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Seasonal Anomalies in Stock Returns in Ghana

Wiredu Sampson* Mamuna Issif
Department of Statistics, Faculty of Mathematical Sciences, University for Development Studies,
P. O. Box 24, Navrongo, Ghana, West Africa

Abstract
In this study, the existence of monthly effect on stock return of Accra Brewery Limited of the Ghana Stock Exchange was investigated. The study revealed that, the returns are not normally distributed and they are leptokurtic in nature indicating high volatility. Using the ADF test for stationarity, it revealed that, the returns were stationary. In addition, the Kruskal-Wallis test and the regression on periodic dummies revealed that there was no evidence of the month-of-the-year seasonality in the stock returns. Thus, the Ghana Stock Exchange market can be said to be weak form efficient.
Keywords: Stock returns, Ghana, Kruskal-Wallis test, Regression on periodic dummies.

1. Introduction

The existence of seasonal effects creates higher or lower returns depending on the time series. Seasonality refers to regular changes in a time series which happens fairly and regularly over a period of less than a year. The main cause of seasonal variations in time series data is the change in climate. For example customs and tradition affect economic variables where for instance, sales of gold increase during marriage seasons. However, stock returns exhibits systematic patterns at certain times of the day, week or month. The most common one of these is monthly. The calendar anomalies have been one of the most widely researched areas in empirical financial economics. Many of calendar anomalies have been documented and an extremely large empirical literature is now available (Boudreaux, 1995). In an early empirical work on seasonal anomalies, researchers gave attention on either the discovery of new anomalies or searched for known anomalies in an ever expanding range of markets (Mei *et al.,*2007). Keim (1983) investigated the seasonal and size results. He found that small firm income is higher than large firm income throughout the month of January. Reingnum (1983) also had a related finding, but he discovered that, the tax-loss-selling theory cannot give details for the whole monthly anomalies. Again Agathee (2008) discovered that, the average return of Stock Exchange of Mauritius is the lowest in the Month of March and Highest in the Month of June using regression analysis. Onyuma (2009) tested the day of the week and the month of the year effects in the Kenyan Stock Market and found evidence that, Friday and January effect produce the largest positive returns, whilst Monday effect provided the smallest negative returns.
Although many of these researches have been carried out all over the world, in Ghana little have been done. Hence, this study further seeks to investigate the monthly effect on stock returns in Ghana.

1.0 Methodology

1.1 Data and Source

In order to achieve the objectives of this study, monthly data on stock prices was obtained from the Ghana Stock Exchange (GSE). The closing stock price series of Accra Brewery Limited (ABL) was selected for the study. These stock prices were converted into returns. To avoid influences of extreme index values the stock returns was measured in terms of the continuously compounded daily percentage change in the concerned share price index. The relationship for estimating the returns is given by

$$R_t = \ln\left[\frac{I_t}{I_{t-1}}\right] \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where R_t denotes the monthly returns in the period *t,* I_t, I_{t-1} denotes the monthly closing prices of the stock index for period *t* and *t-1,* respectively and In is the natural logarithm.

2.2. Kruskal-Wallis Test

Myriad of researches inferred that stock returns are not normally distributed and for that reason, using the Analysis of variance (ANOVA) to test for equality of means of the returns is not the best. Hence, in this study the Kruskal-Wallis Test was employed to test for the equality of median returns across the months of the year (Cheung and Coutts, 1999). The Kruskal-Wallis Test is based on the ranks of the observations.

The test statistic is given by

$$KW = \frac{12}{N(N+1)}\sum_{i=1}^{k}\frac{R_i^2}{n_i} - 3(N+1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where k is the number of trading months return *(k=12),* N is the total number of sample observations, n_i is the sample size in i^{th} trading month, and R_i is the rank sum of the i^{th} trading month. The hypothesis to be tested is as

follows
Ho: There are no differences in the median monthly returns across the months of the year.
H_1: There exist some differences in the median monthly returns across the months of the year.
The *KW* test statistic has a Chi-Square distribution with *k-1* degrees of freedom. If the null hypothesis is rejected then there is a monthly effect in the stock returns. It is worth investigating which pairs of months are significantly different from each other in terms of returns. Thus, the Wilcoxon Rank Sum Test (WRST) was used to do this pair wise comparison.

2.3 Unit Root Test
It is very imperative to deal with a weakly stationary series when working with a time series data. In this study, the Augmented Dickey-Fuller (ADF) test was used to check for the stationarity of the stock returns (Dickey and Fuller, 1979). This test is based on the assumption that a time series data Y_t follows a random walk;

$$Y_t = \rho Y_{t-1} + \varepsilon_t \quad (3)$$

where ε_t is the residual. This is the regression of the squared residuals, where $\rho = 1$, thus, Y_{t-1} is restricted from both sides;

$$\triangle Y_t = \gamma Y_{t-1} + \varepsilon_t \quad (4)$$

where $\triangle Y_t = Y_t - Y_{t-1}, \gamma = \rho - 1$
The hypothesis tested is given by

$$H_0: \gamma = 0 \text{ and therefore } \rho = 1$$
$$H_1: \gamma < 0 \text{ and therefore } \rho < 1$$

In the ADF test, the lags of the first difference are included in the regression equation in order to make the error term ε_t white noise and therefore, the regression equation is presented in the following form:

$$\triangle Y_t = \gamma Y_{t-1} + \sum_{i=1}^{m} \alpha_i \triangle Y_{t-i} + \varepsilon_t \quad (5)$$

The model can also be fitted with an intercept as well as a time trend t, after which the model becomes;

$$\triangle Y_t = c + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{m} \alpha_i \triangle Y_{t-i} + \varepsilon_t \quad (6)$$

The test statistic is given by

$$ADF = \frac{\hat{\gamma}}{SE[\hat{\gamma}]} \quad (7)$$

where $SE(\hat{\gamma})$ is the standard error.

2.4 ARCH-LM Test
The ARCH-LM test is a Lagrange Multiplier (LM) test for Autoregressive Conditional Heteroscedasticity (ARCH) in residuals. The test statistic is computed from an auxiliary test regression. To test the null hypothesis that there is no ARCH up to order q in the residuals, we run the regression;

$$\varepsilon_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \cdots + \beta_q \varepsilon_{t-q}^2 + v_t \quad (8)$$

The test statistics is given by

$$L = nR^2 \sim \chi_q^2 \quad (9)$$

where ε_t is the residual. This is the regression of the squared residuals on constant and lagged squared residuals up to order *q*. The LM test statistic is asymptotically distributed as a Chi-Squared with *q* degrees of freedom.

2.5 Jarque-Bera (JB) Test of Normality
Many literatures have cited that stock return is not normally distributed. In order to affirm the results in literature, this study also employed the Jarque-Bera test to investigate the normality of the returns. The *JB* test is a large sample test. The test first computes the skewness and kurtosis of the series and uses the following test statistic;

$$JB = n\left[\frac{S^2}{6} + \frac{(k-3)^2}{24}\right] \quad (10)$$

where $n =$ sample size, $s =$ Skewness coefficient, and $k =$ Kurtosis coefficient. For a normally distributed variable, $s = 0$ and $k = 3$. therefore, the *JB* test of normality is a test of the joint hypothesis that *S* and *K* are 0 and 3, respectively. In this case the value of the *JB* statistic is expected to be 0. Jarque and Bera proved that asymptotically the *JB* statistic follows the chi-square distribution with two degrees of freedom. If the computed p-value of the *JB* statistic is sufficiently low, which will happen if the value of the statistic is very different from 0, one can reject the hypothesis that the returns are normally distributed.

2.6 Regression on Monthly Periodic Dummies
To investigate the monthly effect on the stock returns, a conventional approach of regressing the returns on periodic dummies was employed. The regression model that was employed to test for the monthly effect is given by;

$$R_t = \beta_1 Jan + \beta_2 Feb + \beta_3 Mar + \beta_4 Apr + \beta_5 May + \beta_6 Jun + \beta_7 Jul + \beta_8 Aug + \beta_9 Sep + \beta_{10} Oct + \beta_{11} Nov +$$

$\beta_{12}Dec + \varepsilon_t$ ………………………………………….. (11)
where R_t represent the return for month t and Jan is a dummy variable which is set equal to one if the month *t* is January and zero otherwise and so on. ε_t is the error term. The null hypothesis is given by $H_O: \beta_1 = \beta_2 = \cdots = \beta_{11} = \beta_{12} = 0$ against the alternative hypothesis that at least one β is not equal to zero. The null hypothesis is rejected if at least one β is not equal if the mean return is the same for each month, then the estimated β_1 through β_{12} would be close to zero and the null hypothesis is not rejected. The coefficient of each month measures the incremental effect of that month. The presence of seasonal effect is confirmed when the overall regression is significant and the coefficient of at least one dummy variable is statistically significant.

3.0 Results

The minimum (Min) and maximum (Max) values for the returns for the entire period was -0.66287 and 0.87225 respectively as shown in Table 1. Also, the return for the entire period was positively skewed and leptokurtic in nature with the average and coefficient of variation (CV) are 0.00963 and 1458.10% respectively. The Jarque-Bera statistic of 1224.43 with a p-value of 0.000 indicates that the returns were not normally distributed. Table 2, presents the descriptive statistics of the returns for each month. Returns for the months of January, May, June, September, October, November, and December are negative and the rest of the months have positive returns. The maximum average return occurs in the month of April and the minimum average return occurs in the month of January. The returns show negative skewness for seven months and positive skewness for the rest of the five months. The results for all the months were leptokurtic in nature. This means they have fatter tails than the normal distribution and very volatile. The coefficient of variation indicates that the returns for all the months have greater variability. The Jarque-Bera test for normality indicates that the returns for the months of February, May and June are normally distributed while those of the other months are not normally distributed as shown in Table 3. The Augmented Dickey-Fuller (ADF) test was employed to investigate the stationarity of the stock returns. As shown in Table 4, the ADF test performed with constant and constant with trend indicates that the returns are stationary and this affirms the fact the stock returns are stationary.

The Kruskal-Wallis test and regression of periodic dummies were employed to investigate the month of the year effect. The Kruskal-Wallis test shown in Table 5, gave a test statistic of 7.7632 and p-value of 0.7343. This indicates that there is no significant difference in the median returns among the months of the year. Thus, the Kruskal-Wallis test reveals that there is no month of the year effect.

Table 6, presents the results of the regression model to test for seasonality from February, 1991 to September, 2007. The regression was performed with the full set of periodic dummies excluding the intercept to avoid dummy variable trap. It was clearly observed that the month of January, May, June, September, October, November and December recorded negative coefficients while the other months recorded positive coefficient value during the study period. Apart from the coefficient of April which was significant at the 5% level of significance, all other coefficients were not significant. This is an indication of "April effect" in the returns. The value of the R-squared of 0.053 was low, and the F-statistic of 0.953 with p-value of 0.491 indicates that the overall fit was poor. The insignificant F-statistic did not confirm seasonality during the period under study. To ensure that the regression analysis performed was not spurious, the model was diagnosed of conditional heteroscedasticity and higher order serial correlation. The ARCH-LM test shown in Table 7 indicates that there is no conditional heteroscedasticity in the residuals of the model. The Ljung-Box test also revealed that there is no higher order serial correlation in the model residuals up to lag 48 as shown in Table 8. The plot of the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) of the residuals clearly indicates that the residuals of the model are random as shown in Figure 1.

4.0 Conclusion

The monthly returns of the Accra Brewery Limited (AGL) of Ghana Stock Exchange (GSE) from the period January 1991 to December 2007 was studied. The Kruskal-Wallis Test was used to test for equality of medians of the returns. The results of the test reveal that, there was no significant difference in the medians of the returns for the various months. Hence, the Kruskal-Wallis Test did not reveal evidence of seasonality in the returns. Also, further investigations of monthly seasonality using regression on periodic dummies reveal that, the entire regression model was not significant.The regression result also showed that apart from the month of April, that was significant at the 5% level of significance and all other months were not significant. Thus, the insignificance of the regression model is clear evidence that, there is no seasonal effect in the monthly stock returns. It can therefore be concluded that, the GSE is a weak form efficient and investors cannot easily predict the market to make larger gains.

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Notes

Table 1: Descriptive statistics for the returns

Variable	Mean	Min	Max	CV (%)	Skewness	Kurtosis
Returns	0.00963	-0.66287	0.87225	1458.10	0.27	12.45

Table 2: Descriptive statistics of returns for each month

Month	Mean	Min	Max	CV (%)	Skewness	Kurtosis
January	-0.0004	-0.6043	0.4676	-44337.96	-1.15	7.97
February	0.0320	-0.0570	0.2068	259.64	1.33	0.74
March	0.0624	-0.0746	0.3948	215.01	1.71	1.83
April	0.0711	-0.0513	0.8722	304.34	3.57	13.49
May	-0.0038	-0.2541	0.2259	-2929.76	-0.15	1.26
June	-0.0044	-0.4458	0.3435	-4183.80	-1.11	2.70
July	0.0188	-0.0714	0.2292	362.35	2.10	5.47
August	0.0174	-0.3279	0.4149	802.53	0.65	5.90
September	-0.0435	-0.3156	0.0247	-213.66	-2.16	4.33
October	-0.0046	-0.3618	0.1614	-2300.88	-2.64	10.17
November	-0.0084	-0.2217	0.1454	-942.74	-0.98	3.39
December	-0.0257	-0.6629	0.1272	-681.88	-3.59	13.86

Table 3: Jarque-Bera Normality test for returns of each month

Month	Test statistic	*P*-value
January	21.8616	0.0000
February	4.1919	0.1230*
March	7.5220	0.0233
April	93.7557	0.0000
May	0.29909	0.8611*
June	4.7641	0.0924*
July	19.7763	0.0000
August	12.1183	0.0023
September	16.6279	0.0002
October	57.6481	0.0000
November	6.5206	0.0384
December	108.954	0.000

*: Means normally distributed

Table 4: Augmented Dickey-Fuller (ADF) test of returns

Variable	Constant		Constant + Trend	
	Test statistic	*P*-value	Test statistic	*P*-value
Returns	-13.0818	0.0000	-13.0515	0.0000

Table 5: Kruskal-Wallis test

Test statistic	Degrees of freedom	*P*-value
7.7632	11	0.7343

Table 6: Regression model to test for seasonality

Month	Coefficient	Std. Error	T-ratio	*P*-value
January	-0.0005	0.0351	-0.0127	0.9999
February	0.0320	0.0341	0.9378	0.3496
March	0.0624	0.0341	1.8312	0.0687
April	0.0711	0.0341	2.0869	0.0383*
May	-0.0038	0.0341	-0.1107	0.9120
June	-0.0044	0.0341	-0.1284	0.8980
July	0.0188	0.0341	0.5521	0.5815
August	0.0174	0.0341	0.5100	0.6106
September	-0.0435	0.0341	-1.2776	0.2030
October	-0.0046	0.0351	-0.1302	0.8966
November	-0.0084	0.0351	-0.2386	0.8170
December	-0.0257	0.0351	-0.7307	0.4659
R-squared= 0.053 *P*-value (*F*) =0.491	$F(11, 188)$ =0.9531			

*: Means significant at 5% significance level

Table 7: ARCH-LM test

Lag	Test statistic	*P*-value
12	10.4560	0.5752*
24	16.9116	0.8524*
36	39.7984	0.3047*
48	39.7507	0.7958*

*: Means no ARCH effect

Table 8: Ljung-Box test

Lag	Test statistic	*P*-value
12	9.1602	0.6890*
24	18.1372	0.7960*
36	38.0648	0.3760*
48	49.0977	0.4290*

*: Means no serial correlation

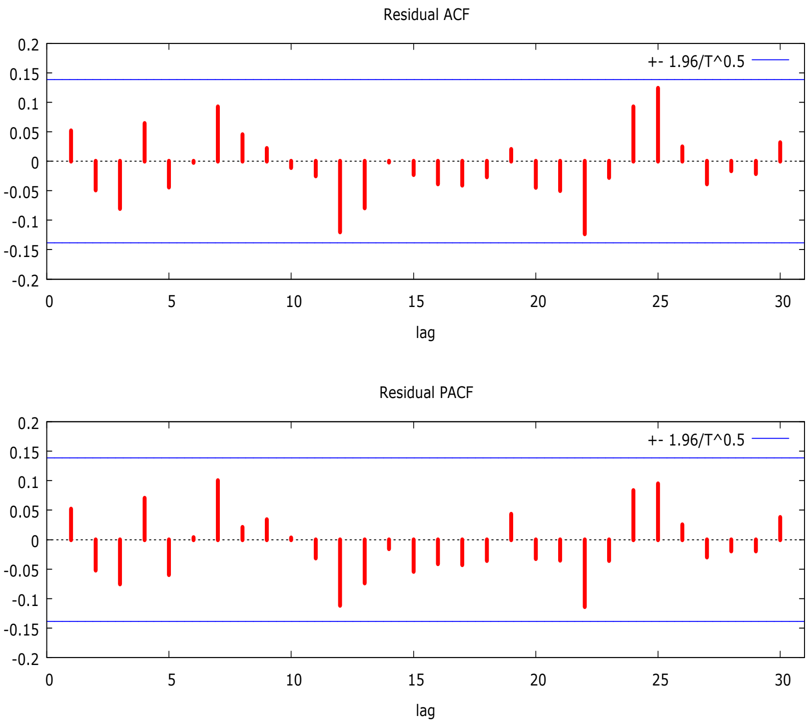

FIGURE 1: ACF AND PACF PLOT OF THE MODEL RESIDUALS