Monthly Patterns in Egyptian Stock Market

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Abstract

In this paper, monthly effect in Egyptian stock market is investigated for the period January 2007 to July 2015. After examining the random walk hypothesis of the return series, a Seasonal Autoregressive Moving Average (SARMA) model is specified to test the monthly effect in Egyptian Stock market. The results of the study imply that the banking sector of stock market is informationally efficient and does not confirm to the existence of seasonality in stock returns.

Keywords: Stationarity, Weak Efficient Market Hypothesis, Seasonality, Time Series

1. Introduction

Considerable attention has been paid to the discovery of anomalies in stock price movements. Time series data may sometimes exhibit strong periodic pattern. This is often referred to as the time series having a seasonal behavior (Douglas, 2008). These anomalies include the monthly effect, the size effect, the weekend effect and others. This paper examines one of these anomalies that is the monthly effect for Egyptian stock returns.

The behavior of stock prices has been a recurrent topic in academic articles for over a century. In this context, financial researchers have developed various theories and models which have been tested empirically for different equity markets. Among such theories is the Efficient Market Hypothesis that is central paradigm in finance.

The efficient market hypothesis (EMH) relates to how quickly and accurately the market reacts to new information. If the market is informationally efficient, security prices adjust rapidly and accurately to new information. According to this hypothesis, security prices reflect fully all the information that is available in the market. Since all the information is already integrated in prices, a trader is not able to make any excess returns. Thus, EMH proposes that it is impossible to outperform the market through market timing or stock selection. If the behavior of the stock returns is inconsistent with the EMH, it is considered an "anomaly" (Choi, 2008). But this does not prevent that there are prerequisites for market efficiency including freely available information, competition among investors and effective communication among market participants (Abeysekera, 2001).

In the literature, a distinction is made between three potential levels of efficiency; 'weak', 'Semi-strong' and 'strong'. Each relating to a specific set of information which is increasingly more comprehensive than the previous one. The weak form of efficient market hypothesis has also been designated in the literature as 'random walk hypothesis' that claims that prices fully reflect information implicitly in the sequence of past price. In this sense, prices are said to follow a random walk and past prices of shares should have no predictive power of future prices (Chakraborty, 2006). In the "semi-strong" form, the focus is whether publicly available information, e.g., the announcement of annual earning, stock split adjusts efficiency. In the "strong" form test, the question is whether investors have monopolistic access to the information relevant to the determination of stock prices (Law, 1982). This paper investigates weak efficient market hypothesis (WEMH) that is related to historical prices.

A large number of studies in the literature on predicting prices of traded securities confirm that some patterns are exist in stock market prices over the day of the week or

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the months of the year. For instance, some days of the week provide lower returns as compared to other trading days and also the month effect would exist if returns on a particular month are higher than other months. The most common calendar anomaly is The January effect which is related to tax-loss selling strategies as investors tend to engage in selling at the end of the year to establish losses on stocks that have declined. After the New Year, there is a tendency to reacquire these stocks or to buy other stocks that look attractive. This scenario would produce downward pressure on stock prices in the late November and December and positive pressure in early January (Reilly, 2012).

The existence of seasonality in stock returns violates efficient market hypothesis since the price pattern is no longer random and can be predicted based on the past pattern. If this is the case, it would help the traders to devise trading strategies accordingly. For instance if January effect is evidenced, the investors can buy the securities in the month of December and sell them in the month of January and can earn abnormal returns not in line with the degree of risk they undertook.

2. Literature Review

Research finding of EMH in the markets of developing and developed markets are controversial. So, the review of earlier studies relating to seasonality of returns is classified as two groups, one group studies seasonality in developed markets and the other is related to seasonality in emerging markets.

2.1 Seasonality in Developed Markets

Kato (1990) examined the calendar effect for Japanese stock market returns using daily stock returns and intraday returns of the value weighted index (TOPIX) of the Tokyo stock exchange from 1978 through 1987. He documented weekly pattern of Japanese stock returns, low Tuesday and Wednesday returns are observed and most of positive returns arise during the non-trading period. The weekly pattern is related inversely to the size effect.

Caporale, et al., (2000) has used a test for unit roots and other stationary and non-stationary hypotheses using the equity series of the standard and Poor's (S&P) price index from 1890 to 1993. The results suggested that there was autocorrelated structure which would imply that the series was perfectly predictable and the market might not be efficient and follow an ARIMA (1,1,1) process.

Jarrett (2006) examined the effects of changes in the day of the week on closing prices of 62 firms listed on organized exchanges in the United States (NYSE and NASDAQ) from 1992 to 2002 using OLS model. The results indicated that there was a day effect; more than 70% of the total variation in closing prices was associated with the regression on the day of the week after correction for autoregressive of the error term.

Choi (2008) examined the seasonal patterns in stock return using market country indices across 18 developed countries from 1970 to 2007. The results indicated that September was the worst performing month in 16 developed countries. Also, its effect was the most pervasive anomalous phenomena that was independent of the size effect, the book to market ratio, past performance and industry.

2.2 Seasonality in Emerging Markets

Al-Kulaib (2005) investigated the existence of a monthly effect in international stock market indices of 12 countries in the Middle East and North Africa (MENA) region from January 1995 to December 2004 the results indicated that Bahrain and Egypt have January effect.

Goa, et al., (2005) examined calendar effects in Chinese stock market particularly daily and monthly effect. Using individual stock returns from 1990 to 2002. They used regression analysis and ARIMA model. They observed the change of the calendar effect over time. The Chinese markets exhibited daily and monthly calendar effects, higher returns were observed on Fridays and in the months of March and April.

Chakraborty (2006) tested the 'week' form efficiency of Colombo stock exchange of Sri Lanka stock market from 1991 to 2002 and used stock prices of 25 companies from 6 sectors using unit root test, parametric serial correlation, variance ratio and ARMA. He suggested some inefficiency in the Sri Lankan market. It has developed one forecasting model for the market index using the ARMA (5, 0) model.

Ray (2012) investigated the existence of seasonality in stock returns in Bombay Stock Exchange (BSE) Sensex. He used monthly closing share price index of Bombay Stock Exchange from January, 1991 to December, 2010.

He first determined whether the BSE return series is stationary by (ACF), (PACF), the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test which are mostly used to test unit root. After a time series has been stationarized by differencing, the next step in fitting an (ARIMA) model is to determine whether AR or MA terms are needed to correct any autocorrelation that remains in the differenced series. The results provided an evidence for a month of the year effect in Indian stock markets; the maximum average return occured in September and minimum average returns resulted in October and the study's results supported the January effect. This could result from several social, economic and political factors such as floods that usually come during August-October in India in particular and other Asian countries.

Sriram, et al., (2013) examined the seasonality in the stock returns of Indian capital market that witnessed developments like the introduction of online trading, introduction of derivatives, rolling settlement and dematerialization of share. The definition of financial year is different in India vis-a-vis the U.S. The financial year in India is April-March while in the U.S, it is January-December. This study analyzed whether the seasonality witnessed in U.S. is the same or different in India using monthly data of BSE Sensex data from April 2004 to March 2012.They used autocorrelation function (ACF), partial autocorrelation function (PACF) and Augmented Dickey-Fuller (ADF) to test the stationarity of the data. They used ordinary least square (OLS) method to find the month of the year effect in the return series and constructed ARIMA (p,d,q) model. There was evidence of autocorrelation between the residuals in the OLS model that needed improvement. Hence the ARMA (1, 1) seems to be a good model that explains 24% of the variation. The results did not confirm the presence of January effect.

All previous studies of stock markets witnessed daily, weekly or monthly patterns despite the differences between developed stock markets and emerging stock markets in market structure, trading volume, series of date, short selling restriction and distributional properties of returns. Interest of this paper is the methodology to prove seasonality. The authors according to EMH tested seasonality of stock market and developed a predicative model if the results reject random walk hypothesis. While some studies tested EMH before testing seasonality and others did not.

3. Data and Methodology

Egyptian stock exchange has 16 economic sectors. The authors chose the banking sector because it is the most important sector of economy and represents 27.8 % of the total market capitalization of the Egyptian market. They took 5 companies from this sector as a random sample. Data represents the end of month closing prices of stocks and banking index from January 2007 to July 2015. To achieve their objectives, they implement the following steps.

The first step: Analyze the time series by summary statistics of the returns series and test the normality of the data using Jarque-Bera test.

The second step: Number of complementary testing procedures for random walk hypothesis or weak form market efficiency (WEMH) have been applied. Starting with unit root test is used to determine if the series are stationary then parametric serial correlation test of independence.

Unit root test: They determine whether Egyptian stock exchange return series is stationary or not using a formal test of stationarity of time series data, that is, the (ADF) testing the unit root and it consists of a regression of the first difference of the series against the series lagged k times. The null and alternative hypotheses for the existence of unit root are H_0; $\alpha = 0$ versus H_1: $\alpha < 0$. The rejection of the null hypothesis implies stationarity in the series.

Serial correlation tests: It is the relationship between a given variable and itself over various time intervals using (ACF) and (PACF) to test the stationarity of the data. In addition to testing the stationarity, ACF and PACF play a crucial role in data analysis which aimed at identifying the extent of the lag in an autoregressive model. The use of this function was introduced as part of the Box-Jenkins approach to time series modeling; by plotting (PACF) one could determine the appropriate lags p in an AR(p) model or in an extended ARMA (p,q) model. The Ljung-Box test is testing whether any of the groups of autocorrelations of a time series are different from zero. It tests the "overall" randomness based on a number of lags and is therefore a portmanteau test. The Ljung-box test is commonly used in ARMA modeling. Note that, it is applied to the residuals of fitted ARMA model, not the original series and in such applications the null hypothesis actually being tested is that the residuals from ARMA models have no autocorrelation.

Third step: Test seasonality of Egyptian stock market and develop a predicative model using SARMA approach, if the results of various tests reject the random walk hypothesis.

4. Results and Analysis

4.1 Summary Statistics

The data set in the study consists of 101 observations of monthly closing price for every company and banking index. Returns are computed by dividing the current month's closing price by the previous month's closing price.

Table 1: Summary Statistics of the Monthly Returns

Index & co.	*Min.*	*Max.*	*Mean*	*S.D*	*Skewness*	*Kurtosis*	*Jarque-Bera*	*P-value*
Banking Index	0.693	1.262	1.019	0.099	-0.329	3.486	2.808	0.245
Housing and development bank(x_1)	0.768	1.352	0.998	0.105	0.276	3.701	3.309	0.191
QNB Alahli (x_2)	0.709	1.393	1.005	0.118	0.684	4.927	23.26	0.0001
CIB(x_3)	0.584	1.282	1.009	0.122	-0.805	4.734	23.23	0.0001
Credit Agricol (x_4)	0.732	1.391	1.012	0.114	0.604	4.180	11.82	0.0027
Export Development bank of Egypt (x_5)	0.534	1.445	1.002	0.124	0.101	3.637	3.481	0.175

Table (1) presents a summary of descriptive statistics of the monthly returns for the index as well as 5 individual companies. The mean return is positive for the banking index (1.019). In the case of individual companies, the lowest mean return is for x_1 (0.998) and the highest mean for x_4 (1.012). The standard deviation of index return is 0.099 and for companies, it ranges from 0.124 (x_4) to 0.105 (x_1). On the basis, x_1 is least volatile, with x_4 being the most volatile.

Skewness is found to be negative for the index and one company (x_3), which indicate the higher possibility of negative returns, while it is positive for the rest of the companies. The value of the kurtosis is greater than 3 in all the cases including the returns of the index. Kurtosis greater than 3 means that the return series has heavier tails (extreme values) than the standard normal distribution indicating banking stocks are risky investments. Finally, the calculated Jarque-Bera statistics and corresponding P-values in table (1) are used to test the null hypothesis that the monthly returns are normally distributed. P-values of X_2, x_3, and x_4 are smaller than 0.01 level of significance, so they are not well approximated but are normally distributed while P-values of the index, x_1 and x_5 are larger than 0.01 level of significance, so they are normally distributed.

4.2 Unit Root Tests

Table 2: Unit Root Test: Results of Augmented Dickey Fuller test

(ADF) test	*T-test*	*P-value*
Banking index	-9.49	0.00001
X_1	-10.89	0.00001
X_2	-9.47	0.00001
X_3	-9.92	0.00001
X_4	-8.91	0.00001
X_5	-9.74	0.00001
Test critical values (1%level)	-3.50	
(5%level)	-2.89	
(10%level)	-2.58	

H_0: series has unit root; H_1: series is trend stationary.

A value greater than the critical t-value indicates non-stationarity

Table (2) presents the results of the unit root test. The results indicate that null hypothesis of a unit root can be rejected for the banking index and individual stocks. Thus the ADF tests prove that the Egyptian stock exchange is stationary. This result seems to provide preliminary support for the random walk hypothesis. However the absence of a unit root in the return series is necessary but not sufficient condition for the stock market to be efficient because it does not necessarily imply that returns are unpredictable. Further tests in coming pages are conducted to examine the issue of market efficiency in greater detail.

4.3 Serial Correlation Tests

The sample serial correlation coefficient for monthly changes in prices has been computed for 12 lags. Essentially these sample coefficients tell us whether any of the price changes for 12 months are likely to be of much help in predicting next month change. Table (3) presents the results of serial correlation test for the market returns.

Table 3: Autocorrelation Coefficients and Ljung-Box Statistic of returns

Lag		*Index*	X_1	X_2	X_3	X_4	X_5
1	AC	0.018	-0.086	0.05	-0.002	0.126	0.02
	PAC	0.018	-0.086	0.05	-0.002	0.126	0.02
	Ljung-Box	0.032	0.777	0.2585	0.0003	1.6503	0.04
	P-value	0.858	0.378	0.805	0.985	0.199	0.85
2	AC	-0.016	-0.022	-0.41	-0.015	0.01	-0.02
	PAC	-0.016	-0.03	-0.044	-0.015	-0.006	-0.02
	Ljung-Box	0.0575	0.8306	0.4345	0.0252	1.6612	0.06
	P-value	0.972	0.66	0.805	0.987	0.436	0.97
3	AC	0.122	-0.024	0.093	0.073	0.171	0.12
	PAC	0.122	-0.029	0.098	0.073	0.173	0.12
	Ljung-box	1.5518	0.8908	1.3529	0.5984	4.7718	1.54
	P-value	0.67	0.828	0.717	0.897	0.189	0.67
4	AC	0.063	-0.064	0.042	0.031	-0.132	0.06
	PAC	0.059	-0.07	0.031	0.032	-0.184	0.06
	L jung-box	1.9549	1.333	1.5441	0.7042	6.637	1.98
	P-value	0.744	0.856	0.819	0.951	0.156	0.74
5	AC	0.169	0.028	0.049	0.013	-0.072	0.17
	PAC	0.175	0.015	0.054	0.016	-0.026	0.17
	Ljung-box	4.9137	1.42	1.8034	0.7235	7.2008	5.01
	P-value	0.426	0.922	0.876	0.982	0.206	0.41
6	AC	-0.187	0.0112	-0.194	0.012	-0.061	-0.19
	PAC	-0.213	0.113	-0.209	0.008	-0.089	-0.21
	Ljung-box	8.5885	2.8054	5.9157	0.7389	7.6074	8.79
	P-value	0.198	0.833	0.433	0.994	0.268	0.19
7	AC	0.006	-0.094	-0.061	-0.111	-0.098	0.00
	PAC	0.01	-0.078	-0.042	-0.116	-0.023	0.01
	Ljung-Box	8.5918	3.7773	6.3213	2.1139	8.6639	8.79
	P-value	0.283	0.805	0.503	0.953	0.278	0.27
8	AC	0.01	0.05	-0.049	0.108	0.048	0.01
	PAC	-0.054	0.039	-0.078	0.106	0.064	-0.06
	Ljung-Box	8.6019	4.0607	6.5873	3.4084	8.9258	8.80
	P-value	0.377	0.852	0.582	0.906	0.349	0.36
9	AC	0.011	-0.11	-0.009	-0.066	-0.061	0.00
	PAC	0.053	-0.1	0.043	-0.075	-0.076	0.04
	Ljung-box	8.6153	5.4194	6.597	3.8979	9.3517	8.80
	P-value	0.474	0.796	0.679	0.918	0.405	0.46

Lag		Index	X_1	X_2	X_3	X_4	X_5
10	AC	-0.207	0.015	-0.23	-0.169	-0.054	-0.21
	PAC	-0.245	0.01	-0.233	-0.154	-0.032	-0.24
	Ljung-box	13.305	5.4466	12.653	7.1691	9.68	13.72
	P-value	0.207	0.859	0.244	0.709	0.469	0.19
11	AC	-0.181	0.023	-0.104	-0.11	-0.109	-0.18
	PAC	-0.096	0.005	-0.042	-0.125	-0.165	-0.10
	Ljung-box	16.946	5.5091	13.903	8.5708	11.063	17.62
	P-value	0.109	0.904	0.238	0.661	0.438	0.09
12	AC	0.061	-0.053	-0.06	0.04	-0.093	0.06
	PAC	0.004	-0.06	-0.13	0.042	-0.027	0.01
	Ljung-box	17.369	5.8327	14.322	8.7551	12.075	18.01
	P-value	0.136	0.924	0.281	0.724	0.44	0.12

As shown in table (3) the values of autocorrelation and partial autocorrelation at different lags are between +1.96 and –1.96. The evidence produced by the serial correlation model seems to indicate the statistical dependence in successive price change is negligible and the residuals of the model are white noise model.

For Ljung - Box static, P-values for market index and individual stocks are not statistically significant because they are greater than 0.05 level of significant, it is evident that autocorrelation of residuals near to zero for the market index and individual stocks.

Until now, the results are consistent with the random walk hypothesis and also suggest absence of monthly pattern. To support more evidences of WEMH, we use Durbin-Watson statistic to test serial correlation of residuals.

Table 4: Results of Durbin- Watson (DW) Statistic

Test	Index	X_1	X_2	X_3	X_4	X_5
DW stat	2.0025	1.9420	1.9738	1.9994	2.0104	2.000
Schwarz Criterion	-1.6494	-1.6059	-1.3505	-1.2777	-1.4691	-1.70
Hannan Quinn Criterion	-1.6814	-1.6369	-1.3815	-1.3087	-1,5001	-1.73

The value of Durbin-Watson statistic between -2, +2 indicates there aren't correlograms and no serial correlation in the residuals. This result also supports random walk hypothesis. It is evidence that the Egyptian market is efficient.

4.4 Season Auto Regressive Moving Average (SARMA) Model

The results of various tests can not reject the random walk. The authors may stop their analysis at this step according to efficient market hypothesis that stock returns follow a random walk and past prices of shares should have no predictive power of future prices. To support their comment, they test seasonality of Egyptian stock market and try to develop a predicative model using SARMA approach.

As shown in the table (5) for banking index and 5 companies, the results indicate that P-values for parameters of AR (1) and SAR (12) in (SARMA) (1,0) $(1,0)_{12}$ are greater than 0.05 level of significance. The models for banking index and individual stocks are not statistically significant. So they could say that there are not monthly patterns in Egyptian stock exchange for banking sector through the period of study and they couldn't predict using (SARMA) (1,0) (1,0) 12 model because the time series follow random walk model.

Table 5: Estimated Parameters of SARMA (1,0) $(1,0)_{12}$ Model

Model	*Coefficient*	*SE*	*T-statistic*	*P-value*	*MSE*
(index)					0.01012
Constant	1.10222	0.00991	111.22	0.00001	
AR(1)	0.0539	0.1003	0.54	0.592	
SAR(12)	-0.1459	0.1008	-1.45	0.151	
(X_1)					0.01098
Constant	1.20225	0.01033	116.41	0.00001	
AR(1)	-0.0675	0.1000	-0.68	0.501	
SAR(12)	-0.1272	0.1046	-1.22	0.227	
(X_2)					0.01401
Constant	1.09195	0.01166	93.63	0.00001	
AR(1)	0.0595	0.0999	0.60	0.553	
SAR(12)	-0.1555	0.1015	-1.53	0.129	
(X_3)					0.01536
Constant	1.06063	0.01221	86.85	0.00001	
AR(1)	0.0243	0.1002	0.24	0.809	
SAR(12)	-0.0803	0.1010	-0.80	0.428	
(X_4)					0.01292
Constant	0.98524	0.0112	87.97	0.00001	
AR(1)	0.1864	0.0983	1.9	0.061	
SAR(12)	-0.1976	0.1022	-1.93	0.056	
(X_5)					0.0158
Constant	0.91560	0.01238	73.93	0.00001	
AR(1)	0.1671	0.0986	1.69	0.093	
SAR(12)	-0.0997	0.1015	-0.98	0.328	

5. Conclusion

Autocorrelation of residuals near to zero for the market index and individual stocks concluded that the Egyptian stock market is efficient for banking sector. So, suggesting that the stock returns follow random walk and past prices of shares should have no predictive power of future prices.

It is a surprising result for investment decision-making in Egyptian stock market with political and economic instability within the period of study. The results of this study also are inconsistent with the conventional argument that the emerging stock markets are not as informationally efficient as their developed country counterparts.

The interpretation of these results that the stocks of banking sector are attractive for institutional investors so, it has sufficient trading activity to move the prices quickly to a new equilibrium value that would reflect the new information. This finding will increase participants' understanding of the prevailing pricing process in the market then setting suitable trading strategies.

Further research is necessary to test random walk hypothesis and investigate seasonality for daily and weekly prices for the same period and the same stocks.

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