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EMERGING MARKETS EFFICIENT OR ADAPTIVE? EVIDENCE FROM ASIA

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ABSTRACT

The paper investigated whether the predictability of return was efficient or adaptive in two different emerging stock markets of Asia; Pakistan and India, by using time series data. For this purpose, the daily returns data of KSE-100 and NIFTY-50 was examined. The sample covered the data of 24 years of the both stock markets (for KSE-100; from January 1992 to December 2015 and for NIFTY-50; from January 1994 to October 2017). A sub sample analysis was used in this research, and the both stock markets were divided into sub samples of four years to apply the linear tests to examine how the stock returns have behaved over the time. The results of the linear tests (autocorrelation, runs, variance and unit root tests) disclosed that the stock markets of the both countries showed evident consistency with AMH, where the returns were fluctuating between the periods of efficiency and inefficiency. Therefore, we found that the linear dependency of both of the stock markets changes over time, and Adaptive Market Hypothesis (AMH) gives a better depiction of stock returns' behavior than the traditional Efficient Market Hypothesis (EMH).

Keywords: *Adaptive Market Hypothesis, Linear Dependence, Efficient Market Hypothesis*

INTRODUCTION

Nowadays, developed countries are seeking knowledge that can provide economic benefits for them (Keshavarz et al., 2017). And, many organizations rely on entrepreneurship for promoting and differentiating their products and services and also to gain business competitive advantages (Keshvarz et al., 2017). In inefficient capital markets, establishing and maintaining the relationship between companies and the state is usually accompanied by competitive advantage (Bazrafshan & Hesari, 2018). Efficient Market Hypothesis (EMH) of Fama (1970) has been considered the most reliable theory in the field of the economics and finance over the period of four decades. A market where the prices fully reflect all the available/possible information is called an efficient market. According to Fama (1970), all the available information related to a stock is fully reflected by the stock prices which is traded in the market, hence no one can predict the future prices of the stocks thus supporting EMH. All the new information related to the security randomly walks into the market, it directly affects the stock prices, and makes the stock prices unpredictable (Fama 1970, Fama 1991). Moreover, Fama (1970) has classified the market efficiency in to three categories, the weak form market efficiency, the semi strong form, and the strong form market efficiency. While all the three forms of the market efficiency have gained attention in the past studies, the weak form of the

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efficient market hypothesis has been studied widely, and it is the main focus in this study. The weak form efficiency claims that the security prices reflect all the historical information related to the security, and no one can predict the prices. According to the study of Malkiel (2003), the capital markets are less predictble and more efficient than what many authors report in their works. Furthermore, "the evidence is overwhelming that whatever anomalous behavior of the stock prices may exist, it does not create a portfolio trading opportunity that enables the investors to earn extraordinary risk of the adjusted returns".

Although early studies have supported EMH, a lot of studies exposed that the returns of the stocks don't follow a random walk (see Fama & French, 1988; Brock, Lakonishok & LeBaron, 1992; Jegadeesh & Titman, 1993; Todea, Ulici & Silaghi, 2009; Urquhart & Hudson, 2013; Smith, 2012 and Ito, Noda & Wada, 2016). Therefore, a conflict exists in the efficiency and inefficiency of the developing and developed markets (see Opong, Gwyneth, Fox & Faramand, 1999; Lim, Brooks & Hinich, 2008; Borges, 2010 and Shahid & Sattar, 2017). The same in the case of Pakistan, the recent studies of Abdul, Hung-Chun & Fakhar-un-Nisa (2011) and Sania & Rizwan (2014) have confirmed that Pakistani stock market is inefficient while Nisar & Hanif (2012) have presented only the data of monthly returns provides the evidence that PSX is weakly efficient. Similarly, PSX is a weak form efficiency in the sub period of 1999-2001 and 2005-2007, and inefficient in all the sub-samples of the study of Rabbani, Kamal & Salim (2013). In the case of India, the studies of (Sharma & Kennedy, 1977; Barua, 1980; Sharma, 1983; Ramachandran, 1985; Gali & Vaidyanathan, 1994; and Prusty, 2007) have supported the weak form of EMH as they have found the efficiency in Indian stock markets. While in Indian stock markets, the studies like (Kulkarni, 1978; Chaudhuri, 1991; Poshakwale, 1996; Pant & Bishoni, 2002; Gupta & Basu, 2011; Mishra, 2009 and Mishra, 2011) have not supported the weak form efficiency. Except a few studies, all the previous studies have investigated the EMH in Pakistani and Indian stock markets, thus the current study has investigated the return predictability of both the markets through AMH which has allowed the market efficiency to vary over time.

Lo (2004) stated that an evolutionary alternative to the market efficiency can be derived from the biological perspectives. A model where the market inefficiency can be coexisting with efficiency of the market in a rational way is called as AMH by Lo (2004). In the frame work of AMH, Lo (2005) stated the investors act in favor of their own benefits/interests but they do not make right judgements, they commit mistakes, learn from them and adapt them to their behavior. Currently, there is a limited work available on AMH of on both countries; like the studies of Shahid & Sattar (2017) in Pakistan and Hiremath & Kumari (2014) in India. The primary focus of this study is to test the AMH of both of these developing countries; Pakistan and India along with the contribution in the literature.

The primary focus of this study is to enhance the existing literature on AMH through the varying degree of two emerging markets of Asia. Furthermore, this is the first study considering Pakistan and India which has investigated the behavior of stock return through AMH and elucidated that Adaptive Market Hypothesis is a superior description of the market efficiency to the traditional EMH.

LITERATURE

Recently, many researchers have moved their interest from tracking static or absolute (traditional Efficient Market Hypothesis) efficiency to measure changing degree of the market efficiency over time. Such focus gives place and attention to the adaptive market hypothesis of (Lo, 2004; Ito & Sugiyama, 2009; Kim, Shamsuddin & Lim, 2011; and Alvarez-Ramirez, Rodriguez & Eapinosa-Paredes, 2012) finding time varying efficiency in stock market of the US, and supports AMH. Similar findings have been supported by Lim, Brooks & Hinich (2008) in Asian markets, Noda (2012) in Japan, and Hiremath & Kumari (2014) in Indian stock market. In the foreign exchange market Neely, Weller & Ulrich (2009) and Charles & Darne (2009) have also supported the evidence of AMH.

On the basis of the monthly returns of S&P 500 index, Ito & Sugiyama (2009) have employed autocorrelation test, and found the level of market efficiency changes with the time as they found market efficiency during 1990s, and inefficiency during 1980s in the US markets. A period of 1900 to 2009 was selected by Kim, Shamsuddin & Lim (2011) to analyze the average industrial index of Dow Jones, and found that the return predictability is dependent on the fluctuating market conditions. In their results, they did not observe any statistical substantial profit predictability over time when the market crashes, but they claimed that the return predictability is based on the grounds of uncertainty. Furthermore, in the time of the political and economic crises, the returns of equity are predictable. In the economic bubbles, the predictability of the stock market is less as compared to the normal time, and the US market has become more efficient after 1980. Charles, Darne & Kim (2012) supported the adaptive market hypothesis through the foreign exchange rates of the emerging countries where they found the predictability of the returns depends on the varying market conditions, and it evolves over time. Urquhart & Hudson (2013) used data of a long period, and divided the sample period into equal length subsamples of (5-years each), they empirically investigated AMH in three most developed markets including the United States, Japan and the United Kingdom. Overall, the results of their study suggested that the Adaptive Market Hypothesis (AMH) gives a better description of the stock returns behavior as compared to EMH. Urquhart & McGroarty (2014) examined the AMH for four renowned calendar anomalies in the Dow Jones Industrial Average, according to their results the behavior of all four calendar anomalies varies over time and in the favor of AMH.

Hiremath & Kumari (2014) studied the Indian stock market and found that it is consistent with AMH. Ramirez, Arellano & Rojas (2015) examined the market efficiency of the future market of the agriculture commodity and according to their findings, future market return is in the favor of AMH. Noda (2016) discovered that the levels of market efficiency in Japan vary over time, and are consistent with adaptive market hypothesis. Shahid & Sattar (2017) investigated the stock market of Pakistan for a long-time period (1992-2015) and found fluctuation in the market efficiency, and stated that Pakistan market strongly supports AMH.

In the recent years, there is strong evidence that shows the return of stock doesn't base on random walk, and there are certain predictable components as well as there is a deficiency of other theoretical clarifications for efficient market hypothesis. In contrast to Efficient Market Hypothesis which takes a market as frictionless, Adaptive Market Hypothesis promotes the friction of the market and claims that the market gets adapted over time. Considering the claim

of AMH, the aim of this paper is to investigate whether AMH offers a better explanation in two developing markets of India and Pakistan's stock market.

THE DATA

The historical data used in this study represented the daily prices of two developing markets of Pakistan and India. These indices represented two important developing markets of the world, and also showed that how the efficiency has changed in the long period of time. Sample period of KSE-100 index data (from Pakistan Stock Exchange of Pakistan) was taken from 1st of January 1992 to 31st of December 2015, while NIFTY-50 index data (from NSE of India) was taken from 1st January 1994 to 31st December 2017. Statistical summary of both stock indices for subsample and full sample are presented in (Table 1). The daily return of all indices for each of the subsamples was calculated by;

$$r_t = \ln(P_t) - \ln(P_t - 1)$$

For both indices, most of the returns are negatively skewed showing that the extreme negative returns tend to be higher than the extreme positive returns. In all of the subsamples, the value of kurtosis is more than 3 showing the distribution is Leptokurtic. For returns of both the indices, Jarque-Bera test rejects the null hypothesis of normal distribution. In order to test the series further, Unit root (ADF) test was applied on the return series of both of the countries, and the results are presented in Table 3. Both the return series were nonstationary at price levels, but when the first difference was taken (returns) of the series, the coefficients of ADF test became significant at 1% level showing stationarity of both the series.

Table 1: Daily descriptive statistics of returns for KSE-100 and NIFTY-50 stock indices

Sample period		N	Mean	Median	Maximum	Minimum	S.D	Skewness	Kurtosis	Jarque-Bera
KSE100										
full sample		5906	0.052211	0.081294	12.76223	-13.2133	1.48714	-0.321306	9.068601	9164.358***
1992	1995	932	-0.00862	0.000000	4.452790	-5.52722	1.184084	0.008935	4.381991	74.18011***
1996	1999	933	-0.00655	0.000000	12.76223	-13.2133	2.103942	-0.360611	8.751121	1306.027***
2000	2003	972	0.118820	0.156579	8.507124	-7.74138	1.626651	-0.021881	6.106237	390.8502***
2004	2007	986	0.116309	0.226229	5.796681	-6.04175	1.486975	-0.597776	4.876053	203.3180***
2008	2011	990	-0.02177	0.000000	8.254687	-5.27841	1.440469	-0.134706	5.883001	345.8515***
2012	2015	991	0.107156	0.104734	4.418603	-4.55796	0.872315	-0.507021	6.301025	492.4050***
					NIFTY50					
full sample		5890	-0.03284	0.060602	43.18754	-76.2578	2.826062	-11.7388	299.3483	21688340***
1994	1997	999	-0.03323	0.020713	43.18754	-34.9561	2.708251	0.321842	111.8449	493157.8***
1998	2001	999	-0.03323	0.020713	43.18754	-34.9561	2.708251	0.321842	111.8449	493157.8***
2002	2005	1006	-0.06572	0.175291	7.969092	-62.7162	3.239515	-14.55967	259.0779	2784266.***
2006	2009	984	0.027252	0.130755	29.63872	-76.2578	3.403466	-10.64858	264.8284	2829314.***
2010	2013	996	0.002516	0.023683	12.35068	-30.5122	1.536524	-7.324003	161.7948	1055360.***
2014	2017	943	0.000888	0.067940	3.311503	-27.0862	1.439981	-11.23278	197.8790	1512042.***

METHODOLOGY

Under the umbrella of weak form of EMH, the future prices can't be predicted based on the historical prices. In order to investigate whether stock markets of Pakistan and India were efficient, the stock returns were examined by using three tests of linearity. To capture the varying efficiency of the stock markets of Asia, a subsample of four years was selected. The details of the tests are as follow;

Autocorrelation tests

In a sequence for investigating the independence of random variables, autocorrelation test is the reliable and simple tool. The presence of autocorrelation proves that the returns are dependent. When the correlations and covariance between multiple disturbances are not all non-zero, it reveals the presence of autocorrelation.

$$\rho_k = \frac{\gamma_k}{\gamma_o} \dots\dots\dots\dots\dots\dots\dots (1)$$

γ_o is the variance and γ_1 is the covariance at lag k. Autocorrelation is positive if P>0 , and negative if P<0, while P=0 shows no correlation which is the null hypothesis that indicates random walk process.

Runs test

Runs test examines the randomness of a sequence of stock market return, and is a non-parametric test. There is no need for returns to be normally distributed in runs test like in the autocorrelation test. The runs test normally supposes a linear test, but in the series of returns, it can also find nonlinearity. Therefore, the results in the runs test may be a little different from the autocorrelation test. If the data of a continuous series is random, in the runs test, the actual number of runs must be close to the estimated number of runs, regardless of the symbols. A run is a sequence of matching signs which are followed by different signs. The sequence of positive or negative symbols is known as a run. P is used for the number of the positive runs, while N is used for the negative runs. Formula by which we can analyze the estimated number of runs is;

$$E\ (\mu) = \frac{2PN(P+N)}{(P+N)} + 1 \dots\dots\dots\dots\dots (2)$$

Formula for calculating variance of runs is;

$$\sigma^2 = \frac{2PN(2PN-P-N)}{(P+N)^2\ (P+N-1)} \dots\dots\dots\dots\dots (3)$$

If critical values are smaller than the z-value, the null hypothesis of the independence of the series is rejected. Also, we say that the returns are not dependent. If the sample has too much or too few runs, it will be called dependent. By examining the distribution of the duration of the runs, the independence of the return can be found out. When actual runs exceed the estimated runs in the results, a positive z-value will be obtained.

Variance ratio test

Based on the seminal work of Lo & MacKinlay (1988), for determining whether the stock market returns are consecutively uncorrelated, the variance Ratio test was considered as a key, and most commonly used as an econometric tool (Hoque, Kim & Pyun , 2007). The variance Ratio test is based on the statistical property that variance of k-period return is equal to k-times the variance of one period return, only if a stock price follows the market efficiency. According to Lo & MacKinlay (1988), random walk is represented by $VR(k)$ and the formula of variance ratio r_t for the holding period is k;

$$VR(k) = \frac{\sigma_k^2}{k\sigma^2} \dots\dots\dots\dots (4)$$

Where for an asset return r_t at time t= 1, 2, 3….T, then σ_k^2= variance $(r_t + r_{t-1} + \cdots + r_{t-k+1})$ is the varience of k -period returns. That can be presented as;

$$VR(k) = 1 + 2\sum_{j=1}^{k-1}(1 - \frac{j}{k})\rho(j) \dots\dots\dots\dots\dots (5)$$

Where $\rho(j)$ is the autocorrelation of r_t of order j. The null hypotheses are calculated by the variance ratio since returns are serially uncorrelated with $\rho(j) = 0$, for all ks variance ratio equals 1. Values exceeding 1 for $VR(k)$ imply positive serial correlation, whereas values smaller than 1 imply negative serial correlation or decline. By assuming that K is fixed, when T $\rightarrow \infty$. Lo & MacKinlay(1988), has examined the asymptotic distribution of VR (x; K) where the null hypothesis $V(k) = 1$, if x_t is i.i.d. The test statistic $M_1(k)$is given by;

$$M_1(k) = \frac{VR(x;k) - 1}{\Phi(k)^{\frac{1}{2}}} \dots\dots\dots\dots\dots (6)$$

Which follows normal asymptotically distribution. The asymptotic variance, is given by;

$$\Phi(k) = \frac{2(2k-1)(k-1)}{3k} \dots\dots\dots\dots\dots (7)$$

Lo & MacKinlay (1988), suggested the heteroscedasticity robust test statistic $M_2(k)$ to accommodate the returns exhibiting the uncertain heteroscedasticity;

$$M_2(k) = \frac{VR(x;k) - 1}{\Phi^*(k)^{1/2}} \dots\dots\dots\dots\dots (8)$$

Table 2: Test results for linear autocorrelation and Runs tests for full and 4-yearly subsamples for the KSE-100 and NIFY-50. The first column presents sample periods. Columns 2 to 6 indicating the autocorrelation at lag 1, 2, 3, 4, 5, while last column represents results of Runs test.

Autocorrelation Test							Runs Test
Sample period		lag 1	lag 2	lag 3	lag 4	lag 5	z-value
KSE100							
Full sample		0.125***	0.06***	0.051***	0.028***	0.029***	-10.18***
1992	1995	0.349***	0.148***	0.084***	0.069***	0.084***	-8.5***
1996	1999	0.106**	0.057**	0.037**	0**	0.028**	-2.98***
2000	2003	0.009	0.044	0.058	0.002	0.065**	-1.90*
2004	2007	0.071**	0.006**	0.055**	0.011**	-0.04**	-0.71
2008	2011	0.195***	0.107***	0.046***	0.074***	0.043***	-3.19***
2012	2015	0.127***	-0.003***	0.019**	0.074***	-0.018***	-5.30***
NIFTY50							
Full sample		0.024**	-0.026***	-0.006**	0.0050	-0.0030	-7.46***
1994	1997	0.134***	-0.037***	0.023***	0.065***	0.009***	-5.74***
1998	2001	0.035	-0.067**	-0.02	0.008	0.024	-3.04***
2002	2005	0.012	-0.04	-0.002	0.003	-0.018	-3.17***
2006	2009	0.017	-0.011	-0.018	-0.042	-0.017	-0.57
2010	2013	0.001	-0.005	-0.042	-0.009	-0.001	-1.22
2014	2017	0.069**	-0.008*	0.014	0.022	-0.032	-2.00*

That follows the ordinary average distribution asymptotically under the null hypothesis which VR(k) =1, where;

$$\Phi^*(k) = \sum_{j=1}^{k-1} \left[\frac{2(k-j)}{k}\right]^2 \delta(j) \dots\dots\dots\dots\dots\dots (9)$$

$$\delta(j) = \frac{\{\sum_{t=j+1}^{T}(x_t - \hat{\mu})^2(x_{t-j} - \hat{\mu})^2\}}{\{[\sum_{t=1}^{T}(x_t - \hat{\mu})^2]^2\}} \dots\dots\dots (10)$$

To capture the hetroskedastic property of the returns, the $M_2(k)$ test is appropriate for the returns of a price series. It is normal to test the variance ratio at holding periods k = 2, 4, 8 and 16 suggested in the literature, and the current study follows the same.

RESULTS

Results of autocorrelation test are presented in (table 2). In case of KSE-100, full sample at all five lags showed that market was fully inefficient. Also, the first two subsamples 1992 to 1995 and 1996 to 1999 results showed that the market is inefficient, and the means of returns are predictable in the first two sub-samples. In the next subsample of 2000 to 2003, the market is efficient, then again in the next subsamples 2004 to 2007, 2008 to 2011 and 2012 to 2015, the market is inefficient, and the means of returns are predictable in all the years as coefficients of autocorrelation test are significant at 1 % level of significance, thus suggesting the AMH. In case of NIFTY-50, the full sample showed that the market was inefficient as coefficients of the tests were significant. In the subsamples of 1994 to 1997 and 1998 to 200, the market is inefficient, but in the later subsamples of 2002 to 2005, 2006 to 2009 and 2010

to 2013, the market was fully efficient, but in the last subsample 2014 to 2017, the returns from NIFTY-50 were again predictable, and the market became inefficient. The results showed that both markets of Pakistan and India have gone through the episodes of dependence (predictability/inefficiency) and episodes of independence (no predictability/efficiency), thus supporting AMH.

Rresults of runs tests are given in (table 2). KSE-100 showed that the market was inefficient in the full sample. Also in the subsamples from year 1992 to 1995 and 1996 to 1999, the results showed that the market was inefficient, and the returns were predictable, but in the next two subsamples from 2000 to 2003 and 2004 to 2007, the results showed the market efficiency, then again in the last two subsamples from 2008 to 2011 and 2012 to 2015, the market was inefficient. In case of NIFTY-50, the full sample showed the market was inefficient, also in the first three subsamples from year 1994 to 1997, 1998 to 2001 and 2002 to 2005, the market was inefficient, but in the last three subsamples from year 2006 to 2009, 2010 to 2013 and 2014 to 2017, the result showed that the market was fully efficient in that period of 12 years. The results showed KSE-100 and NIFTY-50 markets were fluctuating between the periods of inefficiency and efficiency and supporting the AMH.

The results of variance ratio test are presented in (Table 3). In all the cases of k = 2, 4,8 and 16 of the variance ratio test, the results showed that full as well as all subsamples of KSE-100 and NIFTY-50 showed the returns were predictable, and the markets were inefficient thus completely opposing EMH.

CONCLUSION

In this study, it is concluded that the stock markets of Pakistan and India are adaptive because a fluctuation was found in the market efficiency. The returns of both of the markets go under the periods of efficiency and inefficiency. Therefore, it is concluded that AMH is the better description of behavior of both of the emerging markets than the traditional EMH. The results of the study are consistent with the findings of (Urquhart & Hudson, 2013; Urquhart & McGroarty, 2014; Hiremath & Kumari, 2014; Ramirez, Arellano & Rojas, 2015; Noda, 2016; and Shahid & Sattar, 2017). It is believed that the subsample analysis of the long time-period may be more appropriate to explain the idea of the market adaptability. Furthermore, the current methodology can be applied to other stock markets of the world, to the commodity markets and the currency markets, but we rest it for the future studies.

Table 3: Variance ratio test and Unit root test results for KSE100 and NIFTY50 stock indices. The first column presents sample periods. Columns 2 to 5 K periods equal 2, 4, 8 & 16 while last two columns represent results of Unit root test for price and returns.

Sample period		Variance Ratio Test				Unit Root Test (ADF)	
		K=2	K=4	K=8	K=16	Price	Return
KSE100							
Full sample		0.5375***	0.27801***	0.14009***	0.07005***	-1.546667	-39.4953***
1992	1995	0.65399***	0.35888***	0.19169***	0.09414***	-1.021877	-21.1424***
1996	1999	0.52839***	0.28120***	0.13394***	0.07353***	-1.481835	-27.4136***
2000	2003	0.48311***	0.25195***	0.11848***	0.05858***	-2.272587	-30.7921***
2004	2007	0.53612***	0.26753***	0.13772***	0.07187***	-0.103481	-29.3755***

2008	2011	0.55236***	0.28749***	0.16162***	0.07001***	-0.980627	-25.5479***
2012	2015	0.57564***	0.26618***	0.14807***	0.07298***	1.421838	-27.6474***
NIFTY50							
Full sample		0.5256***	0.25506***	0.127013***	0.065303***	-1.832172	-74.9208***
1994	1997	0.599770**	0.27161**	0.145162**	0.075246**	-2.74979*	-27.0029***
1998	2001	0.554141**	0.258340**	0.130650**	0.067062**	-2.197805	-30.4425***
2002	2005	0.526824**	0.253624**	0.129417**	0.066954**	-1.690238	-31.3001***
2006	2009	0.515317**	0.265976**	0.117820**	0.065206**	-2.68169*	-30.7960***
2010	2013	0.504016**	0.253836**	0.128584**	0.066593**	-3.1580**	-31.4829***
2014	2017	0.542703**	0.264110**	0.140294**	0.069539**	-1.98046	-28.6061***

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