

Does the Adaptive Market Hypothesis Exist in Equity Market? Evidence from Pakistan Stock Exchange

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Abstract:

In this study we empirically check the adaptive market hypothesis in Pakistan stock Market by measuring the association among present stock returns and past stock returns over the time of 2001 to 2020. We divided the weekly data of returns into subsamples of equal length of 3 years of seven samples and last sample with two years gap. For this purpose, we applied the five (linear and nonlinear) tests, in linear test Autocorrelation test, Variance ratio test, runs test and in nonlinear BDS independence test and Lagrange Multiplier test was applied to explicate that in what way the efficiency of market varies from time to time and whether their existence of any relationship between market condition and return predictability. Our results showed that efficiency of stock market fluctuates among episodic periods of dependency (inefficient condition) and independencies (efficient condition) in full and each subsample thus it is conclude that PSX follow adaptive market and constant with AMH. Overall findings of the study concluded that AMH can better explain the stock return behavior then EMH. As the variation in market conditions can highly impress the trading activities and market efficiency so the investors can get the help from this study in making the investing decisions. It can be applied to practical setting such as asset allocation, investment consulting and risk management.

Keywords: Efficient Market Hypothesis, Adaptive Market Hypothesis, Efficient Market, Inefficient Market, Pakistan Stock Exchange

1. INTRODUCTION:

In 1970 Fama define the efficient market by means of a market in which at any stage prices completely imitate all existing information. EMH got more attention from 1970 to up till now. In spite of being famous and significant in theory of finance and practice AMH is still disputed and debated in the certainty of stock return both empirically and theoretically. Behavioural finance is one of the solid and still growing school of thought is also against the point of view of Fama's model. The main question behind this conflict is whether the market returns are predictable. No solitary theory has been able to support EMH in any academic or commerce forum. In our study we review contrary to the Efficient Market Hypothesis and define a novel model Adaptive Market Hypothesis (AMH) in which the outmoded model of modern Economics and Finance harmonize in Behavioural model. This model was introduced by Professor Andrew LO (2004), with Massachusetts technology institute, it's also known as the second version of EMH. The vital theme of AMH is designate harmonizes the Behaviour Finance and EMH. Efficient Market Hypothesis got more attention from 1970 to up till now which was projected by Fama (1970). In

spite of being famous and significant in finance theory and exercise EMH is quiet disputed and debatable in the certainty of market return both empirically and theoretically. Behavioral finance is one of the solid and still growing school of thought is also against the point of view of Fama's model. The main question behind this conflict is whether the market returns are predictable. The EMH state that price reflects all available and possible information and consistent of alpha generation is impossible then no one can predict the price (Fama 1970). Most of the investment theories and practice are based on Efficient Market Hypothesis based on the markets accurately, fully and instantly incorporate all existing information. It is complicated to overturn convention that has a yield insight a portfolio optimizer, Capital Asset Pricing Model and famous Arbitrage pricing theory of term structure of interest rate which is predicted on EMH in one way or another. The clash between the promoters of Efficient Market Hypothesis (EMH) and backers of Behavioral Finance has not ever been further inclined and slight harmony occurs as to which side is persuasive or the application for investment administration and referring. The concept of Adaptive Market Hypothesis stem for the logic of Lo (2004), which requested the investor's rationality and support the intuition and biases of human beings. According to AMH the efficiency of market is depending on Environmental factors characterize as market ecologies like level of competition, figure of competitors, degree of profit opportunity and flexibility of participants and investors in different markets show divergent adapting behavior toward the change in market situations. The human beings are rational and irrational make optimal economic decisions and acting for self-interest.

In 1970 Fama define the efficient market such as a market in which at every time prices entirely replicate all accessible information. Jansen (1978) defines it as "A market is said to be efficient with respect to information set if it is impossible to make economic profits by trading". Malkiel (1992) "A capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices". Efficient market assumption is called the efficient market theory that trust stock is always traded at their fair price so it's impossible for investors to purchase undervalue stock and sell it overvalue they can obtain the higher return by purchasing high risky stocks and opponents says that it's possible to beat the market and stock can deviate from their fair market price. The key concepts of EMH are: share price reflects all available information; Securities are always traded on fair value, Investors can gain from investing in low cost passive portfolio, there is no cost associated with trading securities, all data is easily obtainable to all participants and all members imply the present information on existing stock and on the allocation of future prices of each security.

There are three practices for testing the market efficient which are: weak form, semi strong form and strong form of efficiency. In weak form the information package of interest is represented only by the historical price or profit. In semi-strong form both public and private information's are included and in strong form present stock prices totally and instantly replicate all well-known info about the securities plus the confidential available confidential information.

Some familiar studies are in favor of the arguments that returns of stock in fact do not track a random walk (as like Fama and French, 1988; Lo and Mackinlay, 1988; Brock et al., 1992; Jagadeesh and Titman, 1993; Bonilla et al., 2006, 2008; Todea et al., 2009; Smith, 2012; Urquhart and Hudson, 2013; Romero-Meza et al., 2015; Ito et al., 2016). Hence the results are contradict in developed and developing market regarding efficiency and inefficiency as a result the research studies are in explosion in both markets to investigate the rationality of EMH (Opong et al., 1999; Lim et al., 2008; Borges, 2010). Nisar and Hanif (2012)

provide the evidence that Pakistan Stock exchange shows a weak form efficient only in case of monthly returns data. Rabbani et al. (2013) elucidate that during the sub period of 1999-2001 and 2005-2007 returns follow a weak form of efficiency while inefficient in rest of his study period.

In context of Pakistan few studies have been made, too mostly using traditional run test and serial correlation test, like (Khiui, 1994), (Hussain & Qasim, 1997), (Jun & uppal 1994) found that there is an existence of serial correlation in Pakistani stock yields and conclude that independence hypothesis usually hold in Pakistan. Madhumit Chakraborty suggested that the prices can only reflect within a limited time period.

Adaptive Market Hypothesis was established by Professor Andrew LO (2004) with Massachusetts institute of technology, it's also known as the second version on EMH it is based on certain familiar values of evolutionary biology (Competitions, Mutation, natural selection and reproduction) and it is argued that effect of these powers on financial establishments and market contributors can determine the proficiency of market. According to AMH the efficiency of market is depending on Environmental factors characterize as market ecologies like level of competition, amount of competitors, size of profit opportunity and adaptability of members and investors in different markets show unusual adapting behavior toward the change in market situations. The concept of AMH is literally relate with Behavioral Finance theory which claim that people while making the investing decisions are not as much rationale as the traditional finance theory expect. In our research EMH may be viewed as a friction less idea that can only be exist if there are no taxes, transaction cost and market participants are rationale. The assumption which distinct the AMH from EMH are: stock risk premium is not persistent over time then it change according to the recent path of the stock market, Investment goods trends to experience higher and lower cyclical routine, Market efficiency varies constantly over time and not all-or-non conditions, Risk preference of all investors and individuals are not stable over time, Assets allocation added value by systematic change in behavior and market path dependence, there are also some opportunities for arbitrage existence, the cyclic repeat of market ineffectiveness is the sign of adaption.

In extension to Lo's work (2004), Lim and Brooks (2011) projected two principles to test the EMH

- A) The efficiency of market must be shifting over time.
- B) The market efficiency has to be dependent upon market situation (i.e., market crashes, financial returns).

Some applied suggestions of Finance that are explicated by AMH are as follow;

First of all the arbitrage opportunities that exist in AMH (opposing to EMH) vary in different periods. Second the market environment and demographic changes cause the variation in the risk and reward relationship. Third the AMH believe that adaption to change in market and innovation is the key to survive.

In reference to Pakistan studies Rehman and Qamar (2014) identify that the stock flea market of Pakistan are ineffective whereas other researches resulted that the stock markets of Pakistan are effective. Nisar and Hanif (2012) authors suggested that weak form independency of Pakistan stock exchange only shown in monthly data. Rabbani et al. (2013) find that during the period of 1999-2001 and between 2005-2007 respectively. Pakistan Stock Exchange is weak form efficient, while rest of subsample efficient.

Some researchers find that market's efficiency differs from time to time due to the application of different test. Urquhart recognizes that market forces like institutional, Demographic, technological and regulation cause the efficiency of market to fluctuate from time to time. Our study will be considered as a helpful in order to making a decision that AMH is a greater representation of the market's efficiency than EMH. Most of the existing studies considered the developed countries to employ EMH like USA, UK, and JAPAN and ignore the developing markets like Pakistan stock exchange which may origin variation in outcomes. Moreover, all the previous studies of Asian regions used many conventional tests to check the dependency of linearity in stock returns. Amini et al. (2010) explain that the nonlinear dependency of stock returns cannot be picked by linear test. The main problem with the linear tests they are unable to internment the nonlinear inefficiency in equity returns. If through linear tests the existence of linear dependencies is excluded but there are chances that nonlinear dependencies still exist in data series. So due to this problem we apply together the linear and nonlinear experiments to better determine the efficiency of Pakistan stock Exchange. These both tests are applied in different conditions in the markets in command to define the performance of index more favorable in more suitable market conditions.

The predictability of return is a key area of interest for investors, analyst and regulator of stock exchange. In most of the recent studies results are not reliable with efficiency theory in Pakistan because returns don't monitor a random walk in some extent and so the conclusions are not reliable due to variation. Kiani (2006); (Boukai et al., 2008); (Sultan, et al., 2013); (Rehman et al., 2018) disqualified the EMH for KSE-100 index because EMH does not handle the time varying. Investor's irrationality (overconfidence, overreaction and loss aversion) and rationality coexistence, evolutionary model of humane behavior, financial interaction and market ecologies motivate our study by highlighting their role in market condition variation. Minor studies are conducted in Pakistan on AMH under business group and these may be some lack which has not briefly explained the AMH because of its qualitative nature now we present this study in practical. There are main two problems that have to be overcome in this study are: First to make a comparison between EMH and AMH, to make a decision that which model is appropriate in Pakistan Stock Market. Second is to provide a justification for the existence of relative model.

Preceding studies conclude that the ordinary market returns are not predictable through the EHM in Pakistan (E.g. Kiani 2006; Haider and Nishat 2009; Tahir 2011; Sultan, Madah and Khalid 2013). This rejection drew the attention of academics, investors and policy makers toward any other model which can better explain the returns movements. We describe a new model by reconciling the EMH with behavioural biases in satisfying intellectual and constant manner and provide numerous applications of this model to certain more practical aspect of management consulting and investment, and also provide the justification for the presence of AMH in behavioral finance. Our study provides a forum to the opponents of EMH they can express their logical view in the angle of adaptive market hypothesis. As the concept of AMH on its growing development stage this work will help the theory to flourish more. The sequential amendment in model is explained in this study with a purpose to bridge the hole between two schools of thoughts. No evidence regarding the developing countries is available thus we select Pakistan as a study sample it will help to explore the phenomenon in developing country context. Pakistan exhibit different characteristics like increase in integration, financial crisis, increase in market capitalization and moreover returns of Pakistan markets find more variation than the other developing countries, so this study will be more beneficial for security organizations in order to well recognize the market and also for stockholders for

accurate forecasting. The adaption of AMH and rejection of EMH raise a number of questions that will be answered in this study. These questions are as follow.

- a) Does the Adaptive Market Hypothesis exists in the Stock market of Pakistan or not?
- b) Does the Adaptive Market Hypothesis is a valid model to explain the behaviour of Pakistan Stock Market?

Following are the objectives, the paper seeks to:

- a) To check the existence of Adaptive Market Hypothesis in the stock market of Pakistan.
- b) To check the validation of Adaptive Market Hypothesis in explanation of the Pakistan Stock Market behaviour.

2. LITERATURE REVIEW

In this research work we predict the movement of Stock returns and examine that whether AMH can better explain the stock returns predictability. Efficient Market Hypothesis got more attention from 1970 to up till now. In spite of being famous and significant in theory of finance and practice AMH is still disputed and debated in the certainty of stock return both empirically and theoretically. Behavioral finance is one of the solid and still growing school of thought is also against the point of view of Fama's model. The main question behind this conflict is whether the market returns are predictable. Contemporary researches conclude that the stock market returns are not predictable through the EHM in Pakistan (E.g. Kiani 2006; Haider and Nishat 2009; Tahir 2011; Sultan, Madah and Khalid 2013). This rejection drew the attention of academics, investors and policy makers toward any other model which can better explain the returns movements. We define a new model by reconciling the EMH with behavioral biases in satisfying intellectual and consistent manner and offer a number of applications of this model to several more practical aspect of management consulting and

Following are some studies which are in the favor of AMH:

Grieb and Reyes (1999) researched that assumptions of market efficiency are rejected for entire stock market indexes and specific stock in Brazil. Lim Luo & Kim (2003) determined the varying nature of expectable returns patterns over period stated the AMH by applying the automatic Portmanteau Box-pierce test and wild bootstrap automatic variance ratio. Lo (2005) survey the S&P 500 index over the period of 1871 to 2003 by taking the monthly returns and employee the first order correlation. He draws the results that efficiency level is vary from time to time and US markets during 1950's is more efficient and in other the varied behavior of investors and dynamic changes cause the variation in results of efficiency. Whereas Lo suggested that efficiency in AMH sometime decline then again move toward significant level. Lim et al. (2008) choice the advanced economy and emerging markets for observe the growing gradation of market efficiency, by using the bio correlation test and portmanteaus test of static and their results indicate that level of efficiency of market vary in excess of phase in cyclical manner. Todea et al. (2009) ignore the Pakistan stock market and some other Asian countries like china in his study that may cause difference in results. So in this study our main focus is on Pakistan stock market which is highly volatile. Neelay et al. (2009) also support the concept of AMH. Kim et al. (2011) by means the Dow Jones Industrial Average (DJIA) stock returns from the era of 1900 to 2009 examine the theory of AMH by challenging the

probability of stock return prediction. They discovered that autocorrelation significance was varied over time and it depends on market situations.

Charles, Darne, & Kim (2012) test the application of AMH by applying martingale difference hypothesis through automatic portmanteau test and found that returns follow a random walk hypothesis over a certain period. Smith (2012) selects the eighteen stock markets of developing European countries which are more established than the others including United Kingdom, Greece, and Portugal to test the AMH theory. The data was taken subsequently February 2000 to December 2009 and employ the variance ratio test. The outcomes indicate that the efficiency of market vary over time to some extent. Lim et al. (2013) discovered that the division of market efficiency is volatile in enormous US stock indices. The results show that market faces the multiple stages of efficiency besides inefficiency that is stable with the AMH theory.

Urquhart & Hundson (2013) resulted that efficiency of the market is in sensible nature follow an evolving nature and vary from time to time due to the influence of variation in market forces E.g.: technological changes, market participant's behavior, variation in institutions law and regulatory. Urquhart and McGroarty (2014) selected four famous calendar anomalies in the Dow Jones Industrial Midling from 1900 to 2013 by subsample study and rolling window inquiry. Their main finding was that total four calendar anomalies hold up AMH for better justification of calendar anomalies than the EMH.

Ito et al. (2014) employed a non-Bayesian time varying vector auto regressive (TV-AR) to analyze the combined amount of market proficiency. Their main findings were that global relation and market efficiency differ above interval and market behavior keeps in touch with past measures of the international financial system. Gourishankar and kumari (2014) explore the judgment about AMH that whether it can better evaluate the greater explanation related with emerging market of Indian stock exchange and provide the evidence that the Indian market is affecting to efficiency and follow the cyclical repetition during different phases of efficiency and inefficiency in linear dependence. Rodriguez et al. (2014) evaluate Dow Jones industrial average index through fluctuation analysis by using different time scales of weeks, months, quarter and annual returns within the period of 1929 to 2014 in order to inspect the AMH and determine that inter-day and intra-day returns are strongly correlated than overnight returns but its efficiency is not uniform so its support the evidence of AMH. In India (Gourishankar and Kumari, 2014) observed the Indian equity market and discover the constant effects with AMH.

Hud and McGroarty (2014) by applying the Hurst-Manded brot-Wallis rescaled series experiment to check the efficiency of 22 emerging markets that conclude the strong suggestion in relate with AMH.

Manahov and Hudson (2014) by using the learning algorithm on the data of Russell 3000, FTSE 100 and S&P 500 and develop an artificial stock market. They suggest that stock market dynamics are stable with AMH.

Levich and Poti (2015) measure the probability of money market by erecting upper bound on the explanatory power via taking the data over the period of 1972-2012, and suggest that predictability is on peak during 1970 and have a tendency to decrease over time.

Ito et al. (2016) used TV-AR measurement to examine the development over time of the US stock market. They establish that the efficiency of US market change in excess of time, and efficiency violated

throughout recession period. It is reliable with the hypothesis of behavioral finance. Noda (2016) employed a time variable advance to test the AMH within Japanese context and found that the amount of market efficiency change above time in (TOPIX & TSE2) market, the developing course of market efficiency vary over time concerning stock markets.

All these studies which are aforementioned almost have the same findings that AMH theory describes the stock price fluctuation more accurately than EMH.

.As Pakistan's stock exchange efficiency is relate with weak form which was analysed by Chakraborty (2006) by using the sample of 1996 to 2000. In serial correlation and VR test discard the random walk hypothesis and conclude that stock follow weak form incompetent behavior. Hassan et al. (2007) used the daily, weekly and monthly returns over the period of 2000 to 2005 by using the multiple Variance Ratio examination and unit root test and investigate that Pakistan stock exchange is not efficient because returns do not monitor random walk.

Certain studies determine the stock market returns are volatile through the EHM in Pakistan (E.g. Kiani 2006; Haider and Nishat 2009; Tahir 2011; Haque et al 2011; Sultan, Madah and Khalid 2013). In Pakistani literature Haque et al. (2011) and Qamar and Rehman (2014) conclude that the Pakistan's stock marketplaces are ineffective. Nisar and Hanif (2012) provide the evidence that monthly returns follow the Random walk hypothesis. Same as Rabbani et al. (2013) suggested the weak form of efficiency in Pakistan Stock Exchange in relative period of 1999-2001 and 2005-2007 whereas in rest of subsample period show the inefficiency in returns. The stock market of Pakistan is considered to be as a volatile market that is observed by different researchers and economists because of its manipulated nature due to the middleman contribution. Furthermore, it is also analyzed that level of efficiency in developing markets is below the developed markets.

On the contradictory side Riaz et al. (n.d) found that the result that efficiency of the flea market varies through the application of different tests. Most of the existing studies face this type of problems of variation in results due to applying different tools. Nisar & Hanif (2012) take the monthly returns during the sample period as of 1997 to 2011 by applying the unit root test and serial correlation. And find that in daily returns data the market is inefficient and while in case of monthly returns PSX is weak form competent. Same as like Rabbani et al. (2013) analyses the efficiency by taking the sample of 10 years and divided the model era into 4 equivalent groups and applied the Phillip Perron (PP) test, autocorrelation experiment and the Augmented Dickey Fuller (ADF) assessment and conclude that during the sub-sample of 1999-2001 and 2005-2007 the returns follow the weak form efficiency in run test while phillip perron (PP) test rejected the EMH. Lo and Mackinlay (1988) find the permanent and temporary components in stock returns by the Variance Ratio assessment and presented the evidence against the random walk theory.

3 RESEARCH METHODOLOGY:

3.1 Data

The prime data use is the weekly stock returns of KSE 100 index from January 2001 to June 2020. Online portal <https://dps.psx.com.pk/> is used for the collection of data. We use the observed (linear and nonlinear)

test going on the weekly returns of the KSE 100 index during the era of 2001 to 2020. By using the following formula, we calculate the returns.

$$r_t = [\ln(pt) - \ln(pt - 1)] \times 100$$

In the above mentioned formula $\ln(pt)$ is the natural logbook of the KSE returns at period t, and $\ln(pt - 1)$ remains ordinary lag of the KSE returns at time t-1. By following the above formula, we got the computation of return. In table 1 the summary of the descriptive statistic is present in full period and subsamples. The extreme negative returns have less magnitude as compare to the risky optimistic returns in most of subsamples. The evidence of excessive kurtosis is present in full and each subsample that is indicating a leptokurtic chains. The Jarque –Bera’s data values remain significant by equal 1%, so the table yield is abnormal.

4 Results and Discussion

First of all we will present the summary of compressed descriptive statistics it’s also known as the explanatory summary of data set.

Table-4.1: Descriptive Statistics

Sample period	Mean	Median	Max	Min	Std.dev	Skew	Kurtosis	J.B Value
Full- Period	0.018	0.122	11.540	-5.265	1.438	0.614	1.967	108.884
2001-2003	-0.022	0.018	11.284	-4.594	1.945	-0.906	2.536	226.298
2004-2006	-0.079	0.750	45.607	-1.216	2.295	-0.119	1.579	134.854
2007-2009	-0.017	0.108	49.205	-1.566	2.895	0.106	1.850	88.7811
2010-2012	0.021	0.118	94.609	-1.693	1.998	-0.707	2.599	141.336
2013-2015	0.280	0.293	16.591	-3.621	5.508	0.487	2.041	12.756
2016-2018	-0.043	0.040	28.753	-5.265	5.221	0.016	2.494	22.321
2019-2020	0.035	0.034	28.098	-4.319	4.131	-0.407	2.188	14.326

Table-4.2: Autocorrelation test

Sample period	Lag1	Lag2	Lag3	Lag4	Lag5
Full- Period	0.5923	0.3559	0.2466	0.2048	0.1904
2001-2003	0.0594	0.0841	0.1177	0.1483	0.1324
2004-2006	0.5332	0.5415	0.5481	0.5568	0.5675
2007-2009	0.8942	0.9009	0.9045	0.9073	0.9071
2010-2012	0.1788	0.1832	0.2087	0.2819	0.3019
2013-2015	0.5836	0.6058	0.5986	0.5932	0.5923
2016-2018	0.7819	0.7975	0.8129	0.8111	0.8104
2019-2020	0.9722	0.9736	0.9753	0.9726	0.9739

Table-4.3: Variance Ratio Test

Sample period	2	4	8	16
Full- Period	0.5923	0.3559	0.2466	0.2048
2001-2003	0.0594	0.0841	0.1177	0.1483
2004-2006	0.5332	0.5415	0.5481	0.5568
2007-2009	0.8942	0.9009	0.9045	0.9073
2010-2012	0.1788	0.1832	0.2087	0.2819
2013-2015	0.5836	0.6058	0.5986	0.5932
2016-2018	0.7819	0.7975	0.8129	0.8111
2019-2020	0.9722	0.9736	0.9753	0.9726

Full- Period	0.0314	0.0589	0.0931	0.1386
2001-2003	0.0842	0.0072	0.0909	0.5135
2004-2006	0.1907	0.2955	0.5422	0.9505
2007-2009	0.0255	0.0038	0.0042	0.0728
2010-2012	0.6697	0.3571	0.3739	0.7661
2013-2015	0.0236	0.2958	0.9558	0.7173
2016-2018	0.5761	0.4231	0.4065	0.3264
2019-2020	0.3808	0.4482	0.8812	0.28321

Table-4.4: Runs Test

Sample period	T.V	Cases<T.V	Cases>=T.V	Total	N.R	Z-value
Full- Period	0.012	508	508	1016	14	-31.074
2001-2003	0.0185	78	78	156	8	-11.406
2004-2006	0.075	78	62	156	4	-12.049
2007-2009	-0.108	78	51	156	5	-11.888
2010-2012	-1.189	88	79	157	14	-10.489
2013-2015	-0.027	92	65	157	2	-12.408
2016-2018	0.046	105	209	210	16	-12.451
2019-2020	0.034	13	34	26	5	-3.403

Table-4.5: BDS independence Test

Sample period	0.5	1.0	1.5	2.0	0.5	1.0	1.5	2.0
Full- Period	24.428	15.596	20.120	1.559	4.804	4.567	5.136	4.567
2001-2003	20.388	3.7491	3.167	2.363	2.761	7.535	3.919	2.613
2004-2006	2.237	20.026	3.293	2.437	3.802	4.595	2.219	4.299
2007-2009	15.367	22.044	2.932	1.297	4.882	3.762	4.576	3.969
2010-2012	1.799	2.122	1.854	1.278	21.28	3.198	4.613	3.576
2013-2015	2.734	3.062	2.021	3.790	9.115	9.229	4.952	4.209
2016-2018	4.842	20.67	17.720	10.860	12.080	3.413	2.836	3.576
2019-2020	23.277	18.560	18.053	132.050	8.336	8.547	13.140	13.022

Table-4.6: Lagrange Multiplier Test

Sample period	Value of Durbin Watson
Full- Period	0.668082
2001-2003	1.410672
2004-2006	1.467831
2007-2009	1.971655
2010-2012	1.989291
2013-2015	1.231758
2016-2018	1.748124
2019-2020	1.254525

In Table-4.2 we present the outcomes of autocorrelation test equal to five lags in complete and also in substitute samples. The coefficient of correlation in full sample and all subsamples period shows a strong and significant first order correlation which is an evident of returns predictability. The coefficient for first two Subsamples (2001-2003, 2004-2006) undergoes independent behavior of returns so the returns cannot be predictable. While in subsample (2007-2009) also the significant correlation with an indication of predictability. In next subsample (2010-2012) there is an insignificant coefficient. The coefficients for all the remaining three subsamples (2013-2015, 2016-2018, 2019-2020) are apparent of the dependency of PSX because the lags of all samples are substantial and show a first order correlation, this show that the returns can be predictable. The overall results of the Autocorrelation test reveal that PSX have gone through different period of efficiency and inefficiency over time. So the AMH is the more suitable description of the Sock market return over varying period.

Table-4.3 Offerings the outcomes of Variance Ratio Test in full sample period and also in all subsamples with four K's. The output reveals a mean decline between test statistics and index yields, As the level of significance is 1% or less than 1%. So the inclusive results of this test expose that returns can be predictable by supporting the AMH theory.

In Table-4.4 we documents the results of Runs test in which the full sample and also in all subsamples expose a significant Z value which is an evident of first order inefficiency, so the returns can be expected (inefficient) on the base of the previous history price. The overall results of the runs test revealed that KSE 100 index follow the (inefficiency, predictability) dependence movements, thus AMH is considered to be as a better depiction of return in equity market.

Table-4.5 exhibits the summary of BDS independence test in full and all subsamples. The overall result of this test display a solid evident of nonlinear dependence in full and all subsamples at 1% level of confidence.

In Table-4.6 the results of the LM (Lagrange Multiple) are present the Durbin-Watson value of full sample and also in each subsamples are strongly significant, the level of significance is less than 2%. The overall result of this test show that returns can be predictable inconsistent with AMH.

The crux of all tests state that AMH is comparatively better model than EMH in order to present the movement of PSX return and strong helpful of remaining market inefficiency than the AMH, Due to the time varying behavior of PSX.

Conclusion

This research work is significant because the previous studies have some drawbacks and this approach will move the attention of the researcher toward new direction. In order to intricate the time varying nature of stock market returns. The results of linear tests are present in Table-2, Table-3, and Table-4 and nonlinear in Table-5 and Table-6. The summary of Autocorrelation (Table-2) present that returns of PSX has gone through different periods of dependence and independence and provides the arguments consistent with the implication of AMH. Table-3 documented the results of Variance Ratio test with all four k's and a mean reversion between test statistics. The output of this test shows that stock market returns of PSX are strongly significant that fall in inefficient market contrary to EMH. Results of Runs test (Table-4) are evident of Linear dependency (inefficiency) throughout the full and also in all subsamples. All of our linear tests intensely support the AMH theory. In order for further series investigation we also apply the two nonlinear tests: BDS independence test and Lagrange multiplier test. (Table -5). BDS test resulted that returns in full and all subsamples show strong nonlinear dependence and market fall in inefficiency, which is contrary to EMH and consistent with AMH. In second nonlinear test Lagrange multiplier, it is resulted that in total sample period including all subsamples indicate the positive nonlinear dependence at 2%. All the tests we applied including three linear and 2 nonlinear support that PSX follow the significant depended. Only the autocorrelation test reveal that returns are undergo in different periods of dependency (predictability, inefficiency) and independency (unpredictability and efficiency), which is a clear indication of adaptive nature of PSX by supporting the AMH.

In a nut shell the returns of KSE 100 index of PSX follow time varying behavior in both linear and nonlinear tests. Our results shows that returns follow the movement of efficient and inefficient period as PSX follows the evolving behavior, which is contrary to EMH and consistent with AMH. This investigation is convenient and could be of attention to the readers, who are linked with the area of investment and finance. In most of the existing literature, it was observed that researchers use the EMH to check the movements of stock returns with contrary results (opposed to EMH). Thus, finally it is concluding that AMH can better explain and strongly elucidate the behavior of stock return over time than EMH.

As the variation in market conditions can highly impress the trading activities and market efficiency, so the investors can get the help from this study in making the investing decisions. This study will be beneficial for local and foreign investors, forecasting agencies, media and practitioners for arbitrage opportunities from the momentum and reversal strategies in the KSE. it can be applied to practical setting such as asset allocation, investment consulting, risk management and also make a great contribution in theoretical frame work via opposing the EMH and in favor of AMH and advance behavior finance theory This research is useful for institutions, for individual investors, managers, policy makers, students (as a base for further research) and specially for regulating bodies to consider the market conditions in order to implement rules and regulation.

The main significant limitation of this study is that theory suggested by the Lim and Brook (2011) that the efficiency of market should be dependent on market conditions was only measured qualitative nature. We assume it as quantitative approach because the Pakistan's stock market had only suffered a short-term period of stock market bubbles tempted crisis, so the large sample period was incredible for statistically meaningful analysis. The researchers can expand their area of research by applying the Bayesian network modeling with the R package Bayes VL (Vuong and La 2019). This research may not be present solid arguments with subjective opinion due to its quantitative assessment.

In order to remove this shortcoming, the researchers should pool a large period data of different stock returns indices, Pakistan's return indices and some other parallel indices which are similar to Pakistan's stock market. The nature of the data must be panel so that the data in relation to market conditions can huge enough to provide accurate interpretation. For accurate results it requires that the researcher have a sound knowledge of Pakistan's stock market and other harmonious stock market. . We hope that this study might be supportive and adapted to investigate the other countries stock markets, but we left this work for forthcoming researchers.

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