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Examination of the Weak Form Market Efficiency Using Daily Stock Returns in Five Europeans Stock Markets: China, France, Germany, UK and USA

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Abstract: *The random walk theory states that stock prices movement are unpredictable and follow a random unpredictable behaviour. Therefore, past stock prices movement are of no use to forecast future prices movements (Fama, 1970). This study examines the weak form market efficiency using daily stock returns from 2000-2014 in five Europeans stock markets namely; China, France, Germany, UK and USA. Data were obtained from the popular website yahoo finance in line with Johnson (2005). Tests conducted include 3913 as total number of observation. Several techniques were used to test for weak form market efficiency. The results of the autocorrelation shows that the null hypotheses of no serial correlation for China, Germany and France were all rejected in favour of the alternative hypotheses at 1st, 2nd, 3rd, and 4th lags while that of UK and USA provided evidence in support of the alternative hypotheses and rejected the null. The results of the Augmented Dickey Fuller tests for all series do not follow a random walk neither do they provided any sufficient evidences to support weak form market efficiency for all return series of all markets. However, the results of the variance ratio tests did not reject the null hypotheses of random walk for China and Germany, while that of France, UK and USA all rejected the null hypotheses of random walk and do not provide enough evidence in support of weak form market efficiency. Findings from the Martingale Difference Sequence tests shows a mixed results as the returns series for China and Germany could not reject the null hypotheses of being martingale while that of France, UK and USA all rejected the null in support of the alternatives. This study therefore, concludes that the empirical results for the five returns series in all the markets are mixed.*

Keywords: *Random walk theory, efficient market, stock prices movement, economic returns*

Introduction

The random walk theory and the Efficiency market hypothesis have received a monumental attention of academic writers particularly those in the area of finance and economics. The random walk theory states that stock prices movements are unpredictable and follow a random unpredictable behaviour. Therefore, past stock prices movement are of no use to forecast future prices movements. Capital market is considered to be efficient if it reacts immediately and accurately to all available information. Fama (1970) categories market efficiency into three forms: weak-form, semi-strong form and strong-form. Weak-form efficiency held an idea that no investor can be paid above usual economic return by developing trading policy based on past price or return information. If the market is weak form efficient, then stock price reacts so quickly to all past information, that no investor can make above usual return (higher than the market or the return on the S&P 500 index) by acting on this kind of information. Semi strong-form market efficiency is of the view that no investor can make/earn above economic profits

based on any public information that is available. If the market is semi-strong form efficient, then stock price reacts so quickly to all public Information that no investor can earn above usual return (higher than the market or the returns on the S&P 500 index) by acting on this kind of information. Strong-form efficiency theory states that no investor can earn above economic returns from using any information, public or private. If the market is strong form efficient, then stock price reacts so quickly to all information (public and private), that no investor can earn above usual return (higher than the market or the return on the S&P 500 index) by acting on this kind of information. "Because information is reflected in prices instantly, investors ought to only expect to obtain a normal rate of return.

The objective of this study is to investigate the random walk behaviour and the weak-form of efficiency of five European stock markets using daily data from 2000-2014 namely; UK, US, China, Germany and France using Autoregressive Correlation Function (ACF), strict random walk with Dickey-Fuller (DF) and Variance Ratio (VR), and Martingale Difference Sequence (MDS).

Literature Review

According to Ball (2009), efficient market hypothesis as formulated in economics and finance, was first conceived by Samuelson concurrently with Fama (1965) not fully understood until further developed by Fama (1970). According to Fama (1970), the primary responsibility of capital market is the distribution of ownership of the economy's capital stock. In broad terms, the best market is a market which prices provides accurate signals for resource allocation. That is, a market in which firms can make production and investment decisions, and investors can decide among the securities that represent ownership of firm activities with the assumption that security prices at any point in time, fully reflect all available information. A market in which prices always fully reflect available information is therefore, called "efficient market". This hypothesis suggests that properly anticipated prices fluctuate randomly. Using the hypothesis of 'rational expectations' and market efficiency, he was able to make obvious how yt+1 , the expected value of the price of a given asset at time t+1, is correlated to the preceding values of prices y0, y1, ...yt through the relation

$$E [y_{t+1} \; y_0, y_1, \ldots y_t] = y_t$$

Stochastic processes obeying the conditional probability given in the equation above are called martingales sequences (Das, 2011).

Ball (2009) opined that tests of the EMH involve studying the movement of information into market prices, which shows that various types of information could be expected to change or slightly not to be independent of changes in important asset pricing parameters such as interest rates, risk, risk premiums, and securities' risks. Based on his idea, when you think about the information contained in variables like tax rates, investor demographics, technological change, and labour productivity, very little is known about how such variables change over time, or the implications of their development for the time series behaviour of expected return in an efficient priced market.

Bayraktar (2012) maintained that the main idea of the Efficient Market Hypothesis is that if information is not choked-up and if it is quickly reflected by stock prices, then tomorrow's price changes would reflect tomorrow's information's and would be independent of today's price changes. In addition, if news may be estimated, then price changes may not be estimated and

they are incidental. When prices completely reflect information, investors who may not access information and purchase a diversified portfolio from the market may also obtain return as much as it's been obtained by experts (Malkiel, 2003).

Most empirical studies have concentrated on the weak form, which is the bottommost level of the three types of EMH identified because if the proof miss the mark or fail to back the weak-form of market efficiency, it is not essential to inspect the EMH at the severer levels of semi-strong and strong form (Gimba, 2012). For instance, the empirical evidence obtained from studies of Gimba (2012) is mixed. While some results shows that the null hypothesis be rejected of the weak form market efficiency, other evidence support the weak form of EMH. In a broader sense, the studies found that emerging stock markets are doubtful to be efficient in weak form perhaps due to their intrinsic characteristics, such as low liquidity, thin and infrequent trading, and inadequate skills of market participants.

According to Ntim , Opong and Danbolt (2007), an empirical re-examination of the Weak Form Efficient Markets Hypothesis of the Ghana Stock Market using Variance-Ratios Tests indicate that return series of the All Share Index (ASI) is found to show positive serial dependence throughout the full period of examination while some individual stocks display negative autocorrelation. They therefore concluded that, the weak form efficiency market hypothesis is not only rejected in consistent with previous studies, but also theoretically not surprising. However, the result found by Ntim* , Opong, and Danbolt (2007) cannot be concluded generally that weak form efficiency market hypothesis is rejected because the study was only based or conducted using Ghana which is an underdeveloped or developing country. This study could give a different result if the study were to be conducted in a developed economy. The review of literature reveals that weak form efficiency in Indian stock market have been tested by many researchers, semi-strong form of efficiency has been tested by a small number of them, whereas strong form of efficiency has rarely been tested (Mishra, Misra and Rastogi 2012). According Mishra, Misra and Rastogi (2012), to determine whether day-to-day price changes follow a random walk, a test was run and has also been applied to S&P Nifty Index for the period of study and the results rejected the null hypothesis of randomness in return series of Nifty, being standardised value z significant at five per cent level of significance. Accordingly, their results partially confirm the absence of randomness by rejecting the null hypothesis related to the presence of randomness in return series.

It is a universal conviction that emerging markets are less efficient. This findings have been recognized in different studies e.g. Claessens, Dasgupta and Glen (1995), Jarrett & Sun (2009), Liu (2011), Bashir, Ilyas and Furrukh (2011), Chaity & Sharmin (2012). Laurence, Cai and Qian (1997) conduct tests for Weak-form Efficiency and Causality Tests in Chinese Stock Markets using a data of 1,000 daily observations for four Chinese stock market indices and one U.S. and one Hong Kong stock index. The indices considered were Shanghai "A" (SHA), the Shanghai "B" (SHB), the Shenzen "A" (SZA), the Shenzen "B" (SZB), Hong Kong stock exchange index (HK), and the Dow Jones industrial average (DJ) for the U.S. with all indices based on closing prices.

Using data obtained from Dow Jones News Retrieval Services and Datastream International covering the period of March 8, 1993, to October 31, 1996. The Ljung-Box test statistics shows the presence of significant serial correlation in the daily return series in all four Chinese markets. Some of the academic work undertaken by Hasanov and Omay (2007)

analysed the efficiency of the stock markets in Bulgaria, Czech Republic, China, Hungary, Poland, Romania, Russia and Slovakia, using the nonlinear unit root test. In this study, unit root in price series in the stock markets of Bulgaria, Slovakia, Hungary and the Czech Republic have been identified and resolved that these markets were efficient in the weak form. Another work conducted in this area by Choudhry (2001) analysed six Latin American states, which are Argentina, Brazil, Chili, Colombia, México and Venezuela, using the ADF unit root test for the period from January 1989 to December 1993, and inferred that these markets were efficient.

In the study of Borges (2008), the study tested market efficiency in the stock markets of France, Germany, the UK, Greece, Portugal and Spain, for the period from January 1993 to December 2007. Applying the correlation test, the ADF test and the Lo- Mackinley multivariate ratio test on the basis of daily and weekly data, accordingly revealing that weekly prices and returns were consistent with random walk theory.

Chaudhuri and Wu (2015) analysed stock markets in 17 developed countries using the ADF and PP unit root tests for the period from January 1985 to February 1997, on the basis of weekly data, and realized that these markets were efficient. However, the same stock markets was analysed using the SURADF panel unit root test for the period from January 1985 to April 2002, on the basis of weekly data, and arrived at a conclusion that these markets were not efficient. This therefore indicate that given a different set of tests using SURADF panel unit root test as tested above, in both developed and developing economies could produce a result similar to Chaudhuri and Wu (2015) that the market are efficient or not. Since this study was conducted in developed countries, an attempt could be made using a set of developing countries. According to Narayan (2007) analysed the stock markets of the G7 countries using one and two break panel LM unit root test on the basis of weekly data covering the period from January 1975 to April 2003 and identified inefficient market findings. In another different study of conducted by him, using the ADF unit root test on the basis of weekly data, Narayan (2001) realized that the stock prices in Australia and New Zeeland were consistent with the efficiency market hypothesis. Narayan and Smith (2008) performed a test of random walk theory by using different unit root tests in the G7 countries on the basis of weekly stock market data, using different time sequence for each country, and the result support the random-walk hypothesis in these markets. Market efficiency is a mere theory and he who rely solely on it, is only a supporter of such theory without clear proved Lean and Smyth (2008). Kawakatsu and Morey (1999) make analysis of the stock market of 16 developing countries and the result shows that these markets were inefficient. This suggests that both the developed and developing countries are not an exception of the market inefficiency. The studies conducted by LEE, TSONG and LEE (2014) reveals that the real stock prices in different countries present a mixture of I(0) and I(1) processes, and there is weak evidence to support the stationarity of stock prices.

According to Jarrett (2008), the study conducted to clarify the existence of time series characteristics of daily stock prices of securities marketed on the Hong Kong exchanges and clearing limited indicate considerably the existence of time series components in closing prices of a randomly selected set of firms traded on the third largest Asian stock exchange.

Again, the empirical findings from the variance ratio test by Alimovz, Chakraborty, Cox, and Jain (2004), suggested that stocks on the Bombay Stock Exchange follow a random walk process. Their findings from Lo and Mack inlay's variance ratio test support the random walk process on the Bombay stock exchange. However, they found BSE 500 stock to indicate stationary. Alimovz *et al.,* (2004) argue that the refusal of the random walk hypothesis would not

essentially imply the refusal of market efficiency. Thus, refusal of the random walk hypothesis in a given market can only mean that the findings are unreliable with the particular Martingale process of a random walk. They therefore, conclude that a possible explanation of the rejection of a random walk hypothesis is market limitation arising from suboptimal information transparency, which prevents proper spreading of information among investors. According to his empirical study undertaken to examine EMH at the weak form level of Amman stock Exchange (ASE) using daily observations for the period of 2000-2013, Ananzeh (2016) found that the result of serial correlation reject the existence of the random walks in daily returns of the ASE, and the unit root tests was also found to be have the return series of ASE to be stationary and efficient at the weak form level with stock return series on ASE also random. This is in line with Abeysekera (2001), Abraham (2002), and Borges (2010). The study also concludes that the inefficiency in ASE at weak form level could be due to lack of transparency and accountability, poor regulatory framework as well as corporate governance.

Data and Methodology

This study tests the weak form market efficiency of five Europeans countries namely; China, France, Germany, UK and USA using daily closing stock returns for the period 2000-2014 taking into consideration, the days of the weekend in which case, the markets are not expected to be open . The data used for this study were obtained from the popular website yahoo finance. In line with Johnson (2005), these data were transformed using log transformation log return= Ln(yt)-Ln(yt-1). These tests include 3913 as total number of observation. Empirical studies utilize several techniques to test for weak form market efficiency.

This study follows previous empirical work and employ the most common statistical and econometric methods used in the recent literature. The autocorrelation tests was conducted to detecting the randomness of the stock returns. Autocorrelation (serial correlation coefficient) which measures the relationship between the stock returns at current period and its value in the previous period (Gimba, 2012). Augmented Dickey-Fuller (ADF) and Variance Ratio test were performed. Variance Ratio test is used to test the hypotheses of random walk and martingale. The Augmented Dickey-Fuller (ADF) test was employed to determine the order of integration of stock returns, while the variance ratio test is based on the assumption that the variance of increments in the random walk series is linear in the sample interval. Specifically, if a series follows a random walk process, the variance of its q-differences would be q times the variance of its first differences (Johnson, 2005) natural logarithmic transformation is performed for the primary data. To generate a time series of continuously compounded returns, daily returns are computed as follows:

$$rt = \log(pt) - \log(pt-1) = \log(pt/pt-1)$$

Where pt and pt-1 are the stock prices at time t and t-1

This test was developed by Cochrane (1988) and Lo and Mackinlay (1988, 1989) for testing the randomness of stock prices. The VR approach has gained popularity and has become the standard tool in random-walk testing. According Lo and Mackinlay (1988), the variance ratio test is more powerful than the unit root test and that the variance of the random walk increments must be linear function of a time interval (q). Specifically, if a series follows a random walk

process, the variance of its q-differences would be q times the variance of its first differences. The VR is with following:
Var(pt-pt-q) = qVar(pt-pt-1)
Where q, is a positive integer.
This is a very good section that provides a reader with a clear methodology of the tests that will be conducted.

Empirical Application

Table 1: Descriptive Statistics for Stock Price Index of China, France, Germany, UK and USA stock markets

	DCHINA	DFRANCE	DGERMANY	DU_K	DUSA
Mean	0.000109	0.000108	-6.70E-05	-0.000242	7.85E-05
Median	0.000000	-0.000241	-0.000701	-0.000858	0.000260
Maximum	0.094010	0.094715	0.074335	0.067348	0.109572
Minimum	-0.092561	-0.105946	-0.107975	-0.074620	-0.094695
Std. Dev.	0.015252	0.015032	0.015439	0.010906	0.012741
Skewness	-0.088480	-0.026420	-0.013739	0.323467	-0.184365
Kurtosis	7.891270	7.884530	7.358431	6.892527	11.29785
Jarque-Bera	3779.034	3764.139	2996.726	2456.213	10883.21
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	0.412345	0.407695	-0.253756	-0.916616	0.297157
Sum Sq. Dev.	0.880513	0.855303	0.902235	0.450189	0.614388
Observations	3786	3786	3786	3786	3786

Table 1 above shows that the returns are negatively skewed for China, France, Germany and USA, even at first difference level while that of UK has a positive skewedness. This suggest that large negative returns for the four stock markets with negative skewedness indicated above are likely to be larger than the higher positive returns. The level of kurtosis is higher than **3**. The negative skewness indicates that the stock index returns are flatter to the left compared to the normal distribution. However, negative skewness and higher kurtosis indicate that there is a strong departure from normality in the unconditional distribution of returns. The Jarque-Bera statistics reject the hypothesis of normal distribution of returns at a significant level of 1%.

Autocorrelation tests.

The first approach to detecting the random walk of the stock returns is the autocorrelation test. Autocorrelation (serial correlation coefficient) measures the relationship between the stock returns at current period and its value in the previous period (Gimba, 2012). E.g. $\alpha = 0$, $\beta \neq 0$ for H0 and H1 respectively.

Autocorrelation Function (ACF) Test for China.

Hypotheses:

H0: Series is a random walk (no serial correlation).

H1: Series is not random walk (serial correlation).

To test the weak form of EMH of the China stock market, first the autocorrelation test with 20 lags were performed. The result shows that the null hypothesis is to be accepted with consequent rejection of the alternative hypothesis. This is so because p-value for the first four lags are all greater than 5% level of significance with lag 1^{st}, 2^{nd}, 3^{rd} and 4^{th} lags. This therefore means that past information can be used to predict future returns. It then shows that it does not follow random walk and does not provide enough evidence to support weak form efficiency. (**Refer to table 1**)

Augmented Dickey-Fuller test (ADF) for China.

The ADF test assumes that series follows an AR (p) process and add p lags difference terms of the dependent variable to the right side of the test regression. Here, the hypotheses of the Augmented Dickey-Fuller test are as follows:

H0: there is a unit root in the series.

H1: there no unit root in the series (stationary).

The result of the test rejected the null hypothesis that there is a unit root in the series and supports the alternative hypothesis of no unit root. The p-value is found to be 0.0001 less than 0.05 level of significance of the t-value. It therefore follows that we cannot use past information to judge future. This do not provide enough evidence to support a weak-form efficiency. (**Refer to table 4, for all ADF tests**)

Variance Ratio test (VR) China.

H0: Series is a random walk.

H1: Series is no random walk.

The result of the variance ratio test indicates that the null hypothesis cannot be rejected at any reasonable significance level in the sense that, the computed p-value of the joint test is greater than 5% level of significance, and the individual test at lags 2, 4, 8 and 16 all have a p-value greater than 5%. We conclude that the null hypothesis of random walk holds. (**Refer to table 5, for all VR tests**)

Martingale Difference Sequence (MDS) China.

H0: The series is Martingale.

H1: The series is not Martingale.

Martingale model belongs to the earliest models of financial asset prices. Its origin lies in the genetic of probability theory and in the history of games of chance. It follows the principle of a fair game, i.e. the game which is neither in your favour nor your opponent's. Martingale is stochastic process $\{P_t\}$

If P_t is the asset's price at time t, the martingale hypothesis means that tomorrow's price is expected to be equal to today's price under the condition of the entire history development of the asset's price.

The result of the test shows that the null hypothesis cannot be rejected as both the joint tests and the individual tests supported the assumption with p-value all greater than 5% at all observed lags. This series follows Martingale Difference Sequence (MDS) (**Refer to table 6, for all MDS tests**)

Autocorrelation Function (ACF) for France

The result of this tests shows that the null hypothesis is rejected and the alternative hypothesis is therefore accepted because p-value for the first four lags are all less than 5% level of significance with lag 1st, 2nd, 3rd and 4th lags. This therefore means that past information cannot be used to predict future returns. It then shows that it does not have a unit root and does follow random walk. (**Refer to table 1**)

Augmented Dickey-Fuller (ADF) for France

The result of the Dickey-Fuller test on the France stock market did not support the null hypothesis of unit root but provided evidence in support of the alternative hypothesis. The computed t-statistics are more negative to the critical values and the p-value less than the expected 1% and 5%. This suggests that France stock market does not follow random walk and therefore does not provide enough evidence for weak form efficiency.

Variance Ratio (VR) for France Results of the variance ratio tests on the daily observed return data confirms that the null hypothesis of random walks under the assumption of no heteroscedasticity is strongly rejected for this series for both joints and individual tests on France stock market. The expected p-values are less than 0.05 or 5% significance level of the critical value. This series do not follow random walk, hence there is not enough evidence to support weak form efficiency. Also, the z-statistics are found to be negative at all observed periods.

Martingale Difference Sequence (MDS) for France.

The empirical result of the Martingale Difference Sequence (MDS) for joints test on the France stock market did not support the null hypothesis as the expected p-value is 0.0152 less than 5%, which shows that the null is rejected to favour the alternative hypothesis. However, the individual test indicates that the series is Martingale at period 2 with p-value 0.1528 greater than the critical value of 5%, while other periods are not. We therefore conclude that the series is not Martingale Difference sequence at the other three periods.

Autocorrelation Function (ACF) for Germany.

After the test for daily observed returns performed, it is found that autocorrelation coefficients of the daily observed index returns are significant with positive sign at 1st, 2nd, 3rd, 4th lags though the coefficient for lag 4 is less than the 0.05. Additionally, based on the Q-statistics, the null hypothesis of no autocorrelation on the index returns for all lags selected is strongly rejected at the 5% percent significant level. The p-value for the three lags are greater than 0.05. This shows that the alternative hypothesis of no random walk is not rejected. This series does not follow random walk. (**Refer to table 2**)

Augmented Dickey-Fuller (ADF) for Germany.

The empirical result of the Augmented Dickey-Fuller Function (ADF), do not support the null hypothesis of having a unit root, but provided significance evidence to support the alternative hypothesis of random walk. The computed p-value does not provide sufficient evidence for the null. The returns series for Germany stock market does support random walk and does provide sufficient evidence to support weak form efficiency.

Variance Ratio Test for Germany.

The joint tests for variance ratio for Germany indicate that the null hypothesis cannot be rejected under the presumption of no heteroscedasticity, thereby rejecting the alternative hypothesis. The p-value for the joint tests is greater than 5% level of significance interval. Also, the result of the individual tests shows no evidence to reject the null at period 2, 4 and 16, though indicate that

the null hypothesis is rejected at period 8 at 5% significance interval. This returns series do not follows a random walk.

Martingale Difference Sequence for Germany.

The tests result for both the joint and the individual shows that the null hypothesis cannot be rejected. This is indicated by the computed p-values for both. The p-values for both tests are all greater than 0.05 and does not provide enough evidence in support of the alternative hypothesis. The result for Martingale Difference Sequence holds for Germany.

Autocorrelation Function (ACF) for UK

The ACF test result for UK shows that the null hypothesis cannot be rejected. Here, the alternative hypothesis is rejected. The acceptance of the null hypothesis is arising from the significance level of p-value. The p-value for 1^{st}, 2^{nd}, 3^{rd}, and 4^{th} lags all indicate that we cannot used past information to predict the future hence, it follow a random walk. (**Refer to table 2**)

Augmented Dickey-Fuller Tests for UK.

The results for ADF unit root test on UK reveals that the null hypothesis is rejected to support the alternative hypothesis as the result of the p-value being less than 1% and 5% as expected. The daily returns series is unit roots and does follow random walk while it provide sufficient evidence in support of weak form efficiency.

Variance Ratio Test (VR) for UK.

The result of the tests shows that the null hypothesis is rejected with no significance proves supporting its random walk assumption but rather, provided support for the alternative hypothesis with p-values for both joint and individual tests less than the 5% level of significance even though z-statistic are all positive. The series does not follow a random walk approach or theory and does not provide evidence in support of weak form efficiency.

Martingale Difference Sequence (MDS) for UK.

The result of the tests in both joint and individual tests do not support the null hypothesis of being Martingale as the p-value is less than the 0.05 or 5% significance level for joint tests and for period 2, 4 and 8 respectively. UK stock market index is not Martingale and as such it does not follow random walk.

Autocorrelation Function for USA.

The result of the ACF for USA indicates that the null hypothesis can be rejected for the presence of serial correlation. This is so because the p-values 1^{st}, 2^{nd}, 3^{rd} and 4^{th} lags for the tests are all lesser than the 5% level of significance. The alternative hypothesis is accepted as the series follows a random walk. (**Refer to table 3**)

Augmented Dickey-Fuller (ADF) for USA.

The tests result for ADF on US stock market shows that the null hypothesis is rejected in favour of the alternative hypothesis. The computed p-value are less than 0.05 level of significance. The alternative hypothesis of no unit root therefore cannot be rejected. The daily return of USA stock market has no unit root and index series do follow a random walk

Variance Ratio test (VR) for USA.

The empirical result of this tests shows that the null hypothesis of random walk is rejected in favour of an alternative hypothesis. This is so because the probability values (p-values) for both joint and individual tests are insignificance or less than 0.05 or 5% significance level. US stock markets do not follow random walk.

Martingale Difference Sequence (MDS) for USA.

The results of this test reject the null hypothesis and only supported the alternative hypothesis with p-values both under joint and individual tests to be less than 5% significance level. This indicates that the returns series is not a martingale difference sequence and so do not provide evidence for weak form efficiency.

Table 1: ACF for China & France

LAGS	AC	PAC	Q-Stat	Prob.	LAGS	AC	PAC	Q-Stat	Prob.
1	0.003	0.003	0.0271	0.869	1	-0.034	-0.034	4.495	0.034
2	-0.004	-0.004	0.1028	0.950	2	-0.039	-0.040	10.242	0.006
3	0.034	0.034	4.7413	0.192	3	-0.061	-0.064	24.341	0.000
4	0.047	0.047	13.342	0.010	4	0.028	0.022	27.381	0.000
5	-0.022	-0.022	15.235	0.009	5	-0.059	-0.063	40.952	0.000
6	-0.028	-0.029	18.419	0.005	6	-0.024	-0.031	43.247	0.000
7	0.029	0.025	21.610	0.003	7	0.018	0.014	44.543	0.000
8	-0.002	-0.003	21.620	0.006	8	0.032	0.023	48.435	0.000
9	-0.007	-0.003	21.804	0.010	9	-0.034	-0.032	52.952	0.000
10	0.027	0.027	24.645	0.006	10	-0.021	-0.022	54.672	0.000

+0.031 or -0.031 (Confidence interval)

Table 2: ACF Germany **ACF UK**

LAGS	AC	PAC	Q-Stat	Prob.	LAGS	AC	PAC	Q-Stat	Prob.
1	-0.016	-0.016	1.013	0.314	1	0.092	0.092	31.932	0.000
2	-0.015	-0.015	1.855	0.396	2	0.011	0.003	32.395	0.000
3	-0.037	-0.037	7.002	0.072	3	-0.023	-0.025	34.429	0.000
4	0.038	0.036	12.433	0.014	4	0.029	0.034	37.670	0.000
5	-0.048	-0.048	21.137	0.001	5	-0.005	-0.011	37.768	0.000
6	-0.019	-0.021	22.511	0.001	6	-0.037	-0.038	43.083	0.000
7	0.000	0.001	22.511	0.002	7	0.022	0.031	44.857	0.000
8	0.032	0.026	26.338	0.001	8	0.018	0.013	46.149	0.000
9	-0.011	-0.008	26.773	0.002	9	0.003	-0.002	46.177	0.000
10	-0.014	-0.014	27.503	0.002	10	0.000	0.004	46.177	0.000

+0.031 or -0.031 (Confidence interval)

Table 3: ACF for USA

LAGS	AC	PAC	Q-Stat	Prob.
1	-0.084	-0.084	27.788	0.000
2	-0.042	-0.050	34.717	0.000
3	0.007	-0.001	34.909	0.000
4	-0.001	-0.003	34.916	0.000
5	-0.033	-0.033	39.204	0.000
6	-0.011	-0.017	39.649	0.000
7	-0.028	-0.034	42.712	0.000
8	0.041	0.035	49.253	0.000
9	-0.027	-0.024	52.151	0.000
10	0.018	0.017	53.494	0.000

+0.031 or -0.031 (Confidence interval)

Table 4: Augmented Dickey-Fuller tests for countries under study.

ADF	China	France	Germany	UK	USA
P-values	0.0001	0.0000	0.0001	0.0001	0.0001

Table 5: Variance Ratio for countries under study.

VR	China	France	Germany	UK	USA
P-values JOINT tests	0.2768	0.0000	0.1269	0.0000	0.0000
P-values LAG2	0.9254	0.0313	0.3173	0.0000	0.0000
P-values LAG4	0.6534	0.0000	0.0586	0.0000	0.0000
P-values LAG 8	0.2455	0.0000	0.0334	0.0006	0.0000
P-values LAG 16	0.0778	0.0001	0.1015	0.0030	0.0001

Table 6: Martingale Difference Sequence for countries under study.

MDS	China	France	Germany	UK	USA
P-values JOINT tests	0.5623	0.0152	0.5397	0.0005	0.0118
P-values LAG2	0.9466	0.1528	0.4929	0.0001	0.0030
P-values LAG4	0.7425	0.0086	0.2187	0.0021	0.0036
P-values LAG 8	0.3919	0.0038	0.1763	0.0244	0.0090
P-values LAG 16	0.1866	0.0138	0.2983	0.0526	0.0494

Conclusion

The study examined the weak form market efficiency using daily stock returns data for five Europeans Stock markets comprises of China, France, Germany, UK and USA. Empirical analysis of the various markets indicates that the results are mixed. The results of the autocorrelation shows that the null hypotheses of no serial correlation for China, Germany and France were all rejected in favour of the alternative hypotheses at 1^{st}, 2^{nd}, 3^{rd}, and 4^{th} lags while that of UK and USA provided evidence in support of the alternative hypotheses and rejected the null. The study therefore found that Stock returns series for China, France and Germany do not follow random walk and does not provides enough evidence to support a weak form efficiency, while that of UK and USA returns series follow a random walk.

The results of the Augmented Dickey Fuller tests for all series do not follow a random walk neither do they provided any sufficient evidences to support weak form market efficiency for all return series of all markets. However, the results of the variance ratio tests did not reject the null hypotheses of random walk for China and Germany, while that of France, UK and USA all rejected the null hypotheses of random walk and do not provide enough evidence in support of weak form market efficiency.

Also, findings from the Martingale Difference Sequence tests shows a mixed results as the returns series for China and Germany could not reject the null hypotheses of being martingale while that of France, UK and USA all rejected the null in support of the alternatives. This study therefore, concludes that the empirical results for the five returns series in all the markets are mixed.

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