t-1} + \ldots + \alpha_n x_{t-n} + \beta_1 y_{t-1} + \ldots + \beta_n y_{t-n} \end{aligned} \quad (5)$$

The bivariate regressions of the form specified in equations (5) for all possible pairs of (x and y) series are in the group. For example, the causal relationship between ASPI returns and inflation; ASPI returns and money supply, and so on.

Impulse Response Functions

The present study employs the tests on IRF[13] in order to identify the impact of any variable on the other variables in the system. The IRF traces the

[13] IRF traces the responses to a one-time shock in the innovation. The accumulated response is the accumulated sum of the impulse responses. It can be interpreted as the response to step impulse where the same shock occurs in every period from the first (Eviews 5.0 User Guide p. 511).

effect of one standard deviation shock to one of the innovations on current and future values of the endogenous variables.

Variance Decomposition Analysis

The variance decomposition analysis provides a different method of depicting the system dynamics. While the IRF trace the effects of a shock to an endogenous variable on the variables in the VAR, the variance decomposition method decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. As Enders (2004) pointed out, both impulse response analysis and variance decomposition analysis are useful tools to investigate the relationships among many macroeconomic and socio-political variables.

Data

To test the relationship between selected macroeconomic variables and stock returns, monthly closing prices of ASPI are collected for the period from 1985 (1) to 2011 (5). The sample, therefore, includes 317 observations per variable. The monthly closing stock prices are used to generate the monthly returns on ASPI by using the following formula: $R_t = \ln\left(ASPI_t / ASPI_{t-1}\right)$, in which $ASPI_t$ is the monthly closing price of ASPI at time t and t-1, respectively, and R_t denotes returns on monthly ASPI at time t. In order to calculate the monthly stock returns, the ASPI (1985=100) is chosen, because it is the only price index that has been calculated since the establishment of the CSE in the year 1985.

Similarly, data for following selected macroeconomic variables were collected on a monthly basis for the above period and transformed into natural logarithms.[14]

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[14] The main data sources are annual report of the Central Bank of Sri Lanka and IMF data CD-Rom.

a. Monthly average United States dollar and Sri Lankan rupee exchange rate (USD)

b. Monthly Inflation rate (INF) - this is calculated as the monthly change in the CCPI [Splicing method was used to calculate CCPI data for 2008(6)-2011(5)]

c. Monthly broad money supply (M2)[15]

d. Monthly bank rate (B) - since there are few interest rates operating in the economy (e.g.: lending rates, deposit rates, bank rate etc.), the present study only uses monthly bank rate as the interest rate which is one of the official instruments used for monetary policy adjustments.

Money supply and monthly average U.S. dollar and Sri Lankan rupee exchange rate are included to track the impact of the monetary policy on the stock prices. Adam and Tweneboah (2008) note that depreciating currency causes a decline in stock prices because expectations of inflation which is seen as negative news by the stock market, since it tends to curb consumer spending and thereby company's earnings.

We expect the sample period chosen to reflect many changes that have occurred in the CSE during the recent past. In addition to the above mentioned macroeconomic variables, five dummy variables will be included in the model in order to capture economic and political episodes occurred in the economy during the sample time period. They are as following:

D_{ER} represents the change in the floating exchange rate [2001(1)–2011 (05)]

D_{FC} represents the impacts of the 1997 financial crisis [1997 (4) – 1998 (12)]

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[15] M2 broad money supply = narrow money M1 [Cash held by public + Demand deposits held by public in commercial banks] + saving and time deposits held by the public in commercial banks.

D_{MOU} represents the information on peace agreement (MOU)[16] between Sri Lankan government and the Liberalization of Tamil Tiger Ealam (L.T.T.E.) [2002 (2)] which was a separatist terrorist outfit.

D_{MR} represents the United Peoples Freedom Alliance Regime elected in 2005 [2005(11), -2011(05)]

D_{WAR} represents the civil war and unstable political situation in the country [1985 (1) – 2009 (05)].

4. Empirical Results

Table 1 presents a summary of the descriptive statistics of the selected macroeconomic variables and ASPI returns for the entire sample period from 1985 to 2011. It can be seen that all variables have positive mean.[17] The standard deviation is high in the ASPI returns, indicating a greater spread in the monthly stock returns. Table 1 has also reported negative skewness for all variables, except ASPI returns, meaning that the data is skewed to the left side. The kurtosis statistics for variables ASPI returns, Inflation and Bank rate reveal that each of these variables has leptokurtic distribution, while kurtosis values for Money supply and US Dollar exchange rate reveal that they have platykurtic distribution. As all kurtosis coefficients are either less or greater than three, none of these selected variables shows a normal distribution. The Jarques-Berra test statistics of all these variables are significant at one percent level of significance. Thus, the values of kurtosis coefficient and Jarques-Berra statistics confirm that none of these variables has a normal distribution.

[16] The MOU was signed between Sri Lankan government and the L.T.T.E on 22nd February, 2002.

[17] Since all these variables have various scales, a comparison cannot be performed. However, monthly bank rate, the monthly inflation rate and the monthly average USD exchange rate seem to be very close to each other during the sample period (See Table 1).

The JJMCT and Granger causality test requires that the variables are stationary. The ADF test was conducted and the testable null hypothesis is that considered variable has a unit root. The optimal lag lengths for the ADF tests are selected based on the smallest value of the AIC, and the maximum lag length is set to sixteen. Table 2 reports the ADF test statistics for all variables. At levels, none of those absolute values of ADF statistics exceeds the critical values at one percent significant level except R_t (monthly returns on ASPI) and B (Bank rate). Thus, R_t and B_t are stationary at their level and do not contain unit roots. Their order of integration is zero; *I (0)*. The first-differenced data of the non-stationary variables was used in the unit root test. When testing for first difference form, all these variables became stationary because the null hypothesis of unit root can be rejected as the absolute values of calculated ADF test statistics are greater than the critical values for variables including INF (Inflation), USD (US Dollar and Sri Lanka rupee exchange rate) and M2 (broad money supply). This implies that these variables are integrated in order one; *I (1)*.

As explained in the above section, the JJMCT analysis can be performed as the next step of examining the long-run relationship between returns in ASPI and selected macroeconomic variables even if all variables are not integrated in the same order. Following Charemza and Deadman (1997), the order of integration of the dependent variable $R_{t,}$ [*I (0)*] is lower than the highest order of integration of the explanatory variables [*I (1)*]. At least two explanatory variables are integrated in this higher order [*I (1)*].

The above derived model in equation 03 exhibits the following properties in the order of integration: $R_t \sim I\ (0)$, $M2_t \sim I\ (1)$, $INF_t \sim I\ (1)$, $USD_t \sim I\ (1)$ and $B_t \sim I\ (0)$. Thus, the linear combination $(\beta_1 B_t + \beta_2 M2_t + \beta_3 USD_t + \beta_4 INF_t)$ ~*I (0)* of $M2_{t,}$ INF_t and USD_t are integrated of the same order [*I (1)*]. The order of integration of variable B_t is lower than that of other three explanatory variables. Thus, we can deduce that the error term is stationary as well [*I (0)*].

As the first step, VAR models with non-differenced data are estimated up to five lags. Based on the reported AIC values, the optimal lag length is set to three.[18] The following model is employed in the analysis;

$$R_t = (LB_t, LINF_t, LM2_t, LUSD_t) \quad (6)$$

Exogenous variables are $D_{ER,}$ D_{FC}, D_{WAR}, D_{MR}, D_{MOU}[19]

The results of the JJMCT are given in Table 3. Testing for cointegration rank will necessarily help to determine the number of cointegrating relationships in the model. The null hypothesis is that there are no cointegrating vectors in the model so that the rank r is zero. If the calculated Eigen value (λ_{max}) or trace statistics (λ_{trace}) exceeds the critical values, at one percent or five percent levels, one can reject the null hypothesis of no cointegrating vectors and accept the alternative of having one or more cointegrating vectors.

The results of the cointegration test reported in Table 3 indicate that the trace statistic [$\lambda_{trace\,(0)}$ = (108.8738)] exceeds the five percent critical value of the trace statistic 69.8189 so that it is possible to reject the null hypothesis of no cointegrating vectors, and accept the alternative of the presence of one or more cointegrating vectors. However, when using the $\lambda_{trace\,(1)}$ statistic to test the null of $r \leq 1$ against the alternative of two or three cointegrating vectors ($r \geq 2$), the trace statistic [$\lambda_{trace\,(1)}$ (44.36774] is less than the five percent critical value (47.85613). The above mentioned null hypothesis cannot be rejected at this significance level. Hence, the results of the trace statistics with the selected lag length (three) indicate that there is no more than one cointegration vector at five percent level.

[18] The results of the selection of lag length are not provided; can be given upon a request.

[19] However, the critical values were derived without considering the exogenous variables. The test assumes linear deterministic trend in the data.

The maximum Eigen value yields different results. The calculated Eigen value [$\lambda_{max\,(0)}$] is 64.50598 which is greater than five percent critical value, 33.87687, thereby we can reject the null hypothesis of no cointegrating vectors. Similarly, the calculated Eigen value [$\lambda_{max\,(1)}$] 29.41832 is also greater than the five percent critical value, 27.58434, thereby we can reject the null hypothesis of no cointegrating vectors, against the alternative of two or three cointegrating vectors ($r \geq 2$). This is not true with $\lambda_{max\,(2)}$ or above.

It is clear that Eigen value and trace statistic yield different results. While, Eigen value indicate two cointegrating relationships, the trace statistic shows only one cointegrating vectors. According to Johansen & Juselius (1990), it is recommended to use the trace statistics when there is a conflict between these two statistics. Thus, use of trace statistics as the only evidence for possible cointegration relationship is justified. Previously, Wickramasinghe (2006) and Maysami *et al.* (2004) used this method. Finally, based on trace statistics, it can be concluded that there is only one cointegrating relationship between ASPI returns and selected macroeconomic variables, namely, inflation rate, USD and Sri Lankan rupee exchange rate, bank rate and money supply.

The present evidence of cointegration relationships among ASPI returns and selected macroeconomic variables are consistent with the findings of the previous research. For example, Wickramasinghe (2006) finds similar results for Sri Lanka. Adam & Tweneboah (2008), Ibrahim (1999) and Maysami *et al.* (2004), find similar long-run relationships among stock prices and selected macroeconomic variables for emerging stock exchanges in Ghana, Malaysia and Singapore, respectively.

In our study, the normalized cointegrating coefficients for the ASPI returns are[20];

$$Y_t = (R_t \quad LB_t \quad LUSD_t \quad LINF_t \quad LM2_t \quad C) \qquad (7)$$

[20] We used the normalized equation, in order to express the relationship between ASPI returns and the macro economic variables, by choosing the ASPI returns as the dependent variable.

$\eth_1$ = (1.000 -0.00956 0.03114 0.10680 -0.191578 -0.560863)

These values represent percentage changes since log values of ASPI returns, INF, B, USD and M2 are used. Thus, the cointegrating relationship can be re-expressed as follows;

$$R_t = 0.560863 + 0.009556LB_t - 0.031142LUSD_t - 0.10680LINF_t + 0.191578LM2_t \quad (8)$$

(0.00750)	(0.03929)	(0.05048)	(0.10007)
(1.27413)	(-0.79261)	(-2.11568)**	(1.91443)**

Note: Values in parentheses are standard errors and t-statistics, respectively. ** - 5 percent and * - 10 percent significance.

According to equation (8), the coefficients for exchange rate (USD) and inflation rate (INF) are negative, whereas the signs of the other coefficients and the intercept are positive. Thus, above results yield negative relationships between ASPI returns and USD exchange rate and inflation rate. Positive relationships are found between stock returns and bank rate, and money supply. By using the given t-statistics, the statistical significance of above coefficients can be determined.[21] Thus, all the estimated coefficients are statistically significant at least in five percent level, except for the bank rate and USD exchange rate.

Similar to current findings on a positive relationship between long-term bank rate and the ASPI returns, Mukherjee and Naka (1995) and Maysami and Koh (2000) found such positive relationships for data in Japan and Singapore, respectively. Maysami and Koh (2000) explain the possible reasons for such relationship as follows;

[21] The critical t-statistic is 2.45 (for t n-k-1 = 313- 5- 1= 307) for 1 percent, 1.6515 for 5 percent and 1.282 for 10 percent.

> ‘’ ... The long-term interest rate may serve as a better proxy for the nominal risk-free component used in the discount rate in the stock valuation.’’ (Maysami and Koh, 2000:89)

The results of the current study imply that there exists a negative relationship between United States dollar-Sri Lanka rupee exchange rate and the stock prices of the CSE. These findings are contrary to the findings of Maysami and Koh (2000), who found a significant positive relationship between the exchange rate and the stock prices in Singapore. If the value of exchange rate increases, it means that Sri Lankan Rupee is depreciated against the U.S. Dollar. This may signal the local investors as a ‘bad sign’ of their income decrease; thereby incentives for investing in CSE may tend to be low. Yet, such negative long-term causal link between ASPI returns and USD exchange rate was not expected. The non-significant coefficients of both USD exchange rate and bank rate reveal that they are not the dominant causes for fluctuations of stock returns in the CSE.

The negative significant long-run relationship between inflation rate and ASPI returns is similar to the previous findings of Mukherjee and Naka (1995) and Chen et al. (1986). The increasing price level may discourage the investing decisions; thereby down turns in the stock returns can be expected.

The positive significant long-run relationship between broad money supply and stock returns implies about the relative importance of monetary policy changes on stock market activities. In fact, a one-percent increase in the broad money supply, would result in a 0.19 percent increase in the ASPI returns.This possible causal link can be justified as follows; when money supply increases (or the Central Bank changed its monetary policy by implementing an expansionary monetary policy), money demand may tend to be increased, since an increase in economic activities can also be expected. Higher level of economic activities often relates to high expected profitability in assets. This leads to have an increase in stock returns as well.

As discussed in Section 3, the short-run dynamics of the variables in the system are influenced by the deviation from the equilibrium. Thus, the cointegration method helps to examine these short-run dynamic co-movements among variables through an ECM. Further, ECM method can be used to examine the adjustment process towards the long-term equilibrium. Therefore, the parameter ecm_{1t} is included into the following model, in order to find out how the returns on ASPI react to deviations from the long-run equilibrium. The ECM requires that there is cointegration among the considered variables. Since, the above model (8) identifies the presence of at least one cointegration relationship between ASPI returns and selected macroeconomic variables, the following ECM was specified on the optimal lag length four:

$$\begin{aligned}\Delta R_t = {} & a_1 + \beta_1 \Delta R_{t-1} + \beta_2 \Delta R_{t-2} + \beta_3 \Delta R_{t-3} + \beta_4 \Delta R_{t-4} + \tau_1 \Delta LB_{t-1} + \tau_2 \Delta LB_{t-2} \\ & + \tau_3 \Delta LB_{t-3} + \tau_4 \Delta LB_{t-4} + \delta_1 \Delta LUSD_{t-1} + \delta_2 \Delta LUSD_{t-2} + \delta_3 \Delta LUSD_{t-3} \\ & + \delta_4 \Delta LUSD_{t-4} + \phi_1 \Delta LINF_{t-1} + \phi_2 \Delta LINF_{t-2} + \varphi_3 \Delta LINF_{t-3} + \varphi_4 \Delta LINF_{t-4} \\ & + \gamma_1 \Delta LM2_{t-1} + \gamma_2 \Delta LM2_{t-2} + \gamma_3 \Delta LM2_{t-3} + \gamma_4 \Delta LM_{t-4} + \lambda_1 D_{ER} + \lambda_2 D_{FC} \\ & + \lambda_3 D_{MOU} + \lambda_4 D_{MR} + \lambda_5 D_{WAR} + ecm_{1t}\end{aligned} \quad (9)$$

Note: ecm_{1t} is the error correction coefficient, and DER, D_{FC}, D_{WAR}, D_{MR} and D_{MOU} are the exogenous dummy variables explained in the above section III.

Equation (9) specifies that ΔR_t depends on changes in deterministic variables and the equilibrium error term ecm_{1t}. Based on the above ECM, the following results of the model were obtained:

$$\Delta R_t = 0.085612 \quad + 0.042967\Delta R_{t-1} + 0.077424\Delta R_{t-2} + 0.062379\Delta R_{t-3} + 0.073370\Delta R_{t-4}$$
$$(3.47811)^{***} \quad (0.38918) \quad (0.81210) \quad (0.78513) \quad (1.24129)$$
$$-.009927\Delta LB_{t-1} - 0.018277\Delta LB_{t-2} + 0.008712\Delta LB_{t-3} - 0.026309\Delta LB_{t-4}$$
$$(-0.86038) \quad (-1.59754)^{*} \quad (0.76483) \quad (-2.30550)^{**}$$
$$-0.031281\Delta LUSD_{t-1} - 0.010278\Delta LUSD_{t-2} + 0.062815\Delta LUSD_{t-3} + 0.125331\Delta LUSD_{t-4}$$
$$(-0.40057) \quad (-0.12546) \quad (0.73298) \quad (1.52984)^{*}$$
$$+0.422219\Delta LINF_{t-1} - 0.014563\Delta LINF_{t-2} - 0.394999\Delta LINF_{t-3} + 0.086110\Delta LINF_{t-4}$$
$$(2.50015)^{***} \quad (-0.08270) \quad (-2.24757)^{**} \quad (0.50109)$$
$$-0.080945\Delta LM2_{t-1} - 0.223225\Delta M2_{t-2} - 0.461748\Delta LM2_{t-3} - 0.347936\Delta LM2_{t-4} - 0.081519D_{WAR}$$
$$(-0.19840) \quad (-0.55033) \quad (-1.17032) \quad (-0.90860) \quad (-3.62173)^{***}$$
$$-0.012439D_{ER} - 0.004302D_{MR} \quad - 0.008154D_{FC} + 0.074159D_{MOU} - 0.904967ecm_{1t}$$
$$(-1.08025) \quad (-0.28854) \quad (-0.47983) \quad (0.97365) \quad (-7.46385)^{***}$$

(10)

Note: * - 10 percent, ** - 5 percent and *** - 1 percent level of significance. Values in the parentheses are corresponding t statistics. Source: Author’s estimations based on data sources described in Section III.

In the presence of a one percent deviation from long-run equilibrium in period t-1, the dependent variable, Returns on ASPI fall by 0.904967 points. According to Enders (2004), the change in period t initiates the removal of discrepancy from long-run equilibrium occurred in period t-1. Hence, it is clear that 90 percent of the errors in time t (one month period) are corrected in the next period. That is in other words, error term coefficient of -0.90 suggests that following an exogenous shock to the model, 90 percent movement back towards equilibrium in the next period.

Moreover, the error correction parameter, ecm_t (-0.904967) is not equal to zero which is statistically significant at one percent level. The significant non-zero error correction coefficient proves the cointegration results, i.e. that there is a long-run relationship between the ASPI returns and the selected macroeconomic variables. The Figure 1 illustrates the residuals of the models, which again confirm the above possible long-run relationship. That is, the visual evidence of the residuals also proves the stationary properties [*I (0)*] of the error term.

Table 1
The Descriptive Statistics for the Selected Variables

Descriptive Statistics	R	LM2	LINF	LUSD	LB
Mean	0.013484	12.52445	2.142991	4.136350	2.728647
Median	0.009524	12.59982	2.334568	4.140323	2.708050
Maximum	0.309661	14.48696	3.397858	4.765330	3.218876
Minimum	-0.184118	10.72672	-1.108663	3.283914	2.302585
Std. Dev.	0.074789	1.099113	0.783247	0.479698	0.191614
Skewness	0.422590	-0.010025	-1.551494	-0.263180	-0.403760
Kurtosis	4.107724	1.834774	5.763162	1.686176	4.050756
Jarque-Bera	25.56151	17.93896	227.3040	26.37534	23.12299
Probability	0.000003	0.000127	0.000000	0.000002	0.000010
Observations	316	317	317	317	317

Source: Author's estimations based on data sources described in Section III.

In the short-run, the intercept coefficient, coefficients of - lag length two and four of bank rate, lag length four of USD exchange rate, lag length one and three of inflation rate are statistically significant.[22] This indicates the lack of speed adjustments to long-run equilibrium from the explanatory variables in the short horizons. Interestingly, the dummy variable that represents the civil war and the unstable political situation, D_{WAR}, is highly statistically significant even at the one percent level. Thus, the ECM results confirm the idea that political instability and the civil war had created negative impacts in the short run as well as in the long run.

The direction of the short-run bivariate relationships between ASPI stock returns and the selected macroeconomic variables were assessed by using the Granger causality test. Since the test is sensitive to the lag length, based on the AIC values, the optimum lag length was set to two (2). Table 4 provides the summary of findings obtained by the Granger causality test.

According to the results of the Granger causality test, there is no any statistically significant causality between USD_t and R_t on selected lag length 02. But, significant causality was identified-from R_t to USD_t. This type of

[22] Critical t statistics: 10 percent =1.282, 5 percent = 1.6515, 1 percent = 2.45.

causal relationship is called the reverse causality. None of the other explanatory variables shows causal relationship with R_t in the short run.

Table 2
The Results of the ADF Test for Unit Root-Level Form

Variable	The optimum no of lags	ADF test statistics	1% MacKinnon Critical value	Unit root process
R	0	-14.71524*** (C)	-3.4530	Stationary I(0)
MONEY SUPPLY (LM2)	8	-0.199429 (T)	-3.9881	Non-stationary
D_LM2	7	-6.273420*** (T)	-3.9881	Stationary I(I)
BANK RATE (LB)	12	-3.856049*** (C)	-3.4517	Stationary I(0)
USD (LUSD)	1	-2.103717 (T)	-3.9874	Non-stationary
D_LUSD	0	-22.89215*** (T)	-3.9874	Stationary I(I)
INFLATION (LINF)	16	-0.2056 (C)	-3.4519	Non-stationary
D_LINF	15	-3.61108*** (C)	-3.4519	Stationary I(I)

*** indicates statistical significance at the 1 percent. Source: Author's estimations based on data sources described in Section III. T = Trend & Intercept ; C = Intercept only.

There is no short-run causal link between bank rate and ASPI. This can be justified on the basis that bank rate is more or less stable in the short-run, and cannot create significant impacts on stock prices in short horizons. In addition, M2 money supply and inflation, two important explanatory variables in the model do not show any significant impact on stock returns in the short run.

The graphical illustration of the IRF is presented in Figure 2. The results of IRF test show the impulses for all five variables with respect to one standard deviation shock to each of the five endogenous variables. Responses of stock returns to shocks in the endogenous variables seem to be more stable during the entire period, except for bank rate. One standard deviation shock to the R_t suddenly decreases the R_t till horizon two, and then shows a steady decline. Such a standard deviation of shock to the money supply increases R_t till horizon two. Then it decreases till horizon three, and thereafter it shows a steady impact on returns on ASPI. A standard deviation shock to the inflation rate slightly increases the R_t till horizon two, and then again shows a decline in the third period and does not make any negative or positive feedback on ASPI returns till the end of the horizon (10 periods). A similar shock in equation for US dollar and Sri Lankan rupee exchange rate shows a stable response from stock returns on ASPI. The response of R_t for one standard deviation to the equation for the bank rate gradually increases the returns on ASPI till horizon four.

Table 3
The Results of the Johansen and Juselius Test of Cointegration among ASPI and Selected Macroeconomic Variables

Maximum rank (r)	Maximum Eigen value (λ_{max})	Trace Statistic (λ_{trace})	Critical value (Max Eigen value) (5%)	Critical value (Trace Stat.) (5%)
0	64.50598**	108.8738**	33.87687	69.81889
1	29.41832**	44.36774	27.58434	47.85613
2	10.50048	14.94942	21.13162	29.79707
3	4.319067	4.448936	14.26460	15.49471
4	0.129869	0.129869	3.84146	3.84146

** implies significance at the 5% percent level.
Source: Author's estimations based on data sources described in Section III.

The responses of money supply, M2, to a standard deviation shock to the ASPI returns first increase the money supply till horizon three. A sharp increase can be identified in horizon four and then starting to be stable at other horizons. Such a shock given to stock returns will result in clear increase of inflation rate till horizon three, and then it will show a steady increase. A similar shock to stock returns of ASPI does not create any immediate impact on the USD in horizon one. The shock significantly drops the USD till horizon three, and then it further steadily drops the USD. A standard deviation shock given to the equation of R_t does not cause any fluctuations in bank rate in horizon one. But, in horizon two, it shows a slight decline, and then displays no impact.

Table 4
Results of Granger Causality Tests

Null Hypothesis (no Granger causality)	No: of lags	Probability	Rejection of Null Hypothesis	Direction of causality
M2 --→ R R→ M2	02	0.91467 0.30878	Cannot Reject H_0 Cannot Reject H_0	No Causality
Inflation → R R→ Inflation	02	0.82867 0.81732	Cannot Reject H_0 Cannot Reject H_0	No Causality
Bank rate → R R → Bank rate	02	0.82576 0.71563	Can not Reject H_0 Cannot Reject H_0	No Causality
USD → R R → USD	02	0.89892 0.00229***	Cannot reject H_0 Reject H_0	No Causality Reverse Causality

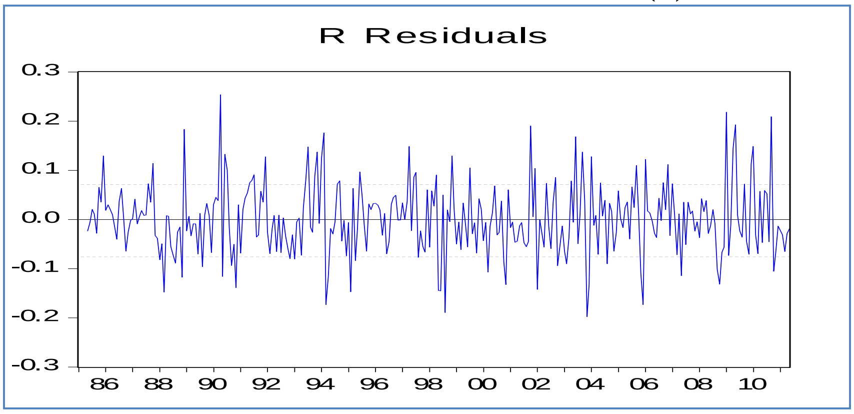
Source: Author's estimations based on data sources described in Section III. Level of significance – *** - 1 percent = 0.01, ** - 5percent = 0.05 & * - 10 percent = 0.1

Table 5
Variance Decomposition Analysis

Period	S.E.	R	LM2	LINF	LUSD	LB
1	0.071607	97.57397	0.012733	0.153556	0.113851	2.145887
2	0.072300	96.90359	0.027640	0.250759	0.137329	2.680683
3	0.072409	96.69550	0.028376	0.258500	0.141139	2.876484
4	0.072494	96.47501	0.069253	0.367610	0.208390	2.879735
5	0.072646	96.07603	0.118236	0.496347	0.372561	2.936824
6	0.072797	95.67626	0.200844	0.645437	0.536507	2.940953
7	0.072944	95.29158	0.286867	0.787694	0.691789	2.942068
8	0.073096	94.89499	0.375290	0.933349	0.850042	2.946329
9	0.073250	94.49727	0.463239	1.079700	1.009864	2.949929
10	0.073404	94.10275	0.550637	1.225057	1.168907	2.952649

Ordering: LB LUSD LINF LM2 R
Source: Author's estimations based on data sources described in Section III.

Figure 1
Residuals of the Stock Returns on ASPI (R)

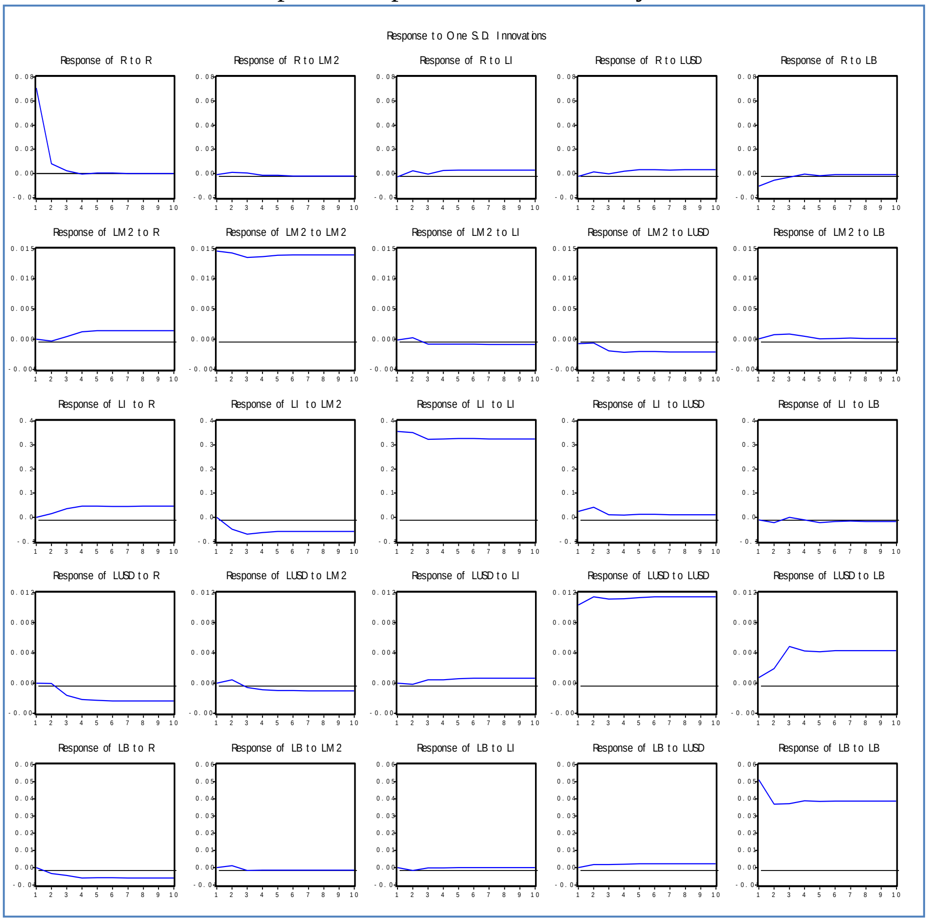


The predicted variances in ASPI returns explained by the innovations in each variable are given in Table 5. The forecast horizon is 10 (*i.e.*, ten months). Table 5 presents how much of own shocks in ASPI return is explained by movements in its own variations and those of other macroeconomic variables. The variance of R_t decreases as the time horizon increases. At horizon one, the amount of variation in R_t that can be explained is 97 percent. However, at horizon twelve, the amount of variation in R_t that can be explained is 94 percent. All the variables, except M2, can explain the variation in stock returns on ASPI in very small percentages. At horizon two, bank rate explains a little more than two percent of the variance of R_t. USD and inflation rate explain about 1.2 percent of it in the last period. If the time horizon is increased, up to 12 months or 24 months, the explained variance would differ from the above results.

5. Conclusion

This paper assessed the long-run relationship between the monthly stock returns in the CSE and selected macroeconomic variables by using various econometric methods. This was to test whether macroeconomic environment influence the stock price movements in the CSE. The JJMCT method showed that there is a long-term relationship between these variables. The cointegration results yielded negative relationships between stock returns on ASPI with the inflation rate and US Dollar exchange rate, while positive relationships were found between ASPI returns and money supply and bank rate. Broad money supply and the inflation rate create significant impact on ASPI stock returns, while bank interest rate and United States Dollar exchange rate do not generate such an impact on stock returns in the long-run.

Figure 2
Impulse Response Function Analysis



The statistically significant error correction parameter obtained by estimating the ECM indicates a negative sign which corrects more than 90 percent of the equilibrium error in the last period. A reverse causality was identified between ASPI returns and the USD in the Granger causality test. That is, ASPI returns create an impact on the USD in the short-run, and not the vice versa. The IRF analysis revealed that the response of stock returns to shocks generated in the endogenous variables is more stable. According to variance decomposition test, much of the forecast variance of stock returns was explained by itself indicating that the internal dynamics of the stock returns tend to affect the price movements more than the effects of outside variables.

With respect to semi-strong form efficiency, all the results empirically justified the presence of the long-run relationship between certain macroeconomic variables and the ASPI prices. As emphasized in the literature, if there is at least a one cointegration relationship between selected macroeconomic variables and ASPI price movements, it indicates that the CSE prices/stock returns are not efficient in the semi-strong form of the EMH. These results are similar to previous findings on CSE by Wickramasinghe (2006) and Gunasekarage *et al.* (2004). However, present findings do not exhibit many significant causal links in the short run as Wickramasinghe (2006) found.

Based on the results of our empirical tests, we could conclude that the movements in stock prices can partially be predicted by macroeconomic and socio-political variables. This means that analysts are able to use these variables to predict the behavior of stock returns. If the analysts could combine the results of the quantitative tests with qualitative analysis, the predictability can significantly be enhanced. The present study generates several policy implications. First, publicly available information on macroeconomic variables and relevant factors are useful in predicting the future movements of stock returns. Investors can earn profits if they carefully use available information. Investors need to be very keen on the external factors as well. As the policy designers, the Central Bank and the Treasury need to also able to use this information. The results of our empirical study confirm that an emerging capital market, the CSE, does not behave in the way the semi-strong form of the EMH states. Our results indicate that stock returns emerging markets such as the CSE can partially be predicted by using macroeconomic and socio-political variables.

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