Stock Market Anomalies in the Colombo Stock Exchange, Sri Lanka

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Quantitative Analysis Report

CID: [redacted]

MSc Finance

2015-2016

Client Specification

Our client is a Mumbai based asset management company. The company is looking to gradually increase its holding in Sri Lankan equities by investing in a market index through the Colombo stock exchange during 2017. Since the end of the civil war, the Colombo Stock Exchange (CSE) has been one of the best performing markets in the world. However, previous research into stock market anomalies in Sri-Lanka is limited. The Company is interested to know if day of the week and month effects exist that could be considered while deciding when, and when not, to increase their position.

This report aims to determine if day of the week and month effects exist on the CSE by looking at daily and monthly return data from CSE All Share Price Index. For daily data, unit-root tests are implemented to test for stationarity. Three types of models are then used with dummy variables for each day of the week to investigate day of the week effects: Model one is a simple linear regression on the dummy variables; Model two incorporates a market risk factor; Model three uses GARCH(1,1) models to test for day of the week effect in returns and volatility accounting for variance in the residuals changing over time. For monthly effects, a simple linear regression is used. All data is collected from Thomson Reuters Datastream. Analysis is carried out using Oxmetrics, OxEdit and R.

Table of Contents

List of Figures

List of Tables

Word Count: 2963

Introduction

Day of the week (DOW) effects and seasonal effects are important stock market anomalies. Their existence suggests that returns are not random and that it is possible to receive abnormal returns over time, which provides evidence against the efficient market hypothesis. This report looks at DOW and month effects on the CSE in Sri-Lanka using the CSE All Share Price Index.

There are currently 294 companies listed on the CSE with a total market capitalization of Rs. 2,591.06 Bn as of March 2016 (Colombo Stock Exchange, 2016). The All Share Index is a market capitalization weighted index and is one of two indices on the exchange. This index was chosen as it includes all companies listed on the exchange and is the longest running and broadest index.

DOW effect is when stock behavior for some days of the week are consistently different to other days (Chandra, 2006). The effect has been reported in developed (Dicle, 2014) and emerging markets (Basher, 2006; Rojas, 2015; Osazee, 2014). It often takes the form of mean negative returns on Monday and mean positive returns on Friday but can exist on other days. Dicle *et al* (2014) investigated DOW effects in 51 markets and found 24 to have Monday DOW effects and 32 to have Friday DOW effects, suggesting that DOW effects still exist. Little research has been done on the Colombo stock exchange. Deyshappriya (2014) investigated DOW and monthly effects on the CSE between 2004 and 2013 and found evidence of negative Monday effects and positive January effects, confirming the presence of stock market anomalies.

The cause of DOW effect is debated. Explanations include the calendar time hypothesis, the settlement issue (Lakonishok & Levi, 1982), a higher number of sell transactions from institutional investors on Monday (Lakonishok & Maberly, 1990) and other psychological related factors.

The best known seasonal anomaly is the January effect, in which mean returns in January are higher than in other months. Positive January effects have been found to exist in both developed markets (Kohers & Kohli, 1991; Mills & Couts, 1995; Corhay, Hawawini & Michel, 1997) and undeveloped

markets (Coutts & Kaplandids, 2000; Wahlroos & Berglund 1983). The January effect has been explained by tax-loss selling and incentives for institutional investors to have certain portfolios at certain times of the year; for example, having a safe position at year end and riskier positions at the start of the year (Ilmanen, 2011).

This report is split into two sections. In the first section, the day of the week effect is examined, and in the second section month of the year effect is examined. Before running regressions, Augmented Dicky Fuller (ADF) and KPSS tests are used to check the data for stationarity. To investigate DOW effects three methods are implemented. The first method, model 1.0 is to use ordinary least squares regression with dummy variables for each day of the week. From the autocorrelogram in figure one it can be seen that their may be some autocorrelation in the returns. Inference from the model may therefore be invalid. To correct for this one-day and two-day return lags are added to the model.

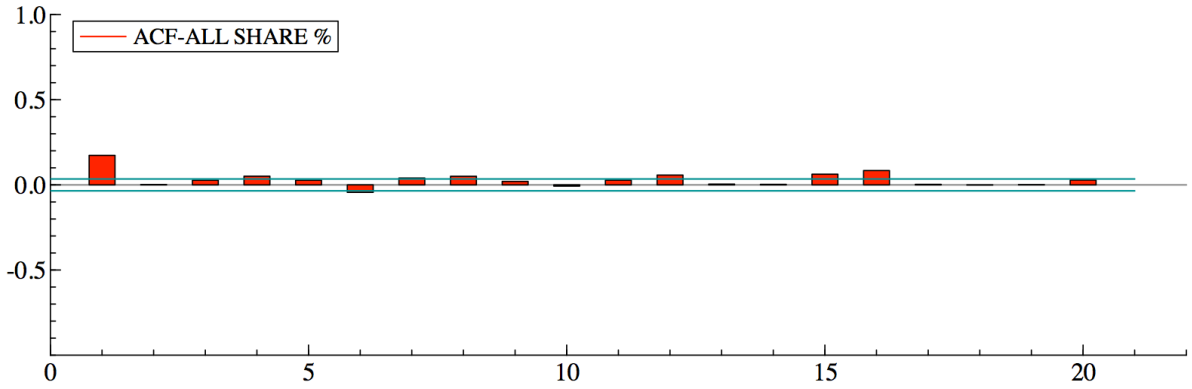

Figure 1 ACF daily returns All Share Index Colombo Stock Exchange 2004-2016

The second method follows Basher *et al* (2006) by adding a market risk factor. A one-day lag of the market risk factor is also included in the model to account for previous day effects.

Figure two shows a plot of daily returns for the All Share Index. Volatility clustering is observed indicating ARCH effects in the daily return data. The autocorrelogram of the squared returns in figure three provides further evidence of this. Method three uses a Garch(1,1) model to account for this.

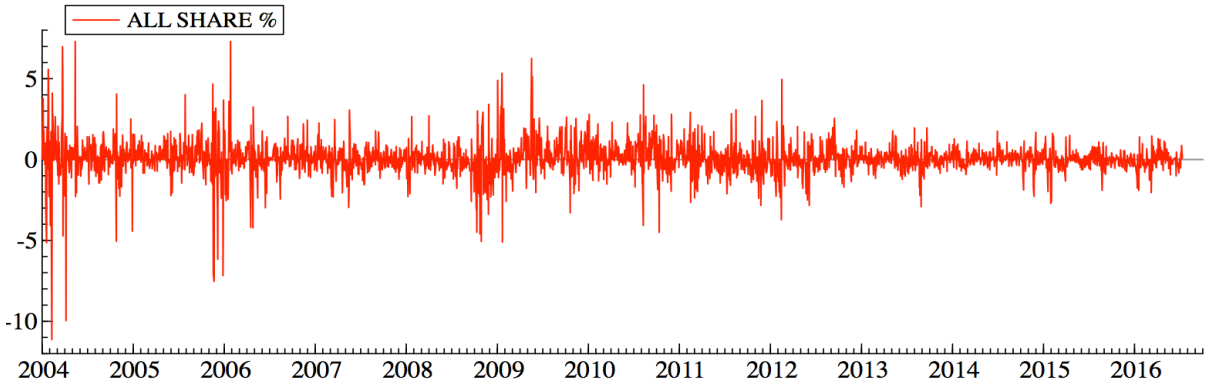

Figure 2 daily returns All Share Index Colombo Stock Exchange 2004-2016

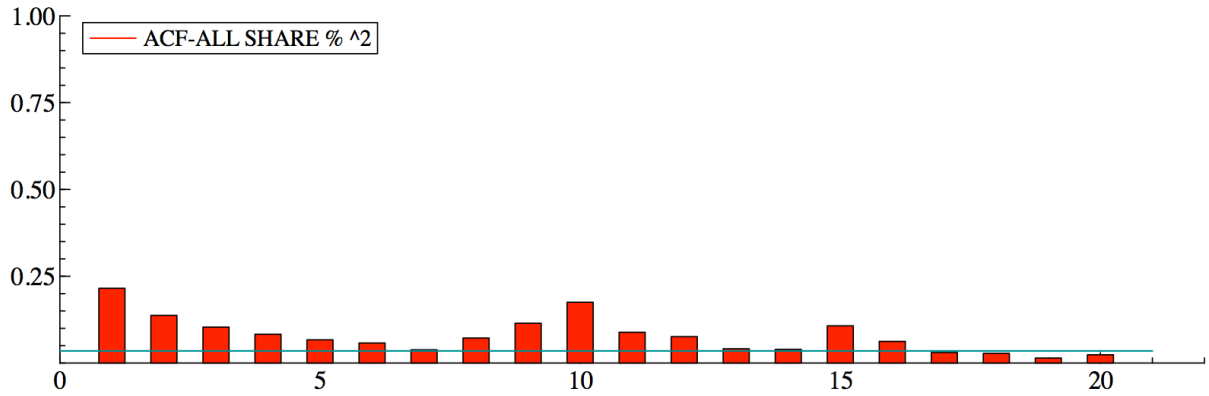

Figure 3 ACF daily returns squared All Share Index Colombo Stock Exchange 2004-2016

In the second part of the report, month of the year effects are investigated. Monthly data are less dynamic than daily data therefore ordinary least squares regression is employed. Figure four indicates that ARCH effects are not significant and that a simple linear regression is appropriate.

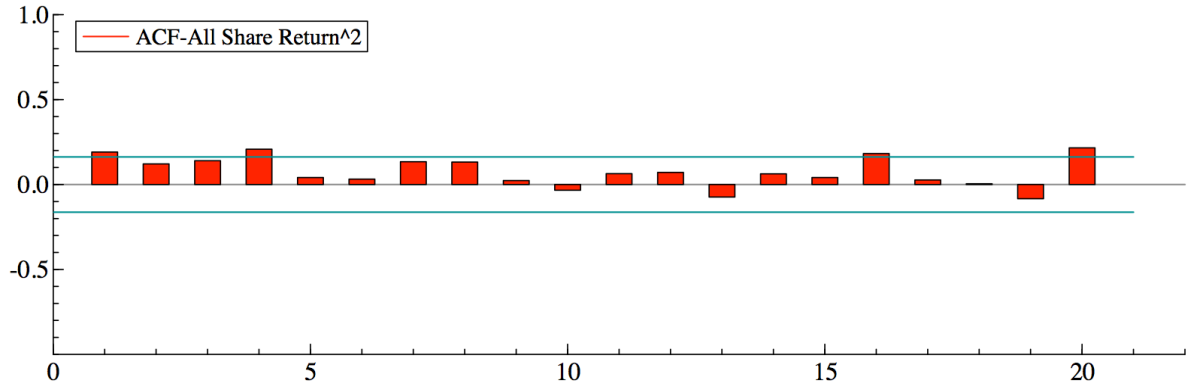

Figure 4 ACF monthly returns squared All Share Index Colombo Stock Exchange 2004-2016

Method

Research is carried out on the CSE All Share Price Index with daily and monthly prices collected from Datastream. Data is included from January 2004 to July 2016 and is split into three sample periods; war period 2004 to 2009, post-war period 2009 to 2016 and the entire period 2004 to 2016. This is to to account for the civil war in Sri-Lanka that ended in 2009 and follows the method used by Deyshappriya (2014). Analysis is carried out on daily and monthly returns data. The whole period for daily data consists of 3268 data observations and 151 observations for monthly data. The war period consists of 1392 daily and 65 monthly observations. The post-war period consists of 1877 daily and 87 monthly observations.

Day of the Week Effect

As discussed in the introduction, three models are used to test for DOW effects. The first model uses ordinary least squares with dummy variables for each day of the week. In the second model, a market risk factor is included to account for daily changes in risk. In model three a GARCH(1,1) model is used.

Returns

As is standard in the literature, analysis is carried out using log returns calculated from the log difference of prices. Returns are multiplied by 100 and can therefore be interpreted as percentages.

$$r_t = ln\frac{P_t}{P_{t-1}} \times 100$$

Where P_t is the price series and and r_t is the continuously compounded return series.

Stationarity Tests

It is necessary to test for stationarity before carrying out any econometric analysis on the data. To test the data for stationarity, Augmented Dicky Fuller (ADF) unit-root test and KPSS test is used. The

number of lags to use in the ADF test p_{max} is determined using the rule of thumb outline by Schwert (2012). The hypothesis of a unit-root is tested versus the alternative of a stationary series. The tests are carried out using R programming language. Results are shown in table two.

Augmented Dicky Fuller (ADF) Test:

$$p_{max} = \left[12\times\left(\frac{T}{100}\right)^{\frac{1}{4}}\right]$$

$$\Delta x_t = c_t + \beta_c x_{t-1} + \sum_{i=1}^{p-1} \phi \Delta x_{t-1} + e_t$$

$$H_0: x_t \; has \; a \; unit - root$$

$$H_1: x_t \; is \; stationary$$

Where x_t is the time series, $\Delta x_t = x_t - x_{t-1}$, c_t is a constant and e_t is the error term (Dicky & Fuller 1981).

KPSS Test:

$$KPSS_t = \frac{\sum_{t=1}^{T}(\sum_{i=1}^{t} \widehat{e_t})}{T^2 \widehat{\omega}_T^2}$$

$$H_0: x_t \; is \; stationary$$

$$H_1: x_t \; has \; a \; unit - root$$

Where $\widehat{\omega}_T^2$ is an estimator of the spectral density. (Kwiatkowski, Phillips, Schmidt & Shin, 1992).

Model One: Ordinary Least Squares Regression

In model one daily returns are regressed on five dummy variables for each of the three sample periods.

Model 1.0

$$r_t = \sum_{j=1}^{5} \delta_j D_{jt} + \epsilon_t$$

Model 1.1

$$r_t = \beta_0 r_{t-1} + \sum_{j=1}^{5} \delta_j D_{jt} + \epsilon_t$$

Model 1.2

$$r_t = \beta_0 r_{t-1} + \beta_1 r_{t-2} + \sum_{j=1}^{5} \delta_j D_{jt} + \epsilon_t$$

Where D_{1t} through to D_{5t} are dummy variables for Monday to Friday. D_{1t} equals one if the return is a Monday or zero otherwise and D_{2t} equals one if the return is a Tuesday and zero otherwise etc. Coefficients to be estimated for each day are given by δ_1 to δ_5. The error term is represented by ϵ_t. To avoid the dummy variable trap of perfect co-linearity, the intercept is not included. To account for autocorrelations models, 1.1 and 1.2 include one and two lags of the return series respectively as the ACF shown in figure one and the results from the AR 1-2 tests in table three indicate there is some memory in the returns. Results from the regressions are shown in table three.

Model Two: Ordinary Least Squares Regression with Market Risk Factor

In model two a market risk factor is included. This accounts for changes in daily returns caused by risk being higher or lower on certain days (Basher & Sadorsky, 2006). Lags of the return series are included to account for autocorrelations. The model differs from Basher *et al* (2006) by including a lag of the market risk factor to account for risk effects from the previous day.

Model 2

$$r_t = \beta_0 r_{t-1} + \beta_1 r_{t-2} + \sum_{j=1}^{5} \delta_j D_{jt} + \gamma_0 mr_t + \gamma_1 mr_{t-1} + \epsilon_t$$

Where D_{jt} are dummy variables for days of the week, mr_t and mr_{t-1} are the market and lagged market risk factor, r_{t-1} and r_{t-2} are the one and two period lagged returns and ϵ_t is an error term. Results are shown in table four.

Model Three: GARCH(1,1) for Returns and Variance

Two GARCH(1,1) models are used to account for possible ARCH effects on returns and volatility. To investigate DOW effect on returns, dummy variables for DOW are included in the mean equation.

Model 3.0

$$r_t = \sum_{i=1}^{5} \delta_i D_{it} + \epsilon_t \qquad \epsilon_t \sim \mathrm{N}(0, \sigma^2)$$

$$\sigma^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2$$

Where D_{jt} are dummy variables for DOW and ϵ_t is the error term in the mean equation. The conditional variance is given by σ^2 and the intercept by α_0. The ARCH term is ϵ_{t-1}^2 and its estimated coefficient is α_1. The GARCH term is σ_{t-1}^2 and its coefficient is β. Two constraints are applied; the constraint $\alpha_1 + \beta < 1$ to meet the non-explosiveness requirement for the conditional variance and α_0 , α_0, β to all be positive in order that the conditional variance be positive. OxEdit is used to obtain the results and the batch code is presented in the appendix. Results are shown in table five.

A GARCH(1,1) model is also used to investigate DOW effect on volatility. Dummy variables for days of the week are included in the variance equation.

Model 3.1

$$r_t = \alpha_0 + e_t \qquad e_t \sim \mathrm{N}(0, \sigma^2)$$

$$\sigma^2 = \alpha_1 e_{t-1}^2 + \beta \sigma_{t-1}^2 + \sum_{i=1}^{5} \delta_i D_{it} + \epsilon_t$$

The notation follows that used model 3.0 and the same restrictions on the coefficients are applied. Results are shown in table six.

Month Effect

Returns

Data consists of monthly returns of the Colombo All Share Price Index sourced from Thompson Reuters Data Stream. Monthly log returns as a percentage are calculated using the same method as used for daily returns.

Stationarity Tests

To test for stationarity, Augment Dicky Fuller and KPSS tests are employed using the same method as for daily returns. Results are showing in table eight.

Model 4: Ordinary Least Squares Regression

To test for month effects, ordinary least squares regression is employed.

Model 4

$$r_t = \sum_{j=1}^{12} \delta_j D_{jt} + \epsilon_t$$

Where D_{1t} through to D_{12t} represent dummy variables for January to December and D_{1t} equals one if the return is January or zero otherwise and D_{2t} equals one if the return is in February or zero otherwise etc. The coefficients to be estimated for each day of the week are given by δ_j and the error term by ϵ_t. To avoid the dummy variable trap of perfect co-linearity, the intercept is not included. Results are shown in table nine.

Results

Day of the Week Effect

Table one below shows summary statistics for daily return data for each of the three periods. The post-war period has a mean daily return of 0.0662% compared to 0.0394% during the war period. The standard deviation of the post-war period is lower than the war period, 0.8088% versus 1.250%. Excess kurtosis is positive in both periods but reduced in the post-war period. This implies that daily returns have heavy tails but to a lesser extent in the post-war period. The Jarque-Bera statistic is significant at one percent level rejecting the hypothesis of skewness and excess kurtosis being zero.

Summary Statistics

Table 1 Summary statistics daily returns All Share Index Colombo Stock Exchange 2004-2016

Statistics	War	Post-war	Entire
Mean	0.0394	0.06620	0.0548
Standard deviation	1.250	0.8088	1.0204
Skewness	-1.031	0.5283	-0.6738
Excess kurtosis	14.36	6.199	15.80
Maximum	7.230	6.260	7.299
Minimun	-11.14	-4.498	-11.14
Jarque-Bera	12250***	3092***	34272***
N	1392	1877	3268

Source Author's calculation

Stationarity Tests

Table two shows the results from Augment Dicky Fuller and KPSS stationarity tests. Results from the ADF test show that the hypothesis of a unit-root can be rejected for all sample periods at a one percent confidence interval. Results from the KPSS test show that we fail to reject the null hypothesis of stationarity for the war and entire period; however, it is rejected for the post-war period at a one percent confidence interval.

Table 2 Results from stationarity tests daily returns All Share Index Colombo Stock Exchange 2004-2016

Test	Statistic			Critical Values		
	War	Post-war	Entire	1%	5%	10%
ADF Test	-20.99	-20.93	-30.45	-2.566	-1.942	-1.617
KPSS Test	0.7045	2.004	0.4113	0.7390	0.4630	0.3470

Source Author's calculation

Model One: Ordinary Least Squares Regression

Results from model one are shown in table three below. Monday returns are negative and significant at five or one percent in all models except the post-war period in Model 1.0. Positive Friday effects are also observed for all periods at five or one percent confidence levels. It is observed that mean returns are negative on Monday and Tuesday but positive on Wednesday, Thursday and Friday. Furthermore, returns become more positive towards the end of the week. For the post-war period, every day of the week is significant. Results from the AR 1-2 test indicate significant autocorrelations when lags of the dependent variable are not included. Adding two lags of the dependent variable removed the autocorrelation problem from all three periods. Results from the Wald F-Test show that day of the week effects are significant in all three periods. The ARCH 1-1 test indicates that there are significant ARCH effects and therefore inferences may be invalid and that alternative models should be sought.

Model Two: Ordinary Least Squares Regression with Market Risk Factor

In model two a market risk factor is incorporated. Results are shown in table four. The same day market risk factor is insignificant however, the previous day market risk factor is highly significant for all periods. Again negative mean returns are found on Monday and Tuesday with positive mean returns on Wednesday, Thursday and Friday. Both lags of the dependent variable are significant except for the second lag in the 'entire' sample. The ARCH 1-1 test indicates that there are significant ARCH effects. Inference from this model may also therefore be invalid.

Model Three: GARCH(1,1) for Returns and Variance

To account for ARCH effects in the data a GARCH(1,1) model is used. From table five it can be seen that mean returns on Monday are negative and significant at ten percent for the war-period and one percent for the post-war and entire period. Tuesday and Wednesday are not significant for the war-period. For the post-war and entire period Monday, Wednesday, Thursday and Friday are significant at five or one percent. The same pattern observed in model one and two, with negative mean returns on Monday and Tuesday and positive mean returns during the rest of the week is observed. The ARCH and GARCH terms are significant at one percent for the war and post-war period which supports the suitability of the model.

DOW effect on variance is also investigated and the results are showing in table six. The results indicate that there are no significant DOW volatility effects. The ARCH and GARCH terms are significant at one percent for the war and post-war period indicating the suitability of the model.

Table 3 Results from Model 1

	Monday	Tuesday	Wednesday	Thursday	Friday	r_{t-1}	r_{t-2}	Wald F-Test	AR 1-2 Test	ARCH 1-1 Test	Adj. R^2	N
War 1.0	-0.1556**	-0.114	0.1004	0.1684**	0.1969***			4.804***	21.97***	72.66***	0.0108	1392
	(0.0746)	(0.0746)	(0.0746)	(0.0745)	(0.0745)							
War 1.1	-0.1877**	-0.0888	0.1189	0.1525**	0.1696**	0.1624***		11.46***	3.467**	46.08***	0.0362	1392
	(0.0738)	(0.0737)	(0.0737)	(0.0735)	(0.0736)	(0.0265)						
War 1.2	0.1787**	-0.0738	0.1097	0.1436*	0.1743**	0.1734***	-0.0672**	10.63***	0.5088	43.333***	0.044	1392
	(0.0738)	(0.0738)	(0.0736)	(0.0735)	(0.0735)	(0.0268)	(0.0268)					
Post-war 1.0	-0.0524	-0.0939**	0.0922**	0.164***	0.2212***			10.83***	41.14***	40.22***	0.0205	1877
	(0.0413)	(0.0414)	(0.0414)	(0.0414)	(0.0413)							
Post-War 1.1	-0.095**	-0.0838**	0.1103***	0.1462***	0.1894***	0.1924***		23.38***	8.133***	50.68***	0.0563	1877
	(0.0408)	(0.0406)	(0.0406)	(0.0406)	(0.0407)	(0.0227)						
Post-War 1.1	-0.1038**	-0.1004**	0.1128***	0.1543***	0.1848***	0.1784***	0.0723***	21.21***	0.225***	46.00***	0.0607	1877
	(0.0408)	(0.0409)	(0.0406)	(0.0406)	(0.0406)	(0.0231)	(0.0231)					
Entire 1.0	-0.0963**	-0.1025***	0.0957**	0.1659***	0.2112***			13.71***	51.00***	169.00***	0.0153	3268
	(0.0396)	(0.0396	(0.0396)	(0.0396)	(0.0396)							
Entire 1.1	-0.1329***	-0.0858**	0.1134***	0.1494***	0.1824***	0.1733***		31.52***	2.800	113.8***	0.0461	3268
	(0.0392)	(0.0391)	(0.0391)	(0.039)	(0.0391)	(0.0172)						
Entire 1.2	-0.1307***	-0.0818**	0.1121***	0.1474***	0.1836***	0.1763***	-0.0172	26.42***	2.247	112.51***	0.0446	3268
	(0.0392)	(0.0393)	(0.0391)	(0.0391)	(0.0391)	(0.0175)	(0.0175)					

Source Author's calculation

Table 4 Results from Model 2

	Monday	Tuesday	Wednesday	Thursday	Friday	r_t MSCI Risk	r_{t-1} MSCI Risk	r_{t-1}	r_{t-2}	Wald F-Test	AR 1-2 Test	ARCH 1-1 Test	Adj. R^2	N
War	-0.1750**	-0.0674	0.1049	0.1438**	0.1764**	0.0294	0.1158***	0.1699***	-0.0634**	10.41***	0.49125	44.48***	0.0515	1392
	(0.0733)	(0.0734)	(0.0732)	(0.073)	(0.0731)	(0.0283)	(0.0283)	(0.0267)	(0.0267)					
Post-war	-0.1026**	-0.101**	0.1073***	0.1503***	0.1824***	0.0188	0.0622***	0.1748***	0.0689***	17.47***	2.092	46.024***	0.0656	1877
	(0.0407)	(0.0408)	(0.0405)	(0.0405)	(0.0405)	(0.0197)	(0.0197)	(0.0231)	(0.023)					
Entire	-0.1288***	-0.0804**	0.1058***	0.1442***	0.1821***	0.0238	0.0942***	0.1726***	-0.0171	24.37***	2.342	114.0***	0.0542	3268
	(0.0391)	(0.0391)	(0.0389)	(0.0389)	(0.0389)	(0.0169)	(0.0169)	(0.0174)	(0.0174)					

Source Author's calculation

Table 5 Results from Model 3.1

	Monday	Tuesday	Wednesday	Thursday	Friday	α_0	α_1	β	N
War	-0.1136*	-0.062	0.0778	0.2144***	0.137**	0.0652***	0.2653***	0.7347***	1392
	(0.0657)	(0.0659)	(0.0677)	(0.0481)	(0.0549)	(0.0247)	(0.0759)	(0.0573)	
Post-war	-0.0656**	-0.0515	0.0676**	0.1385***	0.135***	0.0184***	0.1798***	0.8078***	1877
	(0.03)	(0.0325)	(0.0326)	(0.0323)	(0.0322)	(0.0062)	(0.0367)	(0.03273)	
Entire	-0.0835***	-0.0579*	0.0695**	0.1618***	0.1351***	0.0236	0.1946*	0.8054 ***	3268
	(0.0318)	(0.0302)	(0.0304)	(0.0269)	(0.0288)	(0.0247)	(0.1123)	(0.03273)	

Source Author's calculation

Table 6 Results from Model 3.2

	α_0	α_1	β	Monday	Tuesday	Wednesday	Thursday	Friday	N
War	0.0526*	0.2678***	0.7322***	0.1706	0.0183	0.0989	0.0794	-0.0157	1392
	(0.0283)	(0.0784)	(0.0611)	(0.1557)	(0.1355)	(0.1124)	(0.228)	(0.1737)	
Post-war	0.0509***	0.1572***	0.8237***	0.0855	0.0094	-0.0312	0.0615	-0.0311	1877
	(0.0167)	(0.0309)	(0.0294)	(0.0736)	(0.0638)	(0.037)	(0.0394)	(0.0374)	
Entire	0.0518***	0.1453	0.8516***	0.0964	0.0002	-0.0092	0.0257	-0.0268	3268
	(0.0152)	(0.0905)	(0.0941)	(0.0702)	(0.0706)	(0.0695)	(0.0483)	(0.0399)	

Source Author's calculation

Month Effects

Summary Statistics

Month of the year effects are investigated and the summary statistics are shown in table seven below. Mean returns are 0.69% during the war period and 1.547% during the post-war period. Excess kurtosis is small in all three periods indicating that heavy tails are not present. The Jarque-Bera test for the war-period is not significant, therefore the null hypothesis of zero skew and zero positive excess kurtosis is not rejected at any significance level. For the post-war period, the same null hypothesis is rejected at the one percent confidence interval.

Table 7 Summary statistics monthly returns All Share Index Colombo Stock Exchange 2004-2016

Statistics	War	Post-war	Entire
Mean	0.6997	1.547	1.116
Standard deviation	6.753	5.941	6.278
Skewness	-0.2905	0.7663***	0.1948
Excess kurtosis	-0.1039	0.6495	0.4747
Maximum	15.96	21.15	21.15
Minimun	-15.00	-10.34	-15.01
Jarque-Bera	0.943	10.04***	2.372
N	65.00	87.00	151.0

Source Authors calculation

Stationarity Tests

Table eight shows the results from Augment Dicky Fuller and KPSS stationarity tests. Results from the ADF test show that the hypothesis of a unit-root can be rejected for all sample periods at a one percent confidence interval. The KPSS results show that, for the war and entire period, the null hypothesis of stationarity is not rejected at one or five percent confidence intervals but is rejected at one percent confidence interval for the post-war period.

Table 8 Results from stationarity tests monthly returns returns All Share Index Colombo Stock Exchange 2004-2016.

Test	Statistic			Critical Values		
	War	Post-war	Entire	1%	5%	10%
ADF Test	-4.599	-4.213	-5.963	-2.566	-1.941	-1.617
KPSS Test	0.43230	0.9080	0.1907	0.7390	0.4630	0.3470

Source Author's calculation

Model Four: Ordinary Least Squares Regression

Table nine shows the results from model four. The Wald F-Test for post-war and entire period is significant at five percent, indicating month of the year effects exist. Positive January effects are observed in all periods and significant at ten percent in the post-war period. In the post-war period, mean returns are positive and significant at one percent in May and October. For the entire period, October mean return is positive and significant at one percent. February and August are significant at five percent. For all three periods the AR 1-2 test indicates that there are no significant autocorrelations present. Furthermore, the ARCH 1-1 test indicates that there are no ARCH effects at one or five percent confidence intervals supporting the suitability of the model.

Table 9 Results from Model 4

	January	February	March	April	May	June	July	August	September	October	November	December	Wald F-Test	AR 1-2 Test	ARCH 1-1 Test	Adj. R^2	N
War	-3.9236	7.8034***	1.1189	0.9091	-0.4709	-0.7896	-1.1622	2.9447	-0.0228	3.8127	-0.1992	-4.4351	1.48	1.705	0.93826	0.0774	64
	(2.634)	(2.634)	(2.634)	(2.634)	(2.885)	(2.885)	(2.885)	(2.885)	(2.885)	(2.885)	(2.885)	(2.885)					
Post-War	3.8504*	0.5748	-0.5037	-1.3988	5.2887***	2.2267	0.1088	3.8474*	2.6571	6.8259***	-2.5894	-2.8533	2.302**	4.252	2.872*	0.1414	88
	(2.085)	(2.085)	(2.085)	(1.951)	(1.951)	(1.951)	(1.951)	(2.085)	(2.085)	(2.085)	(2.085)	(2.085)					
Entire	0.2624	3.9111**	0.2452	-0.2768	3.0734*	1.0666	-0.38	3.4713**	1.5405	5.5704***	-1.5935	-3.5124**	2.184**	4.609	3.4053*	0.0799	151
	(1.676)	(1.676)	(1.676)	(1.676)	(1.676)	(1.676)	(1.676)	(1.744)	(1.744)	(1.744)	(1.744)	(1.744)					

Source Author's calculation

Conclusion

This report investigated DOW and month effects in the CSE Sri Lanka between 2004 and 2016. Ordinary least squares regression showed that mean returns are negative on Monday and Tuesday and positive for Wednesday, Thursday and Friday for all three periods considered. The model was improved by adding two lags of the daily return series. A same day and one day lagged market risk factor was also incorporated into the model. The one day lagged market risk factor was found to be significant for all periods. When using ordinary least squares regression ARCH effects were found to be present. A GARCH(1,1) model was used to account for this. Results from the GARCH(1,1) model also showed negative mean returns for Monday and Tuesday and positive mean returns for the rest of the week for all periods.

Ordinary least squares regression was employed to investigate month of the year effects. The results failed to find significant evidence of a positive January effect for any of the periods considered. Positive May and October effects were however found for the post-war period. Results from the F-test indicated that month of the year effects are present in the CSE. This report concludes that DOW and month of the year effects are present in the CSE and that they should be taken into consideration when investing in the CSE All Share Index.

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Appendices

Batch code for GARCH(1,1) Model.

Original code is from Timberlake consultant G@RCH 6.1 user manual. http://www.core.ucl.ac.be/~laurent/. The code was modified to meet the purpose of this report and included here to demonstrate how the GARCH(1,1) model was implemented.

```
#include <oxstd.oxh>
#import <packages/Garch/garch>
#include <oxdraw.h>
StartValues(const object)
{
   object.GetPara();                          // DO NOT REMOVE THIS LINE
   object.Initialization(object.GetValue("m_vPar"));   // DO NOT REMOVE THIS LINE
}
class GARCH_C : Garch                         // CONSTRUCTOR
{                                     // This function defines
   GARCH_C();                                 // a new class called GARCH_C
   cfunc_gt0(const avF, const vP);                 // and launches the cfunc_gt0 function
};
GARCH_C::GARCH_C()
{
   this.Garch();                              // This function defines GARCH_C
   m_iModelClass = MC_GARCH;                       // as a Garch object that thus inherits
   Init_Globals();                            // all the properties of Garch
}
GARCH_C::cfunc_gt0(const avF, const vP)
{
   SplitPara(vP);  // Do not remove this line
```

```
    decl matconstr=new matrix[1][1];
    matconstr[0] = 1.000001 - m_valphav[0] - m_vbetav[0];     // alpha_1 + beta_1 < 1
    avF[0] = matconstr;
    return 1;
}
main()
{
    decl model;
    model = new GARCH_C();

                    model.Load("/Users/stuartlee/Desktop/Project/Colombo prices daily orig.csv");
        model.Deterministic(-1);

        model.Select(Y_VAR, {"ALL SHARE %", 0, 0});
        model.Select(X_VAR, {"MON", 0, 0});
        model.Select(X_VAR, {"TUE", 0, 0});
        model.Select(X_VAR, {"WED", 0, 0});
        model.Select(X_VAR, {"THU", 0, 0});
        model.Select(X_VAR, {"FRI", 0, 0});

        model.CSTS(0,1);
        model.DISTRI(0);
        model.ARMA_ORDERS(0,0);
        model.ARFIMA(0);
        model.GARCH_ORDERS(1,1);
        model.MODEL(1);
        model.MLE(2);
        model.ITER(0);
        model.BOUNDS(1);
```

```
model.SetSelSampleByDates(dayofcalendar(2009,05,1), dayofcalendar(2016,07,11));
model.Initialization(<>);
model.DoEstimation(<>);
model.Output();
                                        delete model;
                                }
```