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EXAMINING THE WEAK FORM MARKET EFFICIENCY RISK: DETERMINANTS OF MACROECONOMIC VARIABLES

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Abstract: *This study investigates the weak form market efficiency of indices for the Financial, Industrial and Service returns as listed in the Muscat Securities Market (MSM30 index) in Oman, by conducting monthly observations from January 2010 until December 2014.*

All macroeconomic variables, covered under three sectoral indices, were found to be co-integrated. Furthermore, the findings exhibit that oil prices as a determinant have the most significant relationship on the three stock indices. The consumption price index (CPI) is the second most significant determinant revealed to impact the Service and Industrial indices prices, although it was found to exert no influence on the Financial index prices. Whilst inflation appears to be a third determinant, there is a significant effect on the Financial and Service indices prices, but no significant effect on the Industrial index prices.

The overall findings from the period suggest that the Financial, Industrial and Service indices prices listed in MSM30 are inefficient in weak form market efficiency, which is consistent with previous studies examining the weak form of market efficiency.

JEL classification: *G32; G12*

Keywords: *Financial Risk; Efficiency; Oman; Capital Market;*

1. INTRODUCTION

After the 2008 stock market crash, the most considerable event to globally impact the stock market is the significant plunge in the price of crude oil, beginning in 2013. The per-barrel-pricing of crude dropped 50% in late 2014 (Bloomberg, 2015). Globally, this has had its effect on the international stock market, and from there, beyond, to other Financial, Service, and Industrial sectors, especially those of countries which are heavily reliant upon the economic contribution of crude oil to their gross domestic product (GDP). For Gulf Cooperation Council (GCC) countries, oil is the main economic

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contribution to the GDP. Using Oman as an example, the price of oil contributes to 80% of Oman's GDP (National Center for Statistics & Information, 2015).

Declining oil prices have impacted the investments of, and into, GCC financial markets, and GCC members find that their economies, and other Financial, Industrial, and Service sectors, are not immune to the effects of events such as falling oil prices, or severe crashes or slow-downs in markets and economies elsewhere in the world. Research by Sedik and William (2011) finds that the GCC stock markets are less protected against global crashes, as they are highly correlated. In fact, the Muscat Securities Market[1] (MSM30) index dropped over 7% in late 2014 as a result from the sharp fall of oil prices (Muscat Securities Market, 2015).

The MSM30 market has quite recently been improved and developed in terms of the corporate governance, market regularity, and disclosure over the last five years (Capital Market Authority, 2015). A solid trading and monitoring system, and increased informational transparency and disclosure, as well as the low price to earnings ratio (P/E) and cash dividends distributed by the listed companies in the MSM30 index, are theorized to be key factors towards securing stability in the MSM30 index performance. This could be surmised to have led to increased market efficiency.

Market inefficiency causes risk for two reasons, these being adverse selection and moral hazard (Chepkoech Kemei, J., and Kenyatta, J., 2014). If there is no viable information on the averaging of insurance premiums, the less risky buyer hazards borrowing at a higher rate than warranted by the actual market. Inaccurate information leads the investor to invest or sell more heavily than actual performance of the market would warrant, had the investor proper knowledge of it (Langevoort, D., 2002). Having late or inaccurate information opens the investor up to chances of higher losses, as it enables the seller/lender to take greater than warranted risks with the buyer/investor's funds (Bernard, C., and Boyle, P., 2009; Langevoort, D., 2002). Also, having doctored or falsified information means the seller may not put acquired funds to the best use, or even the intended use for those funds (Bernard, C., and Boyle, P., 2009; Hurt, C., 2010). In cases of falsified or doctored information, this is almost always at cost to the investor/buyer (Bernard, C., and Boyle, P., 2009; Hurt, C., 2010). Needless to say, late information is of no use to the investor/buyer whatsoever (Bernard, C., and Boyle, P., 2009). For investors in the Bernard L. Madoff Investment Securities LL Cponzi scheme for example, the results of the simple quantitative diagnostics run by Bernard, C., and Boyle, P. (2009) would surely have raised suspicions about the firm's performance. Of course, would have, could have, and should have are no balm for the losses incurred by Madofff's investors.

Abuse of information by agents in investment and lending organizations can go beyond poor and minimal performance on stocks and individual investor and organizational losses; systemic market inefficiency upsets the entire banking system, and as such, can lead to banks failing abruptly, creating inefficiencies on an economic-wide and, worryingly, global scale (Chepkoech Kemei, J., and Kenyatta, J., 2014). Of market inefficiency authors Chepkoech Kemei, J., and Kenyatta, J. conclude that "information asymmetries of capital markets constitute the backbone of financial ineffectiveness and financial crisis" (2014, pp. 2). The purpose of this study is to examine weak form efficient market hypothesis (EMH) on three different sectors listed in the MSM30 index. These sectors are Financial, Industrial and Service, and they are observed in their entirety. This is done to determine the impact of macroeconomic variables, such as oil prices and other factors, on three sectoral indices. This has been done by conducting monthly analysis from the closing period of January, 2010, up until December, 2014. We also observe whether or not the average returns on those indices, made on the historical time (days: t-1, t-2, t-3 and so on) are statistically significant or different from today (t). Significance determines the impact of macroeconomic factors on the three sectoral indices prices volatility in a long-run relationship.

In the literature, to the best of our knowledge, there has been no attempt to assess the weak form EMH in respect to main indices sectors prices (Financial, Industrial and Service) in their entirety. Among the three sectoral indices listed in MSM30, macroeconomic variables determinates instigate prices volatility. Differences represent the first major factor to justify further research concerning this market.

Another factor of relevance to researchers, stakeholders, and investors, is that the monthly analysis period selected (from 2010 to 2014) of this study is current and up to date, and uniquely focuses on the development of Oman's stock market after the market crashes in 2008.

Additionally, this study demonstrates the market level in respect to the Financial, Service and Industrial sectors, in whether or not they are efficient.

Further, the study itself provides the rational for efficiencies and inefficiencies.

Finally, the previous, aids investment decisions[2].

This study is organized as follows. Section 2 provides a review of the relevant literature on weak form market efficiency and the existence of co-integrating vectors and determinants. Section 3 represents the data used and Section 4 describes the research methodology. Section 5 provides all data analysis and our empirical results. Lastly, the conclusion of weak form market efficiency and determinates of the prices impact on the three sectoral indices is addressed in Section 6.

2. LITERATURE REVIEW

2.1. Capital Market Efficiency & Efficient Market Hypothesis

Capital market efficiency is described by researchers to exist in three forms: operational, allocative and informational efficiency (Fama, 1970; Alexander and Bailey, 1995; Muslumov, Aras, and Kurtulus, 2003Jones, 2007; Redhead, 2008;).

Efficient market hypothesis (EMH) embodies the form of informational efficiency. This form consists of the premise that all relevant information is immediately reflected into current market prices and reflects the determination of the market value (Fama, 1970). It refers to a perfect capital market, which assumes that all investors are rational and have direct access to all available information, and that accessible information and transactions are supposedly without costs. However, in real practice the market participants are addressed to cover the transaction costs on their daily trading. EMH also assumes that all stocks are fairly priced, and market participants will only be able to earn a normal return on their stock prices, consistent with inherent market risk.

2.2. Approaches of Efficient Market Hypothesis

According to Fama (1970), the efficient market hypothesis (EMH) can be defined by different approaches, each depending on the type of information revealed to investors. Types of information revealed to investors are often defined or groups as Weak-form efficient market hypothesis, Semi-strong form efficient market hypothesis and Strong-form efficient market hypothesis.

The Weak-form efficient market hypothesis suggests that current stock prices fully incorporate all historical information, reflecting better estimates of intrinsic values (Malkiel, 1999). Hence, future prices cannot be predicted in advance based on the study of past stock prices. Thus, there is no benefit towards using technical analysis to gain excessive stock returns if the market is weak form efficient. Conversely, rational investors still have the opportunity to gain abnormal return on stock prices for value and growth of stocks throughout their efforts of using fundamental analysis relative to accounting measures such as earnings, cash flow, or book value (Dyckman and Morse, 1986). Dyckman and Morse (1986) demonstrate several tests of the market efficient hypothesis to try weak form, which are the variance ratio, serial correlation data, and the running of tests which include smaller unit root tests.

The Semi-strong form efficient market hypothesisposits that the current stock prices fully reflect historical information, and are also reflective of the current available information. This implies that analysts and investors cannot derive abnormal returns on stocks by implementing such information, because it includes corporate dividend announcements, corporate announcements on merging and acquisitions, as well as spilt shares. However, fundamental analysis relative to accounting ratios such as book value, earnings and cash flow can still be used by rational investors to achieve successive returns on stock prices. Fama (1991) has essentially validated this in the form of addressing several findings in respect to speed and the correspondence of the price adjustments on the news about stock splits and earnings announcements. Findlay and Williams (2000) have found there is invalidity of achieving profitability by investors, since the relevant information and announcements were already reflected into the security prices at the time of announcements.

The Strong-form efficient hypothesisis that current available information, as well as historical and private insider trading information reflects in the security prices at any given time. This implies that if the markets are strong form EMH, it would be pointless for investors to use technical, fundamental analysis or the most valuable insider information which is available to top management to achieve abnormal returns. Penman (1982) points out that insider trading can achieve excessive returns on share prices when buying shares before declaration, and selling stocks after the announcement. As a result, insider trading groups have private information which is not reflected in the stock prices.

2.3. Testing weak form EMH

The randomness test can be considerably examined by the weak form market efficient when implementing the weak form test, which demonstrates the independence of price changes at any given point of time. Bachelier (1900) has iterated that the stock prices directions and financial assets are weak form efficient in respect to the irrelevancy of historical prices' movement with current financial securities prices.

Moreover, Fama (1965) examined market efficiency by implementing tests of serial correlation and running tests which generated daily data of approximately 30 stocks listed in the Dow Jones Industrial Average (DJIA) from 1956 to 1962. The findings were not significantly different from zero, and illustrate very low correlation, leading to the conclusion that the DJIA is efficient in weak form market efficiency. Perhaps, the research by Solnik (1973) points out that these markets diverge more from the 'Weak-form' compared to what has been found in the United States. Nevertheless, correlation coefficient is low, which may suggest that when the correlation is zero by using serial correlation and run tests, the market is considered to be efficient at the weak form of EMH.

On the other hand, Summers (1986) exhibits that the efficiency test of serial correlation can mislead the short term returns horizon. Despite, Fama and French (1988) have asserted that negative serial correlations at the short term horizon become stronger as the return of the short term horizon increases. Moreover, the variance ratio and run tests methodology[3] used by Abraham, Seyyed, and Alsakran (2002) have emphasized, that upon implementing adjusted returns in Bahrain and Saudi Arabia covering markets, the period from October 1992 and December 1998, these markets are weak form EMH, and when using the raw data, these markets are inefficient in weak form EMH.

2.4. Testing weak form Market Efficiency in the MSM30 Index

Apart from the above research findings on testing weak form EMH, certain studies conducted randomness tests on the MSM30 index.

Kharusi and Weagley (2014) they found that MSM30 index prices returns observed a positive correlation returns pre financial crisis (January 1, 2007 to June 8, 2008), whereas, a negative correlation for returns during the financial crisis from June 9, 2008 to January 22, 2009 proceeded. Whilst, the results varied between positive and negatives correlation returns on all index prices at post crisis levels from January 23, 2009 to January 17, 2011 the overacting result was that the MSM30 index during the financial crisis 2008 did not really follow the 'Weak-form' pattern, and thus it can be labeled inefficient during that period.

On the other hand one must not ignore a crucial study by Jawad (2011), found that on monthly analysis reflect that the market is efficient in WFE. Whereas his finding on daily analysis is that the market is inefficient in WFE. Arguably, Al-Jafari (2012) points out that the MSM is efficient and the market prices, and that stock returns are unpredictable in advance, as all available information is reflected more or less in the stock prices themselves.

2.5. The Impact of Macroeconomic variables on stock indices returns

Various empirical researchers have investigated the impacts of macroeconomic variables on stock indices examines the influence of oil price changes on U.S stock indices prices with varied results, illustrating that the reaction of U.S stock indices returns may considerably fluctuate depending on the crude oil market. They returns.

An empirical study by Kilian and Park (2009) found insignificance of effect on stock indices returns relevant to the shocks of crude oil supply, whilst the positive shocks of the demand on crude oil prices. Other studies by Jones and Kaul (1996), and Kling (1985) report that declines of stock indices returns are correlated with increases in crude oil prices, demonstrating a negative relationship.

Research by Park and Ratti (2008) explains that the negative relationship between those variables exists on the oil importing countries, whilst the positive relationship substantially exists on the oil exporting countries.

In contrast, Huang, Masulis, and Stoll (1996) have found no existence of a negative relationship between stock returns and oil prices, which is in line with findings from Chen, Roll, and Ross (1986), who had previously suggested that the oil prices have no influence on stock returns. More recently, an empirical study by Cong et al. (2008), demonstrated[4] that the shocks of crude oil prices had no significant impact on the majority of Chinese stock indices returns.

On the other hand, Yahyazadehfar and Babaie (2012) have used an auto regression model (VAR) to examine the relationship between the macroeconomic variables and stock prices fluctuation. They point out that the Iranian stock prices and returns have significant response on macroeconomic variables such as CPI, inflation, GDP, oil and gold prices. Additionally, several studies exhibit the influence of macro-economic factors on stock indices prices differently by implementing the Johansen co-integration test[5], which represents the most common test methodology to determine the relationship between those variables and the stock indices prices changes.

From the literature is can be argued that the relationship between macroeconomic variables and stock market indices partially reveals the informational market efficiency.

3. DATA AND VARIABLE SELECTION

Initially, the data in this study is based on time series[6]. The data implemented herein was collected in May 2015. The method of data collection is based on secondary information collected from two main financial institution sources, the Muscat Securities Market (MSM) and the National Center for statistics and information - Directorate General of Economic Statistics in Oman. The data was divided into two samples based on the research purpose.

For the first sample, the data was obtained in the monthly closing prices for three market sectors in their entireties, which are the Financial, Service and Industrial indices prices, as these are listed in the MSM30 index. They were collected for a period of five years, from the closing period of January, 2010 to December, 2014. There werea total of 60 observations. This was done to investigate whether the entire sectors listed in MSM30 follow a random walk and efficient in weak form market efficiency.

For the second sample, the data sought and captured firstly consisted of monthly macroeconomic factors which are oil prices, CPI index (Consumer Price Index) and inflation rates as independent variables. Secondly, the three entire indices sectors monthly prices listed in MSM30 as dependent variables for five years from closing period of January, 2010 to December, 2014. There were a total of 60 observations. This was done to investigate the significance of the impact of the macroeconomic factors on the return of the sectoral indices listed in MSM30.

Normally, the monthly closing which provides 60 observations are excluding the closing, due to public holidays.

4. RESEARCH METHODOLOGY

Essentially, the prices of sectoral indices used to obtain the index returns. The following equation was deployed:

$$R_t = [(P_t)/P_{t-1}] - 1 \tag{1}$$

Where the:

- R_t – The daily returns of the index,
- P_t – Index price at time t,
- P_{t-1} – Index price at time t-1.

The correlation coefficient test is the statistical tool commonly used to indicate whether or not there is randomness in indices prices changes. According to Gujarati (2012), the serial correlation coefficient known as autocorrelation test and it is defined as a measure of time series of returns and a different lagged period of the return within the same time series. Thus, autocorrelations accurately tests the independence and dependence of the random variables in a time series. Additionally, the former is calculated by using the beta coefficient from the following estimated regression formula:

$$R_{i,t} = a_i + \beta_i R_{i,t-k} + \varepsilon i, t \quad (2)$$

Where the:

$R_{i,t}$ – Represents the monthly return of sectoral indices at time t,

a_i – Constant,

β_i – The correlation coefficient of the current and lagged returns,

$\varepsilon i, t$ – The random error or white noise,

k – Reflects different time lags in months.

To clarify further, the suggestion of the weak-form is that the existence of insignificant correlation coefficient between sectoral indices prices returns implies that:

$$\beta_1 = \beta_2 = \beta_3 = \ldots = \beta_J = 0 \quad (2.a)$$

The serial correlation test or autocorrelations will be used to examine correlation coefficient between the sectoral indices monthly return listed in MSM30 index by employing 30 lags. Thus, if the correlation coefficient is zero, then this entails that the return of the sectoral indices follow random walk and thus the market is efficient. Conversely, if the correlation coefficient shows positive or negative then it demonstrates a trend on the monthly prices returns of the sectoral indices, and therefore the market is inefficient. Accordingly, the equation of the correlation coefficient is calculated as:

$$\rho(k) = \frac{\mathrm{cov}[r_t, r_{t-k}]}{\sqrt{\mathrm{var}[r_t]}\sqrt{\mathrm{var}[r_{t-k}]}} = \frac{\mathrm{cov}[r_t, r_{t-k}]}{\mathrm{var}[r_t]} \quad (3)$$

In which signifies the sample of autocorrelation, where the:

$\rho(k)$ = Autocorrelation coefficient of sectoral indices returns at time series t,

r_t = Sectoral indices prices returns at time t,

k = the lag of the period,

$cov[r_t, r_{t-k}]$ = represents the covariance between the sectoral indices return at time period $(t-1, t)$, where the lagged return $t-k$ represents prior periods,

$var\ [r_t]$ = Shows the variance of sectoral indices returns over time period $(t-1, t)$.

Moreover, Ljung and Box (1978) have shown how the Q-Statistics[7] are deployed to test the serial correlation or autocorrelation between stock prices. The Q-Statistics is considered to show if there is any departure at different time lags from the zero serial correlation. The Q-Statistics is computed as follows:

$$Q = n(n+2)\sum_{k=1}^{h} \frac{\rho^2(k)}{(n-k)} \quad (4)$$

Where:

- n – The sample size or number of observation,
- h – Represents the number of lags,
- pk – The sample serial correlation at lag k. whilst, n is number of observations,
- Q – Statistic test is distributed from chi-squared with I degrees of freedom.

The null hypothesis implies that the sectoral indices are efficient, whereas the alternative hypothesis signifies that these indices are not efficient. Accordingly, the null hypothesis is rejected when the value of Q exceeds the critical value of Q from chi-squared X^2 distribution at a significant level for the degree of freedom. As a result, the null hypothesis shows insignificant autocorrelation and thus the market is weak form EMH. This entails that the series of data do not follow the random walk if the autocorrelation shows statistical significance. This is when the β1 is indicated with positive autocorrelation greater than zero and negative autocorrelation when less than zero. Both results signify appearance of autocorrelation and thus the sectoral indices tend to be inefficient, and the alternative hypothesis is accepted. The critical value of $Q30$ at 5% significance level is equals to (43.77).

Moreover, the Variance Ratio test represents the second implementation method, and it is confirmed by Lo and MacKinlay (1988). This method suggests that the variances of q-period returns are equals to the q interval the variance of one time return. It proposes that the market indices follow a random walk only if this assumption is applied. Thus, this test will be conducted on the sectoral indices prices returns listed in MSM30 index to examine the one period return, under assumption that it follow a random walk. The equation is computed as follows:

$$Var(p_t - p_{t-n}) = qVar(p_t - p_{t-n}) \tag{5}$$

This implies that the variance of n times returns equals to n period of the variance in respect to prior initial period return.

In terms of the multiple of periods, the variance can be calculated as follows:

$$VR(q) = \frac{Var(p_t - p_{t-n})}{qVar(p_t - p_{t-n})} = \frac{\sigma^2(q)}{\sigma^2(1)} \tag{6}$$

Where the:

$VR(q)$ – is the variance of log prices over the period from t to $t\text{-}n$,

$\sigma^2(q)$ – is the unbiased estimator of $\frac{1}{q}$ of the variance of the qth logged prices difference of $(p_t - p_{t-n})$.

Thus, the null hypothesis for weak-form efficiency suggests that $VR(q) = 1$ for all q. Hence the null hypothesis is rejected when the VR is significantly different than 1 which implies that if $VR(q) > 1$ then is it an indication of a positive serial correlation. According to Urrutia (1995), an existence of positive serial correlation is demonstrated in emerging markets, which indicates a growth signal of this market. On the other hand, the indices returns show negative serial correlation if the null hypothesis is rejected and the $VR(q) < 1$. Fama and French (1998) have explained that this situation reflects market indices prices correction efficiently in developed markets. While, Summers (1986) has suggested that this an indication of economic and market bubble in the emerging markets.

Lo and MacKinlay (1988) have developed two test statistics hypothetical asymptotic distribution over the estimated variance ratio. Thus, under assumption of null hypothesis, the $Z(q)$ represents the null hypothesis of homoscedasticity and $Z^*(q)$ is for heteroscedasticity. Smith (2007) extolls that the validity of heteroscedasticity is used to examine the random walk hypothesis in the financial markets in respect to returns volatility and time varying. Hence, if the null hypothesis is rejected, this may indicate the existence of heteroscedasticity or autocorrelation. However, the return of indices are serially correlated when the latter is rejected. The $Z(q)$ and $Z^*(q)$ can be computed as following equation:

$$Z(q) = \left(VR(q) - 1\right) / \left[\hat{s}^2(q)\right]^{1/2} \tag{7}$$

$$Z^*(q) = \left(VR(q) - 1\right) / \left[\hat{s}^{*2}(q)\right]^{1/2} \tag{8}$$

Where the $\hat{s}^2$ and $\hat{s}^{*2}$ are hypothetical asymptotic variances of the variance ratio test under the assumptions of homoscedasticity and heteroscedasticity, respectively.

With characteristics of infrequent trading existing in the Muscat Securities market, and Oman being defined as a developing country, Miller, Muthuswamy, and Whaley's (1994) recommendation for data adjustment for infrequent tradinghas been applied so that the results might be more accurate. The adjustments of infrequent trading days has been devised by computing the residuals as following equation:

$$R_t = \alpha_0 + \alpha_1 R_{t-1} + \epsilon_t \tag{9}$$

Therefore, using this equation to calculate the adjusted returns of non-trading days as following:

$$R_t^{adj} = \epsilon_t / (1 - \alpha) \tag{10}$$

In addition, this paper will further examine the existence of any Co-integration equilibrium long-run relationship between the selected three macroeconomic variables and the stock indices prices. Hence, this paper uses the Johansen co-integration test and vector correction model (VECM) to examine the co-integrating vectors between integrated time series. The Johansen co-integration test suggests that data must be non-stationary and this test can be run, only if all variables $X_{t\sim} I(1)$, $Y_{t\sim} I(1)$ and $Z_{n\sim} I(1)$, where *n* considering more data or variables are integrated of same order (1), thus after first difference the former becomes stationary, only then can the Johansen co-integration test be applied to unrestricted variables. This method also determines trends and estimates how many co-integrating vectors distinct the long-run equilibrium relationship between the variables; which means these variables move together in the long term, therefore:

$$\Delta X_t = A_t X_{t-1} + X_{t-1} + \in_i \tag{11}$$

Where X_t and $\in_i$ are $nx1$ vectors, whereas A_t is nxn matrix of *n* variables.

The raw data are applied to run the model for the second and third hypothesis; and then the trace and max tests are derived from the Johansen co-integration test are carried out to help identify whether there exists of co-integration long-run relationship between variables (Johansen and Juselius, 1990). Thus, the number of co-integrating vectors that are significantly different from zero are t tested through implementing trace and max test statistics methods which derived from Johansen test of co-integration, as follows:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} \ln\left(1-\hat{\lambda}_i\right) \tag{12}$$

$$\lambda_{\max}(r, r+1) = -T\ln\left(1-\hat{\lambda}_{r+1}\right) \tag{13}$$

Where $\lambda_i^{\wedge}$ indicates the estimated values of trace and max tests, *T* is the number of observation and *r* is co-integrating vectors against the alternative of $r + 1$.

Consequently, for any co-integrating vectors, the vector error correction model (VECM) is constructed[8]. This is in order to check the model specification of co-integrating vectors if the long-run relationship is existed between all variables from the first difference. The specification of the latter is verified and performed to obtain the significance of long-run relationship between the macroeconomic variables and the stock prices indices. The sample period used to conduct this test is over the monthly time period from 2010 to 2104. The following model is developed to test significance coefficients after determining the impact among macroeconomic variables on each indices prices, as following estimated equation:

$$\Delta P_i = \alpha_0 + \beta_{1(Oil\ prices)} + \beta_{2(CPI)} + \beta_{1(Inflation)} + \in i \tag{14}$$

Where the:

ΔP_i – The sample prices changes of *i* sectoral indices prices which are Financial, Industrial and Service as dependent variable,

α_0 – Represents the constant,

$\beta_{1\ (Oil\ prices)}$ = The slop or correlation coefficient for the oil prices as an independent variable,

$\beta_{2\ (CPI)}$ = The slop or correlation coefficient for the CPI as an independent variable,

$\beta_{1\ (Inflation)}$ = The slop or correlation coefficient for the inflation as an independent variable,

$\in i$ = The error term or residuals.

Correspondingly, the data is plotted based on the logarithmic scale, so that all variables are converted into natural logarithm; the reason is based on monthly statistics, all indices returns data are estimated. Gujarati (2014) has suggested this approach in order reduce the gap among the variables. Hence, the model considered for regression, is as follows:

$$\Delta Ln\left(P_i\right) = \alpha_0 + \beta_1 Ln\left(oil\ prices\right) + \beta_2 Ln\left(CPI\right) + \beta_1 inflation + \in i \quad (15)$$

Where Ln = the natural logarithm.

Therefore, the elasticities of estimated coefficients for the long run relationship between variables can be interpreted, since the four variables are transferred to natural logarithm.

5. RESULTS AND DISCUSSION

5.1. Descriptive Statistics

Table 1 presents the summary of descriptive statistics for all stock returns indices sectors listed in MSM30 index and macroeconomic variables, for the monthly sample period from January 2010 to December 2014. The number of observations is 60 for each variable. It shows that Financial Index return and inflation have negative mean of -0.2% and nearly -15%, correspondingly. The returns of Industrial and Service indices, as well as oil prices and CPI have a positive mean of 0.3%, 0.5%, 0.3% and 0.1%, respectively. The mean of all variables are very close to the median, which denotes there is no existence of outliers within the data. Thus, the mean is surmised to be an unbiased estimator for these variables. The monthly returns dispersion is measured by the standard deviation, which indicates how possible rates of return are volatile around the expected rate of return.

The Service sector index has the lowest standard deviation of approximately 4% compare to Financial and Industrial indices with nearly 5% and 4%, respectively. This implies that the Service sector index has a low risk compared to other indices sectors.

On the other hand, the outcome indicates that the oil prices variable has a positive mean return of 0.3%, while CPI and inflation have a positive of 0.1% and nearly negative

Table 1
Results of Descriptive Statistics for all stock indices returns and macroeconomic variables

Variables	*Mean*	*Median*	*Standard Deviation*	*Skewness*	*Kurtosis*
Financial	- .002	0.002	0.047	-1.294	2.826
Industrial	0.003	0.000	0.041	-0.182	0.291
Service	0.005	0.008	0.036	-0.042	0.398
Oil prices	0.003	0.006	0.047	-0.29	-0.072
CPI	0.001	0.000	0.012	5.331	33.051
Inflation	-0.155	-0.039	1.519	-5.197	34.194

This table shows the results of descriptive statistics for all stock indices returns listed in MSM30 index and macroeconomic variables, for the monthly period from January 2010 to December 2014.

of -0.2% mean returns, respectively. The CPI has the lowest standard deviation of 1% among macroeconomic variables and stock indices. This suggests that the CPI has a low risk compared to other variables.

In addition, Skewness is a measure of a distribution asymmetry degree of return series around it is mean. The former can come in different forms, whether zero, negative or positive. Skewness of normal distribution is zero, whereas positive value of skew means the data distribution is skewed to the long right tail, while the negative skew value implies the return series distribution has long left tail or skewed to the left of the average. Thus, it appears that the returns distribution for all indices have negative skewness. This implies the returns distributions are substantially concentrated on the left tail compare to the right tail of asymmetric distribution. This may demonstrate more probability of significant decline in indices returns compare to incline in returns, specifically in Financial sector index. The Financial sector has the highest skweness, -1.294 in comparison to other indices.

Moreover, the determination of peakedness or flatness of indices return series distribution is measured by the Kurtosis of a data distribution. The distribution is considered to be normal if the kurtosis value is equal to three, while the distribution is peaked if the kurtosis value is greater than three. However, the data distribution is considered to be flat if the kurtosis is less than three. As a result, all three indices series returns distribution shows kurtosis values of less than three. Therefore, the distribution tendency is to be flat, considerably more so in Service and Industrial sectors with 0.291 and 0.398, respectively, and less so with the Financial sector index exampling a skewness of 2.826 in contrast to symmetric distribution.

Consequently, the results show all macroeconomic variables have negative skewness except for CPI, which means the changes distribution of oil prices and inflation are considerably concentrated on the left tail rather than the right tail, while CPI changes are significant distributed on the right tail of asymmetric distribution. This denotes the degree the drop in oil prices and inflation has more probability in comparison to incline, while CPI changes signify more likelihood to increase compared to decline. Additionally, all three macroeconomic variables show kurtosis values significantly more than three, except for oil prices. Hence, the distribution tendency to be substantially peaked in CPI and inflation, whilst flatter on oil prices in contrast to symmetric distribution.

5.2. Results of monthly Serial Correlation Test for Financial Sector Index

Table 2 contains the results of the serial correlation test up to 30 lags using monthly arithmetic return of the Financial sector index over the period from January 2010 to December 2014.

The basic assumption is that the null hypothesis of weak form EMH is rejected if the Financial index returns are serially correlated. Thus, all lags correlation coefficients are not statistically significant at the 5% significant level in Financial sector index except for lags 10 and 20 are statistically significant at 10%.

Table 2
Results of monthly Serial Correlation Test for Financial Sector Index

Lags	*AC*	*Q-Stat*	*Probability*
1	-.0.017	0.018	0.897
2	-0.034	0.083	0.805
3	0.143	1.171	0.315
4	0.029	1.191	0.841
5	-0.113	1.864	0.440
6	0.115	2.938	0.441
7	-0.088	3.233	0.563
8	0.199	4.620	0.195
9	0.193	6.612	0.121
10	-0.279	10.465	*0.0751
15	-0.199	11.732	0.238
20	-0.347	16.923	*0.0617
25	-0.323	23.032	0.133
30	0.088	27.188	0.719

This table shows the results of autocorrelation test for Financial Sector Index returns up to 30 lags using monthly arithmetic return using Ljung and Box (1978) Q-Statistics for the period of January 2010 to December 2014. The *, **, *** represents the significance at 10, 5, and 1 per cent significance levels respectively.

Hence, the significance at 5% level of AC coefficients shows that the index returns series exhibit serial independence for all intervals. Thus, the null hypothesis of random walk is accepted. In this particular sample, the tendency of serial dependence for these lags shows the returns cannot be easily used to predict the future returns. On the other hand, the Q-Statistics exhibit that all Q values for all lags are lower than the critical value of 43.77. Thereby they are inside critical interval. Therefore, the Q-statistics confirm that the lags from 1 to 30 fail to reject the null hypothesis and thus the Financial index return has no autocorrelation. As a result, the Financial index return is efficient in efficient market hypothesis.

5.3. Results of monthly Serial Correlation Test for Industrial Sector Index

Table 3 demonstrate the results of autocorrelation test for Industrial sector index on the monthly period from 2010 to 2014. It appears at 5% significance level all correlation coefficients lags are statistically non-significant except for lag 3 is statically significant at 5% significance level and lags 9 and 10 are statistically significant at 10% significance level. This implies that the index return at the period of month 3, 9 and 10 can be used predict the future return.

Table 3
Results of monthly Serial Correlation Test for Industrial Sector Index

Lags	*AC*	*Q-Stat*	*Probability*
1	0.092	0.416	0.511
2	0.283	4.482	**0.042
3	0.018	4.565	0.900
4	0.023	4.885	0.874
5	0.072	4.981	0.873
6	0.073	5.456	0.628
7	0.004	5.484	0.980
8	0.216	8.166	0.158
9	0.288	11.891	*0.060
10	-0.269	12.582	*0.083
15	-0.015	13.537	0.931
20	-0.007	23.004	0.969
25	-0.007	30.764	0.725
30	-0.077	38.316	0.964

This table shows the results of autocorrelation test for Industrial Sector Index returns up to 30 lags using monthly arithmetic return using Ljung and Box (1978) Q-Statistics for the period from January 2010 to December 2014. The *, **, *** represents the significance at 10, 5 and 1 per cent significance levels respectively.

However, the significance level are differs between those lags. In general, the serial-positive sign of autocorrelation coefficients at lags 3, 9 indicate that abnormal monthly returns tend to obtain the same sign. Thus, the successive return of current month will follow by increase of return in the following next few months. Conversely, the serial-negative sign of autocorrelation coefficient at lag 10 shows the declines in returns of the current month tend to have same sign. Hence, the decrease of index return in the current month will follow by decrease in next following few months. Thereby, the null hypothesis of serial independence is the null hypothesis of random walk is rejected only for lag 3 at 5% significance level, whereas it is accepted for the rest of lags. Therefore, this shows an evidence of serial independency on index returns and thus is efficient in EMH of monthly return for those lags.

Furthermore, the Q-Statistics signifies that all Q values for all lags are lower than 43.77 of critical value. Thus they are inside critical interval and insignificant at significant level of 5%. Therefore, the lags from 1 to 30 fail to reject the null hypothesis and thus the Industrial index return have monthly serial independence. As a result, the Financial index return follow random walk and is efficient in efficient market hypothesis. This implies the current month of index return cannot be easily used to predict future index returns.

5.4. Results of monthly Serial Correlation Test for Service Sector Index

Table 4 determines the results of monthly serial correlation test for Service sector index for the period from 2010 to 2014. This indicates that all lags coefficients at 5% significance level are statically non-significant except for lag 5 is statically significant at 1% significance level. This suggests that the index return at the period of month 5 can be used to predict the future return at only the 1% significance level. Generally, the serial-negative sign of autocorrelation coefficient at lag 5 exhibit the decrease in returns of the current month tend to result same sign. Hence, the decline of index return in the month 5^{th} expected to fall in next following few months. Thus, the index return at lag 5 have autocorrelation and it is not random. Therefore the null hypothesis of serial independence is rejected at 1% significance level. Thereby, this provides an evidence of serial dependency on index returns and thus is not efficient in EMH of monthly return on this lag. Whilst, the serial correlation of the index returns are substantially shows non-significant for all monthly intervals at 5% significance level. This suggests that these intervals fail to reject the null hypothesis and the Service index is efficient in EMH.

Table 4
Results of monthly Serial Correlation Test for Service Sector Index

Lags	*AC*	*Q-Stat*	*Probability*
1	-0.099	0.612	0.452
2	0.097	1.311	0.470
3	0.164	2.421	0.232
4	-0.067	2.896	0.629
5	-0.367	7.996	***0.008
6	0.041	8.913	0.777
7	0.035	9.853	0.810
8	0.113	9.880	0.449
9	-0.035	9.939	0.815
10	-0.073	9.984	0.633
15	0.086	11.417	0.596
20	-0.133	19.294	0.467
25	-0.200	21.198	0.345
30	-0.132	22.286	0.579

This table shows the results of autocorrelation test for Service Sector Index returns up to 30 lags using monthly arithmetic return using Ljung and Box (1978) Q-Statistics for the period from January 2010 to December 2014. The *, **, *** represents the significance at 10, 5 and 1 per cent significance levels, respectively.

The Q-Statistics indicates that the critical value 43.77 is greater than the Q values for all lags. Thus, the latter are inside critical interval and thereby non-significant at significant level of 5%. Therefore, the Q-Statistics confirm the autocorrelation does not exists for the monthly lags from 1 to 30 and null hypothesis is rejected. Hence, the Service sector index follow random walk and is efficient in efficient market hypothesis. This demonstrates of inability to predict the future index returns using the historical lags.

5.5. Results of monthly Variance Ratio Test for Financial Sector Index

Table 5 determines the results of the monthly variance ratio test up to 25 lag orders using of Financial sector index returns under assumptions of homoskedasticity and heteroskedasticity, which are presented for the sample the period of January 2010 to December 2014. Correspondingly, the null hypothesis of weak form EMH is rejected if the variance rations of Financial index returns are different than one under those assumption. Thus, it demonstrates from the results of variance ratio test under assumption homoscedasticity that z-statistics shows the values of (q) at 5% significance level are considerably different than one for all lags 6, 8 and 9, and for lags 4, 5, 6 under assumption of heteroskedasticity. Therefore, under both assumption, the null hypothesis is failed to be accepted for Financial sector index, which signifies the returns is serially correlated and it does not follow a random walk process. The rejection of random walk process due to the monthly index returns suffers from heteroskedasticity and autocorrelation. Thus, the index is inefficient in efficient market hypothesis.

Table 5
Results of monthly Variance Ratio Test for Financial Sector Index

Homoskedasticity	*Heteroskedasticity*				
Lags	*Variance Ratio*	*Z-Statistics*	*Probability*	*Z-Statistics*	*Probability*
2	0.509	-3.737	***0.000	-2.673	***0.007
3	0.277	-3.659	***0.000	-2.790	***0.005
4	0.238	-3.046	***0.002	-2.291	**0.022
5	0.212	-2.655	***0.008	-2.079	**0.038
6	0.141	-2.553	**0.011	-2.067	**0.039
7	0.171	-2.275	0.229	-1.866	*0.062
8	0.118	-2.230	**0.023	-1.820	*0.069
9	0.096	-2.093	**0.036	-1.414	0.157
10	0.155	-1.770	*0.077	-1.606	0.108
15	0.082	-1.449	0.147	-1.414	0.154
20	0.075	-1.177	0.239	-1.214	0.225
25	0.081	-1.160	0.246	-1.153	0.249

This table shows the results of monthly variance ratio test for Financial Sector Index returns, conducted up to 25 lag orders using Lo and MacKinlay (1988) under homoskedasticity and heteroskedasticity, for the period from January 2010 to December 2014. The *, **, *** represents the significance at 10, 5 and 1 per cent significance levels respectively.

5.6. Results of monthly Variance Ratio Test for Industrial Sector Index

Table 6 presents the results of the monthly variance ratio test performed up to 25 lag orders. The returns for the sample period from January 2010 to December 2014 is used to perform the variance ratio test for Financial sector index under

Table 6
Results of monthly Variance Ratio Test for Industrial Sector Index

Homoskedasticity	*Heteroskedasticity*				
Lags	*Variance Ratio*	*Z-Statistics*	*Probability*	*Z-Statistics*	*Probability*
2	0.423	-4.392	***0.000	-3.331	***0.001
3	0.354	-3.270	***0.001	-2.552	**0.011
4	0.266	-2.937	***0.003	-2.299	0.215
5	0.228	-2.613	***0.009	-2.124	**0.034
6	0.181	-2.434	**0.015	-2.048	**0.040
7	0.182	-2.246	**0.025	-1.909	*0.056
8	0.124	-2.215	**0.027	-1.929	*0.054
9	0.097	-2.090	**0.036	-1.892	*0.058
10	0.155	-1.769	*0.077	-1.684	*0.092
15	0.098	-1.425	0.154	-1.427	0.153
20	0.096	-1.150	0.250	-1.185	0.236
25	0.163	-1.051	0.293	-1.100	0.271

This table shows the results of monthly variance ratio test for Industrial Sector Index returns, performed up to 25 lag orders using Lo and MacKinlay (1988) under homoskedasticity and heteroskedasticity, for the period from January 2010 to December 2014. The *, **, *** represents the significance at 10, 5 and 1 per cent significance levels respectively.

assumptions of homoskedasticity and heteroskedasticity. The z-statistics demonstrates all values of (q) at 5% significance level, the variance ratios are significantly different than one under both assumptions of homoskedasticity and heteroskedasticity. Therefore, the null hypothesis is rejected for Industrial sector index returns. Thus, the latter does not follow a random walk process over the sample period and has occurrence of serial correlation, which confirms the rejection of random walk process due to heteroskedasticity and hence the index is inefficient in efficient market hypothesis.

5.7. Results of monthly Variance Ratio Test for Service Sector Index

Table 7 shows the results of the monthly variance ratio test performed up to 25 intervals. The sample period from January 2010 to December 2014 is used to perform the variance ratio test for Service sector index returns under assumptions of homoskedasticity and heteroskedasticity. The z-statistics determines all values of (q) intervals under assumptions of homoskedasticity and heteroskedasticity, that variance ratios at 5% significance level are significantly different than one. This demonstrates the rejection of null hypothesis of random walk process for Service sector index returns. Thus, the sample period which implemented for the random walk test has occurrence of index returns are serially correlated. Hence, the index return does not follow a random walk process due to heteroskedasticity. Therefore, the index is inefficient in efficient market hypothesis.

Furthermore, in majority the z-statistics shows the values at all monthly intervals for variance ratios are significantly greater than one of the sampled period. This suggest that the presence of positive serial correlation of the index returns follow

Table 7
Results of monthly Variance Ratio Test for Service Sector Index

Homoskedasticity	*Heteroskedasticity*				
Lags	*Variance Ratio*	*Z-Statistics*	*Probability*	*Z-Statistics*	*Probability*
2	0.414	-4.460	***0.000	-3.375	***0.001
3	0.266	-3.716	***0.000	-2.892	***0.004
4	0.264	-2.943	***0.003	-2.315	**0.020
5	0.251	-2.535	**0.011	-2.046	**0.041
6	0.143	-2.547	**0.011	-2.115	**0.034
7	0.168	-2.285	**0.022	-1.898	*0.058
8	0.129	-2.202	**0.028	-1.861	*0.063
9	0.112	-2.055	**0.040	-1.797	*0.072
10	0.107	-1.869	*0.061	-1.688	*0.091
15	0.071	-1.467	0.142	-1.436	0.151
20	0.088	-1.160	0.246	-1.194	0.232
25	0.063	-1.178	0.239	-1.120	0.263

This table shows the results of monthly variance ratio test for Service Sector Index returns, performed up to 25 lag orders using Lo and MacKinlay (1988) under homoskedasticity and heteroskedasticity, for the period from January 2010 to December 2014. The *, **, *** represents the significance at 10, 5 and 1 per cent significance levels respectively.

the process of mean aversion (Grieb and Reyes, 1999). According to research by Urrutia (1995) this indicates that the mean aversion of the indices stock returns are explained as a growth sign in indices stock returns, which does appear in emerging markets.

5.8. The monthly results of Johansen long-run co-integration test and vector error correction model (VECM) for all three macroeconomic variables and the Financial Index prices

Table 8 demonstrates the monthly results of Johansen long-run co-integration method which exists of one co-integrating equations. Commonly, the process performed on raw data over the sample monthly period from 2010 to 2014 for the all four variables and selecting lag 2 of level intervals in the first differences. The lag order selection based on the minimum scale criteria of Akaike criterion (AIC) and Hannan-Quinn criterion (HQC) with 26.396 and 26.894, respectively. The multivariate tests of co-integrating says that the null hypothesis of no co-integration is rejected which states the model is not stationary if the p-value is less of 5% significance level and accepted if it is greater than 5%. Hence, the p-value of trace and max tests is approximately 4% which is less than 5% significance level. This implies to reject the no co-integration relationship. While the p-value of both tests are greater than 5% significance level which means to accept the null hypothesis which obtain there at least an existence of one co-integration long-relationship between all three macroeconomic variables and the Financial index prices. Which means the model possess one error term. Therefore, the VECM model will be constructed to obtain the significance relationship between the three macroeconomic variables and the Financial index prices.

Table 9 demonstrates the monthly results of vector error correction model (VECM) performed for lag 2 of level intervals in the first differences; for the target equation variable of Financial index prices as dependent variable and oil prices, CPI and inflation variables as independent variables. The results show the adjustment effect of each macroeconomic variables to Financial index prices are varied towards long-term equilibrium relationship. The adjusted coefficient of oil prices signifies positive relationship with Financial index prices. In other word, the positive changes in oil prices of one unit leads to increase in prices of Financial index approximately of 5%. While the adjusted coefficients have negative signs of CPI and inflation, which indicates that the one unit increase of CPI and inflation leads to decrease of Financial index prices of nearly twice and 0.8%, respectively.

Table 8
The monthly results of Johansen co-integration test for Financial index prices

Rank	*Eigenvalue*	*Trace Test*	*p-value*	*Max test*	*p-value*
0*	0.0387	49.001	0.037	28.427	0.036
1	0.169	20.574	0.396	10.735	0.681
2	0.126	9.839	0.299	7.837	0.404
3	0.034	2.002	0.157	2.002	0.157

This table shows the outcome of Trace and Max tests indicates 1 co-integrating equations at the 0.05 significance level. * Signifies rejection of the null hypothesis at the 0.05 level. The information criteria of AIC and HQC are 26.396* and 26.894*, respectively for selected lag order.

Table 9
The monthly results of vector correction model
(VECM) for the targeted equation of Financial index prices

	Coefficient	*std. error*	*t-ratio*	*p-value*
Const	**-0.0612	0.028	-2.213	0.031
D_Ln(FIP)_1	0.0802	0.126	0.635	0.529
D_Ln(OP)_1	0.0463	0.137	0.337	0.737
D_Ln(CPI)_1	***-2.2365	0.570	-3.922	0.000
D_Inf_1	-0.0078	0.006	-1.331	0.189
EC1	**-0.1452	0.066	-2.187	0.033
	R-squared: 0.297		Adjusted R-squared: 0.230	

This table exhibits the results of vector error correction model (VECM) of lag order 2 for the targeted equation of Financial index prices and the three macroeconomic variables, the *, **, *** represents the significance at 10, 5 and 1 per cent significance levels respectively. The dependent variable is the Financial Index prices, here (D) is the difference of D times to be integrated from first order to make it stationary, Ln stands for natural logarithm, FIP is the Financial index prices, OP is the oil prices, CPI is the consumption index prices, Inf. stands for inflation, 1 interval refers to lagged order and EC1 is the error term of one period lagged of residual.

This means the higher CPI is more severe in inflation. Thus, both factors have negative impact and inverse relationship to Financial index prices. The error correction of coefficient is about –15% which suggests the differences between long run and short term that is corrected within monthly in the equation of Financial index prices. In which, this signifies a modest rate of adjustments to the long term balance relationship among variables. On the other hand, the results determines that the oil prices have significant effect on the Financial index prices, that is because of p-value of oil prices factor equals to 74% is significantly greater than 5% significance level. Considering the p-value of the inflation factor is statistically significant at 5% significance level, which implies that this factor has strong relationship to the Financial index prices, but less compared to the factor of oil prices.

Whereas, the p-values of CPI shows less than 5% significance level which mean that CPI is non-significant at 5% significance level, which implies the null hypothesis for lag 2 is rejected for the CPI and accepted for the oil prices and inflation factors. Furthermore, this specifies that Financial index prices is considerably affected and has significant impact by oil prices in comparison to the inflation factor, whilst CPI factor have no influence to Financial index prices in the long term balance relationship. The R square of the model statistically obtains 30%, which means that 30% of variability in Financial index prices can be explained by the differences in macroeconomic variables. The adjusted R square is equal to 23%. Hence both measures suggests that R square quite modest to fill the desirable of this model. Thus, the estimated long run stable relationship of targeted model for Financial index prices is applied as following:

$$\Delta L_n\,(FIP)_1 = -0.0612 + 0.0463\,Ln(OP) - 2.2365\,Ln\,(CPI) - 0.00784\,Inf - 0.1452 \qquad (16)$$

5.9. The monthly results of Johansen long-run co-integration test and vector error correction model (VECM) for all the three macroeconomic variables and the Industrial Index prices

Table 10 shows the results of Johansen long-run co-integration method which determine an existence of one co-integrating equations. The sample raw data is applied for all four selected variables over the monthly period from 2010 to 2014. The 6 level intervals is chosen from the first differences. In this study, the author faced limitation and barriers in lag interval selection criteria. However, in order to prevent any biases in this study. The author decided to overcome this issue by selecting lag order basis on upper scale criteria of Akaike criterion (AIC) and Hannan-Quinn criterion (HQC) with 26.733 and 28.153, respectively.

The results show that p-value of both trace and max tests are nearly 2% which is less than intervals of 5% significance level; and thus it is non-significant at significance level of 5%. Hence, the null hypothesis which states of no co-integration is rejected. Whilst the second null hypothesis at rank 1 which indicates there at least one co-integration long-run relationship between all variables; thus both multivariate tests of co-integrating shows the p-value of trace and max tests are greater than 5% significance level.

Therefore, both tests fail to reject the null hypothesis, which implies an existence at least of one co-integration and thus the series exhibits linear combination of a long run balance relationship between all three variables and the Industrial index prices.

Table 10
The monthly results of Johansen co-integration test for Industrial index prices

Rank	*Eigenvalue*	*Trace test*	*p-value*	*Max test*	*p-value*
*0	0.426	52.414	0.016	29.942	0.021
1	0.228	22.471	0.282	14.001	0.379
2	0.126	8.470	0.424	7.288	0.464
3	0.022	1.183	0.277	1.183	0.277

Note: the information criteria of AIC and HQC are 26.153, respectively for selected lag order.
This table shows the results of Trace and Max tests indicates 1 co-integrating equations at the 0.05 significance level. * Signifies rejection of the null hypothesis at the 0.05 level.

This entails that one error term is existed in this model. Hence, the VECM model will be used to obtain the long-run relationship between the coefficients of macroeconomic variables and the Industrial index prices.

Table 11 exhibits the monthly XI of VECM conducted for the equation targeted for the Industrial index prices as dependent variable and oil prices, CPI and inflation variables as independent variables. The 6 interval level is selected from the first differences. The results determine the adjustment effect towards long-term balance relationship differs among macroeconomic variables to the Industrial index prices. The adjusted coefficient sign of oil prices indicates positive sign, which means one unit positive change in oil prices may cause Industrial index prices increase about 8%. Conversely, the long run relationship between CPI and inflation shows a negative sign to the latter, which specifies an existence of inverse long run stable relationship. This suggests that one unit positive change in these factors could lead to decrease the investments prices in Industrial index sector to 67% and nearly 2%, respectively. Correspondingly, the error correction of coefficient is about -1% which reflects the differences between long run and short term that is adjusted within a monthly in the equation of Industrial index prices. As a matter of fact, this suggests a low rate of adjustments to the long term equilibrium relationship between all variables.

On the other hand, the results showing the impact of the long run equilibrium relationship between macroeconomic variables and the Industrial index prices are varied. The oil prices factor have shown that it has the most significant impact on the latter compared to the CPI variable at 5% significant level. While the first difference coefficient of inflation variable is non-significant at 5% significance level. Thus, at lag 6 interval level, the null hypothesis is accepted for all macroeconomic variables accept for inflation, as this variable has low effect on the Industrial index prices. The R square of the model statistically shows 54%, which signifies that nearly 54% of differences in Industrial index prices can be explained by the changes in macroeconomic variables. The adjusted R square is about 24%.

Thus, both measures proposes that R square quite good fit to fill the desirable of this model. Therefore, the estimated co-integrating vectors of long-term equilibrium relationship for targeted model of Industrial index prices is applied as following:

Table 11
The monthly results of VECM for the targeted equation of Industrial index prices

	Coefficient	*std. error*	*t-ratio*	*p-value*
Const	-0.2615	1.853	-0.141	0.889
D_Ln(IIP)_1	0.2944	0.196	1.503	0.143
D_Ln(IIP)_2	0.0222	0.191	0.116	0.908
D_Ln(IIP)_3	0.1570	0.198	0.794	0.433
D_Ln(IIP)_4	-0.0930	0.192	-0.485	0.631
D_Ln(IIP)_5	0.2067	0.169	1.227	0.229
D_Ln(OP)_1	0.0756	0.211	0.357	0.723
D_Ln(OP)_2	-0.2166	0.170	-1.271	0.213
D_Ln(OP)_3	0.1821	0.165	1.107	0.277
D_Ln(OP)_4	-0.1034	0.156	-0.661	0.513
D_Ln(OP)_5	-0.1973	0.143	-1.376	0.179
D_Ln(CPI)_1	-0.6725	0.766	-0.877	0.387
D_Ln(CPI)_2	0.3947	0.730	0.541	0.592
D_Ln(CPI)_3	0.3695	0.697	0.530	0.600
D_Ln(CPI)_4	-0.0078	0.747	-0.010	0.992
D_Ln(CPI)_5	-0.0455	0.649	-0.070	0.945
D_Inf_1	**-0.0158	0.008	-2.077	0.046
D_Inf_2	0.0079	0.007	1.129	0.268
D_Inf_3	-0.0118	0.007	-1.623	0.115
D_Inf_4	0.0029	0.007	0.431	0.670
D_Inf_5	0.0058	0.006	1.027	0.312
EC1	-0.0107	0.076	-0.142	0.888
	R-squared: 0.538		Adjusted R-squared 0.235	

This table exhibits the results of vector error correction model (VECM) of lag order 6 for the targeted equation of Industrial index prices and the three macroeconomic variables, the *, **, *** represents the significance at 10, 5 and 1 per cent significance levels respectively. Where (D) is the difference of D times to be integrated from first order to make it stationary, Ln stand for natural logarithm, IIP refers to Industrial index prices, OP is the oil prices, CPI is the consumption index prices, Inf. stands for inflation, 1 to 5 intervals are the lagged orders and EC1 is the error term of one period lagged of residual. Dependent Variable: Industrial index prices

$$\Delta L_n\,(IIP)_1 = -0.2615 + 0.0756\,Ln(OP) - 0.6725\,Ln\,(CPI) - 0.0158\,Inf - 0.0107 \quad (17)$$

5.10. Results of Johansen long-run co-integration test and vector error correction model for all the three macroeconomic variables and the Service Index prices

Table 12 denotes the monthly results of Johansen co-integration test for long run which arise one co-integrating equations. The sample raw data is implemented for all four selected variables. The 7 lag order is selected from the first differences. In this research, the author faced limitation and barriers on one of selection criteria of choosing the lag interval. Nevertheless, in order to prevent any biases in this study. The authors decided to base the lag order selection on upper scale criteria of Hannan-Quinn criterion (HQC) with 25.270, while Akaike criterion (AIC) obtains a minimum scale of 23.612.

Table 12
The monthly results of Johansen co-integration test for Service index prices

Rank	*Eigenvalue*	*Trace test*	*p-value*	*Max test*	*p-value*
**0	0.514	71.510	0.000	38.221	0.001
1	0.320	33.290	0.018	20.470	0.061
2	0.154	12.820	0.122	8.889	0.303
3	0.071	3.932	0.047	3.932	0.047

Note: The information criteria of AIC and HQC are 23.612* and 25.270, respectively for selected lag order. This table exhibit the outcome of Trace and Max tests. It shows 1 co-integrating equations at significance level of 0.05 by Max test, while it signifies non co-integration equations at 0.05 significance level by Trace test. ** Signifies rejection (acceptance) of the null hypothesis at the 0.05 significance level, by Max and Trace tests, respectively.

The results are varied from the trace and max tests. The p-value of trace test shows that the null hypothesis of no co-integration is rejected, because the p-value is inside the interval level of 5% significance level, whereas the null hypothesis is rejected for at least an existence of one co-integrating equations, as the p-value is still inside the interval level of 5%. This implies that the there is no co-integrating log run equilibrium relationship between all variable. As a result, the model cannot run by VECM to get the vector co-integrating and thus in order to obtain the long run relationship between variables.

The max test, however, shows that the p-value for the non-co-integration is rejected because it is less than significance level of 5%, whereas the p-value is slightly greater than 5% significance level, which entails to accept the null hypothesis that guidelines with an existence of at least one co-integration equilibrium relationship between all variables.

This means that there is one error term existed in this model. Therefore, according to the results obtained by max test, the Johansen co-integrating model can be run by constructing the VECM model and thus to signify the relationship between the three macroeconomic variables and the Service index prices.

Table 13 shows the monthly results of VECM conducted for the equation targeted for the dependent variable which is the Service index prices and independent variables which are oil prices, CPI and inflation. The 7 interval level is selected from the first differences. The results denote the adjustment effect towards long-run balance relationship. The positive sign of adjusted coefficient of oil prices indicates positive change, it would be worth that expressing of one unit increase in oil prices could cause the stocks in Service index prices to increase 24%.

Conversely, the long run balance relationship between CPI and inflation shows a negative sign to the latter. Which means any increase of one unit in these factors could help decrease the stock prices in Service index sector to 95% and 1%, respectively. Additionally, the error term correction of coefficient is about –8% which states the discrepancy between long run and short term that is justified within a monthly in the equation of Service index prices.

Table 13
The monthly results of VECM for the targeted equation of Service index prices

	Coefficient	*std. error*	*t-ratio*	*p-value*
Const	-2.1235	2.235	-0.950	0.351
D_Ln(SIP)_1	0.0950	0.219	0.433	0.668
D_Ln(SIP)_2	0.1087	0.184	0.591	0.559
D_Ln(SIP)_3	0.1926	0.181	1.064	0.297
D_Ln(SIP)_4	-0.1566	0.159	-0.987	0.332
D_Ln(SIP)_5	0.2810	0.172	-1.634	0.114
D_Ln(SIP)_6	0.1560	0.157	0.992	0.330
D_Ln(OP)_1	0.2414	0.195	1.238	0.227
D_Ln(OP)_2	-0.2379	0.161	-1.481	0.150
D_Ln(OP)_3	*0.2926	0.159	1.842	0.077
D_Ln(OP)_4	-0.0392	0.128	-0.306	0.762
D_Ln(OP)_5	-0.1277	0.122	-1.051	0.303
D_Ln(OP)_6	-0.0451	0.126	-0.359	0.722
D_Ln(CPI)_1	-0.9575	0.662	-1.447	0.160
D_Ln(CPI)_2	-0.8690	0.651	-1.334	0.193
D_Ln(CPI)_3	-0.3523	0.661	-0.533	0.598
D_Ln(CPI)_4	-0.7950	0.649	-1.225	0.231
D_Ln(CPI)_5	-0.1977	0.648	-0.305	0.763
D_Ln(CPI)_6	-0.8953	0.572	-1.565	0.129
D_Inf_1	*-0.0103	0.006	-1.839	0.077
D_Inf_2	0.0046	0.006	0.708	0.485
D_Inf_3	0.0073	0.005	1.404	0.172
D_Inf_4	-0.0002	0.005	-0.041	0.968
D_Inf_5	0.0012	0.004	0.270	0.789
D_Inf_6	-0.0028	0.004	-0.662	0.513
EC1	-0.0826	0.087	-0.955	0.348
	R-squared: 0.686		Adjusted R-squared: 0.395	

This table demonstrates the results of vector error correction model (VECM) of lag order 7 for the targeted equation of Service index prices and the three macroeconomic variables, the *, **, *** represents the significance at 10, 5 and 1 per cent significance levels respectively. Where (D) is the difference of D times to be integrated from first order to make it stationary, Ln stand for natural logarithm, SIP refers to Service prices index, OP is the oil prices, CPI is the consumption index prices, Inf. stands for inflation, 1 to 6 are the lagged orders and EC1 is the error term of one period lagged of residual.

On the other hand, all macroeconomic variables have shown significance impact on the latter. The impact, however, remains diverse among the variables. The p-value for oil prices demonstrates greater impact on the Service index prices, whereas inflation obtains less effect. In contrast, the CPI factor has observes low influence among other macroeconomic variables to the Service index prices. However, it is still significant at 5% significance level.

Therefore, at lag 7 interval level, the null hypothesis is accepted for all macroeconomic variables which specifies that the macroeconomic variables have significance influence on the Service index prices in the long-run balance relationship. The model statistically obtain high R square around 69%, which signifies that approximately 69% of changes in Service index prices can be explained by the variability in macroeconomic variables. The adjusted R square is about 40%. Thus, the former and the latter measures suggest that R square rate is a good fit to fill the desirable of this model. As a result, the estimated co-integrating vectors long term stable relationship of targeted model for Service index prices is applied as following:

$$\Delta L_n\,(SIP)_1 = -2.1235 + 0.2414\,Ln(OP) - 0.9575\,Ln\,(CPI) - 0.0103\,Inf - 0.0826 \qquad (18)$$

6. CONCLUSION

This research ultimately considers and examines the 'random walk' theory and investigates the 'weak form' market efficient hypothesis of the Financial, Industrial and Service indices returns which are listed in the MSM30 index, over the monthly data period from January 2014 to December 2014.

Tests are conducted to measure the 'weak form' market efficiency of these indices, and of these, there are serial correlational variants and variance ratio tests. Consequently, both tests are parametric, which is the most appropriate method for testing normal distributed data. This area however, could be one of the limitations of the study, as other studies have used non-parametric tests in order to examine the 'weak form' market efficiency.

Overall results of this study exhibit a clear reference of co-integrating relationships among the variables. The results infer that indices prices are predictable based on historical information and other macroeconomic factors. Therefore, based on such inference, investors do and will have a chance to outperform the stock indices and thus gain profit above market average through use of information regarding macroeconomic variables in order to improve the prediction of the indices prices. Concluding thus is the inherent finding sought for, that the stock indices of Financial, Industrial and Services listed in MSM30 are inefficient in the 'weak form' of market efficiency.

NOTES

1. The Muscat Securities Market (MSM) was founded in 1988. It lists over 152 companies coming from Financial, Industrial and Service indices sectors. The market capitalization posted its highest record in 2014, reaching OMR 14.560 billion over OMR 14.160 billion in 2013 (Muscat Securities Market, 2015).
2. Investment decisions are aided thus: attempts to find mispriced assets have no benefit in an efficient market. In the efficient market investors may decide to invest considerably in selecting passive management in one of the sector, over another. Alternatively, if the market is inefficient in a particular sector, it is an opportunity for the rational investor to use common analysis tools to outperform the market in order to achieve abnormal returns. In the inefficient market greater funds invested in active management of a particular sector which appears to be inefficient in EMH provides the opportunity to enhance returns adjusted with risk, by recognizing the misprices in securities, and thus short selling the overvalued securities and buying the undervalued securities.

3. The variance ratio and run tests methodology was developed by Beveridge and Nelson (1981).
4. The demonstration was rendered using multivariate vector auto regression, Johansen-Jueslius co-integration, Phillips-Perron and Kwiatkowski and Philips unit root tests, onmonthly data collected from January 1996 to December 2012.
5. This methodology was founded by Johansen and Juselius (1990).
6. Gujarati (2012) has defined time series as a set of data observations collected in different time intervals, every ten and five years, such as annually, monthly, weekly and daily.
7. The essential development of Q-Statistics was originated by Box and Pierce (1970).
8. The term (VECM) model term was first named by Sargan (1964) and later simplified by Engle and Granger (1987).

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