Modeling Stock Returns and Trading Volume of Colombo Stock Exchange

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Abstract

The main objective of our study was to test causal relationship between returns and trading volumes in the Sri Lankan share market and to model the relationship. If causality did not exist it was intended to test some other time series techniques for forecasting returns. Further, it was intended to identify patterns of trading volume. Results of multivariate tests reveal that there is no causal relationship between market returns and trading volumes. Therefore, time series techniques were tested on returns and trading volume. Ljung-Box Q (LBQ) statistic reveals that stock returns are auto-correlated and stationary while trading volumes are auto-correlated but not stationary. It was concluded that ARIMA (0, 0, 1) is the best model for forecasting stock returns and that the Quadratic Trend model is the best for forecasting trading volume. Most of the early studies have provided evidence of a causal relation between stock returns and trading volume. However, the results of this study were contradictory. It is recommended that the applicability of Sri Lankan share market indices be tested as it may be a cause of the contradictory results. Further researchers suggest testing return and trading volume by GARCH/ ARCH models, Artificial Neural networks and Non-linear models such as the Malthus model, Gomperts model, Alometric model, etc.

Key words: Causality, Auto-correlation, Stationary, Multivariate, Trend.

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Introduction

Share trading is an important aspect of the economy of a country from both the industry's and the investor's point of view. Predictability of asset returns play a vital role in a stock market as it makes investment decisions easy and more profitable. Fundamental Analysis and Technical Analysis are the two main strands of investment decisions. Fundamental Analysis involves analyzing the economic factors or characteristics of a company, namely, company value, company earnings, etc. in order to estimate the intrinsic value of a company while Technical Analysis focuses on price movements and trading volume in the market. Studies by Banz (1981), Bhandari (1988), Fama & Kenneth (1999) are examples of fundamental analysis while those by Ciner (2003), Gong-Meng, Michael & Oliver (2001), Kamath (2007) are examples of applications of technical analysis.

The Sri Lankan stock market has domestic investors as well as foreign investors. They are either individuals or firms. In year 2010 share trading accounted for 12% to 13% of Sri Lanka GDP. According to the CSE Annual Report 2010, domestic investors' interest in share trading increased while that of foreign investors decreased. As Javad (1993) explains, a major factor hindering foreign investment in stock markets is lack of information about the price/return behaviour of equity markets. This may be true of the Sri Lankan share market as well.

Forecasting returns of the Sri Lankan share market is mainly based on the Capital Asset Pricing Model (CAPM), which is the fundamental analysis approach. The central assertion of CAPM is that there exists a linear relationship between the expected return and its market beta (risk) and that no other factors are necessary to explain expected returns. CAPM has been subjected to extensive empirical testing in past few decades. This was argued by many scholars some of whom are Banz (1981, Fama & MacBeth (1973), Bhandari (1988), Fama & Kenneth (1999), Chan, Hamao & Lakonishok (1991) and Basu (1983). Their findings provide considerable evidence that risk itself cannot explain returns of individual securities, portfolio returns as well as total market returns. Nimal (1997) and Samarakoon (1997) have shown that CAPM is unable to predict share returns of the Sri Lankan market, but the Sri Lankan stock market still depends on CAPM. Therefore, it is essential to find a suitable technique for forecasting returns of the Sri Lankan share market.

Technical analysis approach: forecasting stock returns based on the relationship between return and trading volume has been tested all over the world and found

successful in a large number of share markets. But we could not find any attempt to test return-volume in the Sri Lankan share market. The main objective of our study was to test causality between returns and trading volumes in the Sri Lankan share market and model the relationship. It was intended to test some other time series techniques for forecasting returns, if causality does not exist. Further, it was intended to identifying patterns of trading volume.

Significance of the study

Share trading is an important aspect of the economy of a country. Whenever a company wants to raise funds for further expansion or settling up a new business venture, instead of taking loans it can issue shares of the company. On the other hand, an investor can get part ownership of the company by buying shares. This gives him/her a vote at annual shareholder meetings, and a right to a share of future profits. Investors have the ability to quickly and easily sell securities. This is an attractive feature of investing in stocks, compared to other less liquid investments such as real estate.

In year 2010 share trading accounted for 12% to 13% of Sri Lanka GDP. The CSE Annual Report 2010 shows that domestic investors' interest in share trading increased while foreign investors' interest decreased. As Javad (1993) explains, a major factor hindering foreign investments in stock markets is lack of information about these markets, especially about the price behavior of equity markets. This may be true of the Sri Lankan market as well.

The literature shows considerable evidence that CAPM is unable to explain market returns of many share markets of the world. Nimal (1997) and Samarakoon (1997) confirmed that CAPM has failed in CSE. On the other hand, the technical analysis approach has been widely used and proved successful throughout the world for stock market forecasting, but we were unable to find any attempt at technical analysis in the Sri Lankan share market. As such, this study will fill the existing knowledge gap.

If there is a causal relationship between return and volume, then returns can be predicted by volume or vice versa. This will be a great relief for investors as it helps them to achieve their investment objectives. If a causal relation between returns and trading volume does not exist, this study extends to testing other time series techniques which will pave the path for further research in forecasting.

Literature Review

A literature review is a discussion based on price/return-volume relationships. The first attempt in this regard is the study of Osborne (1959). Osborne applied the Brownian motion in Stock Market. The findings of Osborne (1959) showed that common stock prices and the value of money can be regarded as an ensemble of decisions in statistical equilibrium. By assuming that transactions are uniformly distributed in time, Osborne was able to express the price process in terms of time intervals.

Karpoff's (1987) survey of literature on this subject provided a thorough review of price-volume relationships. As Karpoff's study reveals, an early empirical examination of the volume-price relation was conducted by Granger and Morgenstern (1963). They could discern no relation between movements in a Securities and Exchange Commission composite price index and the aggregate level of volume on the New York Stock Exchange. But Ying (1966) and Crouch (1970) demonstrate conclusively that Granger and Morgenstern's inference is not correct.

Clark (1973) found a positive relation between the square of a measure of the price change and aggregated volume using daily data from the cotton futures markets using four-day interval and monthly data from a total of 51 stocks. Regression analysis was used to investigate the curvilinear relationship between price variance and trading volume, and Bayesian approach used to test the lognormal-normal (LN) family against the stable (S) family of distributions as the parent of the observed distribution of price changes for cotton futures.

Study of Timothy (1992) based on NASDAQ stock market, the second largest stock exchange by market capitalization in the world, investigates whether portfolio return auto-correlation can be explained by time-varying expected returns, non-trading, stale limit orders, market maker inventory policy, or transaction costs. He found that portfolio return auto-correlation is not caused by time-varying expected returns, non-trading, stale limit orders, or market maker trading strategies. Cross-sectional tests provide evidence that price adjustment is associated with the standard deviation of returns and the bid-ask spread.

Timothy (1994) examined the relationship between the level of trading volume and the magnitude of price changes, thereby providing scientific evidence on this

topic in the Australian stock market. His findings support the relationship between price change and trading volume, irrespective of the direction of the price change. Furthermore, he found that the volume-price change slope for negative returns is smaller than the slope for positive returns, thereby supporting an asymmetric relationship. Trading volume was examined in the context of conditional volatility using a GARCH framework and the findings show a reduction in the significance and magnitude of the GARCH coefficients and a reduction in the persistence of variance when trading volume is added as an exogenous variable to the conditional variance. Hence, there is evidence that if trading volume proxies for the rate of information arrival, then ARCH effects and much of the persistence in variance can be explained.

Heimstra & Johathan (1994), Chordia & Swaminathan (2000), Gong-Meng et al., (2001), Guillrmo, Roni, Gideon & Jiang (2002), Jianping, Olesya & Lubomir (2002), Ciner (2003), Xiangmei, Nicolaas & Yanrui (2003), Kamath (2007), Malabika, Srinivasan & Devanadhen (2008), Ghysels, & Joann (2000), Sarika & Balwinder (2009), Habib (2011), Naliniprava (2011), Ong Sheue & Ho Chong (2011) and Marwan (2012) also tested the bidirectional relationship between return and trading volume for various stock markets and found the existence of such relationship.

Heimstra & Johathan (1994) have tested nonlinear causality between return and volume in the world's largest stock exchange, the New York Stock Exchange. They have tested linear reduced-form auto regression VAR models and found evidence of non linear causality from volume to stock returns. Chordia & Swaminathan (2000) formed a set of portfolios based on USA stock databases in order to test Modified Vector Auto regression models. Their investigations indicate that trading volume is a significant determinant of the cross-auto correlation patterns (lead-lag patterns) in stock returns. Specifically, returns of portfolios containing high trading volume lead to returns of portfolios comprised low trading volume stocks. A study by Gong-Meng et al., (2001) is based on the nine largest stock exchanges -New York, Tokyo, London, Paris, Toronto, Milan, Zurich, Amsterdam, and Hong Kong. They tested the Granger Causality between trading volume and stock returns. The study showed that for some countries, returns cause volume and volume causes returns, but not for all. Guillrmo et al., (2002) studied the dynamic relation between return and volume of individual stocks listed on NYSE and AMEX, USA. They tested the multiple linear regression models with interactions. The study showed that the returns generated by different sources exhibit different dynamics; returns generated by public information on future payoffs are independent over time, returns generated by trading are

serially correlated and returns generated by speculative trades tend to continue themselves. Ciner (2003) attempted to find the linkage between trading volume and price of small-capitalization firms in the US and France. They tested the Vector Auto Regressive models including a dummy variable to account for the day of the week and month of the year effects on stock returns. The authors have concluded that the information asymmetry problems tend to be more important for small-capitalization firms. Jianping et al., (2002) studied individual stocks in Russia and other emerging markets. Their study concentrated on 28 large Russian stocks, which constitute about 93% of the market capitalization of all companies traded on the Russian Trading System (RTS). They tested the multiple regression models. Using corporate announcement data from Russia, they discovered that private information trading is especially strong around major corporate event dates. In addition, they found stocks in countries that enforce insider-trading law and provide better investor protection exhibit less private information trading. These results suggest a possible measure of "information asymmetry" for ranking emerging market stocks. Xiangmei et al. (2003) based their studies on two Chinese A-share markets and ten individual stocks in the energy sector. They also investigated the effects of exogenous government policies on the relation between trading volume and stock return. They found that the relationship between trading volume and return is asymmetrically V-shaped, with the response of trading volume to a rising return being stronger than that to a falling return. Granger causality tests demonstrate stronger evidence of return causing volume: volume has only a weak effect on future returns but a strong and predictable effect on absolute returns. Kamath (2007) based on the nascent stock exchange of Istanbul, Malabika, et al., on the Asia-Pacific Stock Market, Ghysels et al., on the Paris Stock Exchange, Habib (2011) on the Egyptian Securities Exchange (ESE), Ong Sheue et al,. (2011) on Malaysia and Singapore and Marwan (2012) on the Palestine Exchange found similar results.

The study by Chia-Chang, Chung-Ming & Hsin-Yi (2009) takes a different approach of price-volume relationships. They investigate the causal relations between stock return and volume based on Quantile Regression. They tested the linear as well as non- linear relationship between price and volume while controlling the time trend effects, and found that the causal effects of volume on return are usually heterogeneous across quantiles and those of return on volume are more stable. This is alternative evidence that volume has a positive effect on return volatility.

Pathirawasam (2009) examines the relationship between trading volume and stock returns for the Colombo Stock Exchange (CSE) in two ways: first, the contemporary

relation between changes in volume-return and then the relationship between past trading volume and future stock returns. Pathirawasam (2009) has found that stock returns are positively related to the contemporary change in trading volume. Further, it was found that past trading volume change is negatively related to stock returns.

According to the literature, most of the studies were based on developed markets and very few attempts on emerging markets. However, the majority of the studies resulted in supporting the return-volume relationship. And the most tested models on return- volume relationship were:

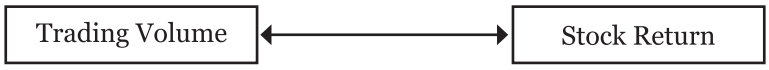
$$R_t = \alpha + \sum_{i=1}^{n} \beta_i R_{t-i} + \sum_{j=1}^{n} \gamma_j V_{t-j} + e_t$$

$$V_t = \lambda + \sum_{i=1}^{n} \rho_i V_{t-i} + \sum_{i=1}^{5n} \varsigma_j R_{j-i} + \varepsilon_t$$

Conceptualization

Figure 1 presents the conceptual framework for the causal relationship between returns and trading volume:

Figure 1: The Conceptual Framework



Based on the above framework the following hypotheses were developed:

Hypothesis 1:

H_o: Trading volumes do not cause returns.

H_1: Trading volumes cause returns.

Hypothesis 2:

H_o: Returns do not cause trading volumes.

H_1: Returns cause trading volumes.

Methodology

This is an applied research study which employs deductive approach. It starts with existing theory and ends with modeling; as such this is a modeling research. The variables of the study are market return (R_i) and trading volume (Vi) on i^{th} day.

According to the literature, the main tested and successful models for causal relationships were:

$$R_t = \alpha + \sum_{i=1}^{n} \beta_i R_{t-i} + \sum_{j=1}^{n} \gamma_j V_{t-j} + e_t$$

$$V_t = \lambda + \sum_{i=1}^{n} \rho_i V_{t-i} + \sum_{i=1}^{5n} \varsigma_j R_{j-i} + \varepsilon_t$$

where R_t = return on day, V_t = trading volume of day t, α and λ =constants, β, γ, ρ, ζ are regression coefficients. As such, we also intended to test the same set of models for the causal relationship between return and trading volume.

Then we tested the Auto Regressive Integrated Moving Average [ARIMA (p,d,q)] models:

$$R_t = c + \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} + \sum_{i=1}^{p} \phi_i R_{t-i}$$

R_t = return on day, V_t = trading volume of day t,

φ_i's and θ_i's are ARMA coefficients.

Finally, we tested the following models on trading volume:

Linear trend model: $V_t = \alpha + \beta t$

Quadratic trend model: $V_t = \alpha + \beta_1 t + \beta_2 t^2$

Growth Curve model: $V_t = \alpha(\beta)^t$

Operationalization

This study analyzed the return-volume relationship in two ways:

i. Total market return based on ASPI/ASTRI and trading volume on a monthly basis.

ii. Total returns of sectors, based on sector indices and trading volume on a monthly basis.

Sample of Study for analysis of sector indices

Among 20 business sectors of CSE, a Simple Random Sample of four sectors was selected:

Bank Finance and Insurance (BFI)

Diversified Holdings (DIV)

Telecommunication (TLE)

Hotels and Travels (H&T)

Daily indices for sectors are available, but not for trading volume. As sector trading volumes are available on a monthly basis from 2005-2011, the study is limited to monthly information. Therefore, the sample period of the study is from year 2005 to 2011.

This study obtained the following data from the CSE data library 2011:

i. All Share Price Index (ASPI) on a daily basis.

ii. All Share Price Index computed on total returns (ASTRI) on a daily basis.

iii. Trading volumes of the market on a monthly basis.

iv. Sector indices computed on total returns on a monthly basis.

v. Sector trading volumes on a monthly basis.

Computation of Market Returns

Total market return on day t is calculated by ASTRI /ASPI and Geometric Mean of daily returns based on ASTRI /ASPI of the month is taken as the monthly total market return as follows:

Total market return on day t by ASTRI, $R_t = \left(\frac{ASTRI_t - ASTRI_{t-1}}{ASTRI_{t-1}} \right).100$

Total market return on month j by ASTRI= $\left[\prod_{i=1}^{n} R_{t,i} \right]^{1/n} - 1$

Total market return on day t by ASPI, $R_t = \left(\frac{ASPI_t - ASPI_{t-1}}{ASPI_{t-1}} \right).100$

Total market return on month j by ASPI= $\left[\prod_{i=1}^{n} R_{i,t} \right]^{1/n} - 1$

Where

$ASTRI_t$: All Share Price Index computed on total returns on day t

$ASPI_t$: All Share Price Index on day t

n : number of trading days.

Total market returns for the selected are calculated by monthly sector indices as follows:

Total market returns of a sector on month i, $R_i = \left(\frac{I_t - I_{t-1}}{I_{t-1}} \right).100$

Where I_t is the sector index on month t

Techniques and Models used in data analysis

Time Series Univariate methods such as Classical Linear Regression, Stochastic processes or ARIMA (Box-Jenkin's) models, Causal/Multivariate models and some Non linear models were tested in the study.

Stationary returns and trading volumes were tested by t statistic and Ljung-Box Q (LBQ). When the stationary is not held various transformations such as first difference and second difference are used and then the stationary tested.

Results and Data Presentation

The data analysis consists four parts:

- Comparison of total market returns by ASPI and ASTRI.
- Testing the causal relationship (Multivariate) between return and volume.
- Testing auto correlations and [stationary] of stock returns and trading volumes.
- Modeling market returns and trading volumes.

MINITAB 14 and SPSS 16 statistical software are used for data analysis.

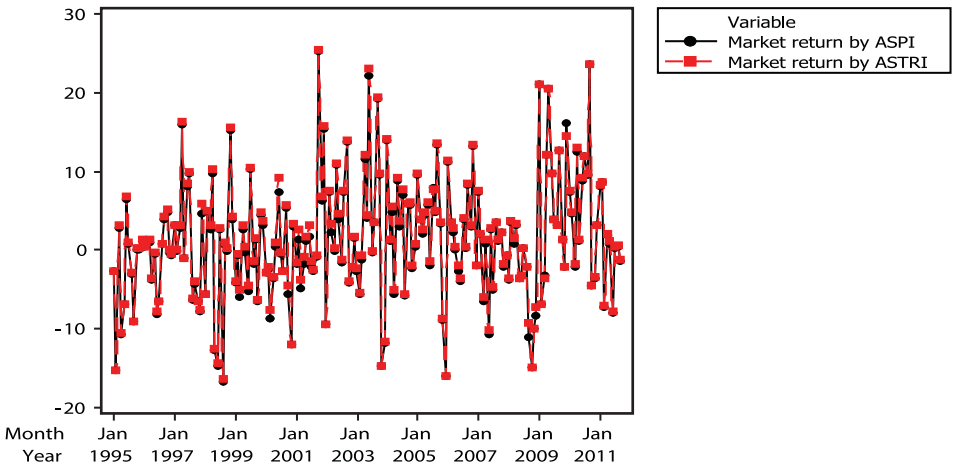
Comparison of total market returns by ASPI and ASTRI

The All Share Price Index (ASPI) and Total Return Index (TRI) play a vital role in CSE. ASPI is the main stock market index which encounters all the listed companies of the Colombo Stock Exchange (CSE). It is a capitalization weighted index which measures the movement of all listed companies using market capitalization (Q) and share price (P). However, ASPI does not reflect the returns due to dividend income while TRI reflects returns due to price changes and dividend income. Therefore ASPI as well as all Sector Indices are adjusted on total returns and ASPI computed on total returns is known as ASTRI.

There is a belief that market returns estimated by ASTRI are more accurate than the market returns estimated by ASPI. The reason for that belief is that ASPI accounted only for capital gain but ASTRI accounted for both capital gain and dividend yield. As such, market returns by ASTRI and market returns by ASPI are compared in order to see whether it is necessary to test the return-volume relationship for both market returns by ASTRI and market returns by ASPI.

First, the total market returns estimated by ASPI and market returns estimated by ASTRI from January 1995 to September 2011 were plotted (Figure 1):

Figure 2: Time Series Plot of Market Returns by ASPI and Market Return by ASTRI



The time series plot for total market returns by ASPI and ASTRI shows no difference in total market returns calculated by ASPI and ASTRI. Therefore, the two sample t- test was used and confirmed that there is no difference between means of market returns calculated by ASPI and ASTRI. Hence, for the rest of the study, the analysis was continued by using total market returns calculated by ASTRI.

Testing causal relation between returns and trading volumes

Various linear regression models were tested on market return on day t (Rt) and market trading volume on day t (Vt) and the results are given in Table 1:

Table 1: Summary of causality test results

Model	P value of regression	Adjusted R^2
i) $R_t = \alpha_0 + \beta_1 R_{t-1} + \gamma_1 V_t + e_t$	0.291	0.2%
ii) $R_t = \alpha_0 + \beta_1 R_{t-1} + \gamma_1 V_t + \gamma_2 V_{t-1} + e_t$	0.231	0.3%
iii) $V_t = \lambda_0 + \rho_1 V_{t-1} + \beta_1 R_t + \beta_2 R_{t-1} + \varepsilon_t$	0.000	83.3%
iv) $V_t = \lambda_0 + \rho_1 V_{t-1} + \varepsilon_t$	0.000	83.3%

P values of models (i) and (ii) are greater than 0.05. It reveals that there is no linear relationship between the variables. Adjusted R^2 of both models was very small. Therefore, these models are not suitable for forecasting. P value of model (iii) is significant and adjusted R^2 is also very high (983%). It seems that the present trading volume (V_t) is caused by past trading volume (V_{t-1}), present returns (R_t), and past returns (R_{t-1}). But this result is contradicts the results of model (i) and (ii). Therefore, we tested model (iv). P value and adjusted R^2 of model (iv) are similar to model (iii). It shows that the present trading volume (V_t) was caused only by past trading volume (V_{t-1}). Hence, we concluded that the causal relationship between market returns and trading volumes do not hold for the Sri Lankan market.

Testing auto correlations and stationary of stock returns and trading volumes

Auto correlations and stationary were tested for:

Total market returns by ASTRI and trading volumes

Returns by sector indices and sector trading volumes

A time series is a white noise process or stationary process if each value in the sequence has zero-mean, constant conditional variance and is uncorrelated with all other realizations. The autocorrelation function (ACF) is the tools used to test the stationary of a time series. Auto correlation is the correlation between observations of a time series separated by k time units. The plot of auto-correlations is called the auto-correlation function or ACF. Partial autocorrelation computes and plots the partial autocorrelations of a time series.

Outputs of autocorrelation function (ACF) for first differences of market returns (MR) by ASTRI are given in Figure 3:

Figure 3: ACF of MR by ASTRI

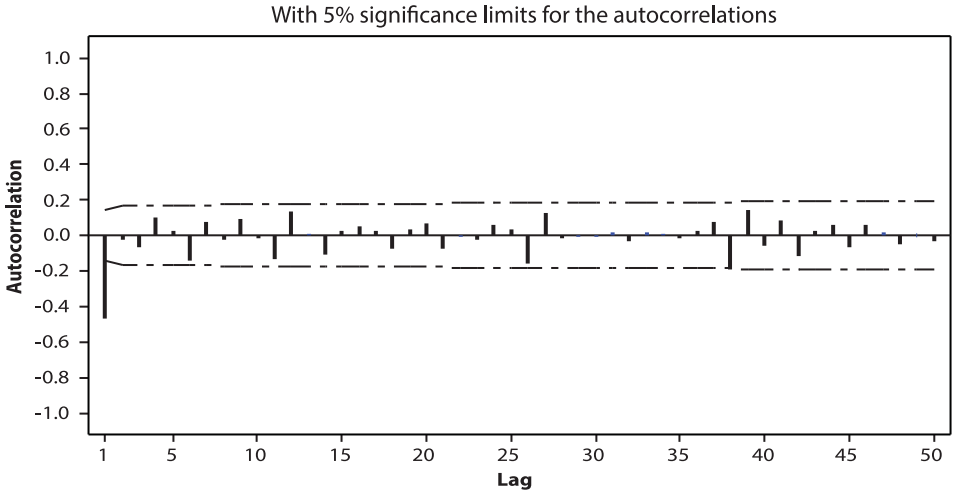
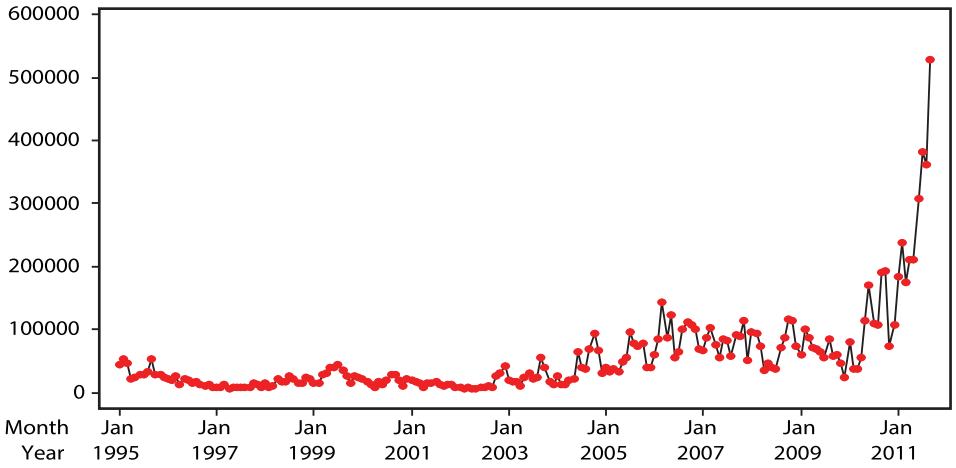


Figure 3 has a significant spike at lag 1; meaning 1st difference series is stationary?

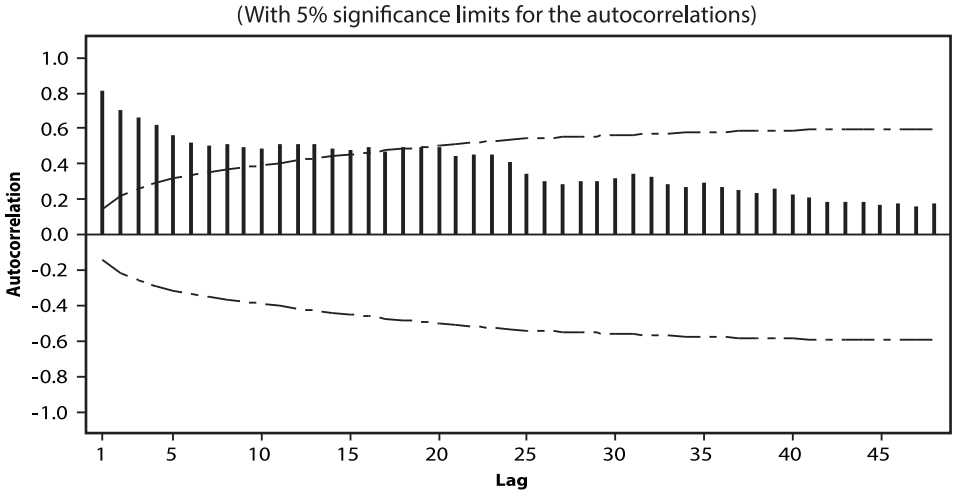
Time series plot of market trading volumes (Figure 4) showed that there is an increasing trend in trading volume.

Figure 4: Time Series Plot of Trading Volume



If there is a trend in data series, holding stationary cannot be expected. ACF in Figure 5 also confirmed that trading volume series is not stationary.

Figure 5: ACF for Trading Volume



Testing auto correlations and stationary for sector returns and trading volumes

Returns were computed for four sectors: Bank, Finance and Insurance (BFI), Diversified Holdings (DIV), Telecommunications (TEL) and Hotels and Transport (H&T). ACFs of their returns were obtained and it was found that returns of all four sectors were stationary. But, data sets of trading volumes of these sectors were incomplete or discontinued; as such, stationary for trading volumes could not be tested.

Modeling market returns and trading volumes

Stock market returns were stationary, and, therefore, various ARIMA models were tested and the results given in Table 2 were obtained with the help of Autocorrelation function (ACF) and Partial autocorrelation function (PACF). The partial autocorrelation at a lag of k is the correlation between residuals at time t from an autoregressive model and observations at lag k with terms for all intervening lags present in the autoregressive model.

Table 2: Summary of ARIMA outputs

Model	P value of the model	P value of Modified Box-Pierce (Ljung-Box) Chi-Sqare statistics				MSE
		At lag				
		12	24	36	48	
ARIMA (0,0,1)	0.00	0.33	0.51	0.73	0.70	56.4
ARIMA (1,0,0)	0.00	0.00	0.00	0.00	0.00	79.7
ARIMA (2,0,0)	0.00	0.00	0.02	0.02	0.01	72.7

Generally, the best fitted model has the least Mean Square Error (MSE). Thenalysis reveals that Mean Square Error (MSE) of the ARIMA (0, 0, 1) model is 56.4, ARIMA (1, 0, 0) model is 79.7 and ARIMA (2, 0, 0) model is 72, 7. Accordingly, ARIMA (0, 0, 1) has the least MSE. Comparing p values, Ljung-Box statistics and MSE, researchers concluded that the best model among the above is:

$$R_t = R_{t-1} + 0.02423 + \varepsilon_t + 0.9882\varepsilon_{t-1}$$

Model fitting for trading volumes

Trading volumes were not stationary; as such ARIMA models were not tested and the following trend models were tested:

i. Linear trend model

ii. Quadratic trend model

iii. Growth Curve model

Figure 6 shows the Linear Trend model, Figure 7 shows the Quadratic Trend model and Figure 8 shows the Growth Curve model:

Figure 6: Linear Trend model

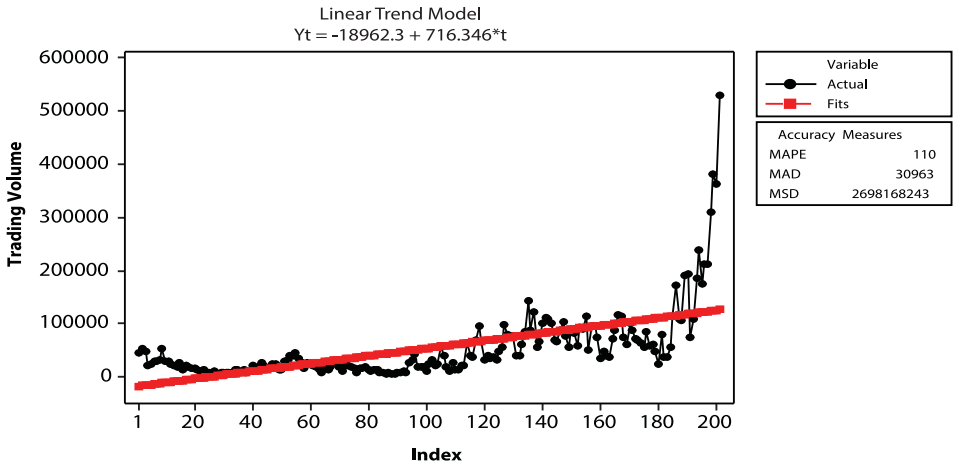


Figure 7: Quadratic Trend model

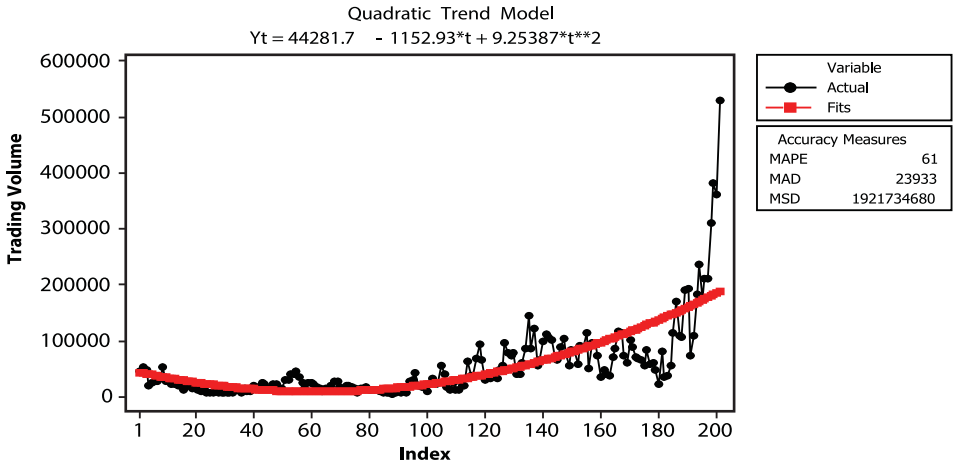
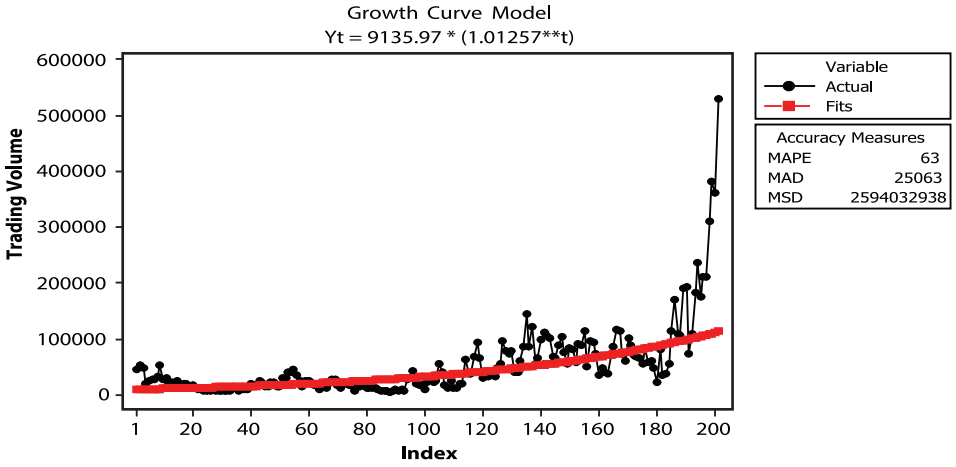


Figure 8: Growth Curve Model



A summary of the above three models are given in Table 3:

Table 3: Summary of trend models

Model		MAPE	MAD	MSD
Linear	$Y_t = -18962.3 + 716.346t$	110	30963	2698168243
Quadratic	$Y_t = 44281.7 - 1152.936t + 9.25387t^2$	61	23933	1921734680
Growth	$Y_t = 9135.97(1.01257)^t$	63	25063	2594032938

Among the three models, the Quadratic Trend model, $Y_t = 44281.7 - 1152.936t + 9.25387t^2$ has the least mean absolute percentage error (MAPE), mean absolute deviation (MAD) and mean square deviation (MSD). Therefore it is the best suitable model for forecasting market trading volumes of CSE. However. the results in Table 1 confirm that the linear model $V_t = \lambda_o + \rho_t V_{t-1} + \varepsilon_t$ is also a suitable model for forecasting market trading volume with R2 more than 83%.

Discussion

Fundamental Analysis and Technical Analysis are the two main strands of investment decisions. Fundamental Analysis involves analyzing the economic factors of a company while Technical Analysis is focused on testing the return-volume relation for the Sri Lankan stock market. Further, it was intended to test some other time

series models for forecasting returns and trading volumes, if the return-volume relation does not hold.

Variables considered were market return (RI) and trading volume (Vi). Two hypotheses were developed based on literature. They are: "Trading volumes do not cause returns" and "Returns do not cause trading volumes". The data analysis consists of four parts: comparison of total market returns by ASPI and ASTRI, testing the causal relationship (Multivariate) between return and volume, testing autocorrelations and stationary of stock returns and trading volumes and modeling market returns and trading volumes.

The All Share Price Index (ASPI) and Total Return Index (TRI) are two main indices of CSE. Sri Lankan academics in the field of financial management believe that market returns estimated by ASTRI are more accurate than the market returns estimated by ASPI because ASTRI accounted for dividends. As such market returns by ASTRI and market returns by ASPI were compared and no difference found.

The results of the causality tests in the current study were not significant. Therefore, both testing hypotheses of the study were not rejected. It reveals that there is no causal relationship between market returns and trading volumes. But in the literature, most of the studies resulted in supporting the existence of a bidirectional return-volume relationship. As such our results are contradictory. This may be due to nature, but some doubts arose in our minds about the accuracy of market returns used in the study. The market returns of the current study were estimated based on Sri Lankan main stock market indices, ASPI and ASTRI. Academics and professionals in the field of Sri Lankan financial market argue that ASPI, the Sri Lankan main stock market index has certain weaknesses and does not reflect the true situation. We also believe this argument for several reasons. The All Share Price Index (ASPI) is a capitalization weighted index. Weighting capitalization indices allows companies with large market capitalizations to influence the Index heavily. Market capitalization data of CSE for past years reveals that capitalization of the Sri Lankan stock market is dominated by a few companies like Dialog, John Keels, Sri Lanka Telecom, etc. As such, ASPI and ASTRI may be erroneous. If ASPI is erroneous, then ASTRI is also erroneous. This weakness may lead to over estimation of market performance and hence market returns estimates. So it can be a possible reason for the contrasting findings of causality in our study.

Stock returns were auto correlated and stationary but trading volumes were not stationary. As such ARIMA models were tested on total market returns while linear and non linear models were tested on trading volumes.

Among the tested models on market returns, ARIMA (0, 0, 1) has the least Mean Square Error (MSE). Non significant p values of Ljung-Box statistics confirmed that errors of the ARIMA (0, 0, 1) model are uncorrelated. Therefore the researchers concluded that the best fitting model is:

$$R_t = R_{t-1} + 0.02423 + \varepsilon_t + 0.9882\varepsilon_{t-1}$$

Among the linear and non-linear models tested on trading volumes, the Quadratic Trend model, has the least mean absolute percentage error (MAPE), mean absolute deviation (MAD) and mean square deviation (MSD). Therefore, it is the best suitable model for forecasting market trading volumes. However, results shown in Table 1 reveal that the linear model obtained in causality tests has significant p value and adjusted R2 83.3%. Therefore, $V_t = \lambda_o + \rho_t V_{t-1} + \varepsilon_t$ is also a suitable model for forecasting market trading volumes.

Conclusions and Recommendations

A causal relationship between returns and trading volume does not exist in the Sri Lankan share market. Therefore, it was concluded that returns cannot be forecasted by trading volumes or trading volumes cannot be forecasted by returns, Auto Regressive Integrated Moving Average [ARMA (p,d,q)] models are suitable for forecasting returns, and trend models are suitable for forecasting trading volumes.

Almost all the developed stock markets have changed their weighting system to a method known as “Float-adjusting” in index calculation. The float-adjusting method encounters actual trades, not total outstanding shares. As such over-estimation may not occur and is more close to reality. It is recommended that the suitability of the “Float- adjusting” technique to index calculation in CSE be tested.

Studies of Bhandari (1988), Fama & Kenneth (1999). Stattman (1980), Rozenberg et al., (1985), Chan et al., (1991), Basu (1983) and many others showed that market performance of a company depends on several factors such as risk, book-to- market equity, earnings-price ratios (E/P) and leverage. It is worth testing the suitability

of these factors as weights in stock market index and revising the index calculation methodology. Some of the standard weighting techniques such as Principle Component Analysis and, Factor Analysis can be used for this purpose.

Some of the studies in the literature have succeeded with non –linear regression models. CSE data also can be tested on non- linear regression models such as Malthus model, Gomperts model and Alometric model.

It is time to extend the horizons of return-volume relationships to more advanced techniques such as GARCH/ARCH and Artificial Neural networks.

Limitations of the study

It was intended to test the causal relationship between returns and trading volume for total market as well as for a sample of sectors. But, causality could not be tested on sector returns and trading volumes due to incompleteness or discontinuity of sector trading volumes.

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