Analysis Test of Market Efficiency: A Case Study of KSE

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Analysis & Test of Market Efficiency: A Case Study of KSE

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Abstract

This study employs more recent and comprehensive data (1997-2013) for the empirical verification of weak form efficiency in Karachi Stock Exchange (KSE). We use Augmented Dickey Fuller (ADF) and Philips-Perron (PP) tests to detect unit root in the daily returns series. Further, we run Random Walk Model (RWM) to detect unit root in returns series. We use Runs test to detect any possible serial correlation in residuals. Results are in support of weak form efficiency. However, the study argues that strong form efficiency does not exist in KSE. We compare equity funds returns with KSE 100 Index returns for 10 years (2003-2012) and we find that the mean returns and standard deviations are not much different. However, the correlation between the returns is found to be low which indicates that equity funds do not mimic market index and have very concentrated portfolios comprising of growth stocks. Finally, we also compare the returns and Sharpe ratio for Islamic and conventional equity mutual funds. Since Islamic funds due to investment and trading restrictions can not exactly mimic market portfolio, the return comparison could help in studying whether the contention of EMH proponents that expert investors too can do as good as earning returns on market portfolio is entirely valid or are there some qualifications and exceptions. We report evidence that challenges the EMH proposition.

Keywords Market Efficiency, Weak Form Efficiency, Strong Form Efficiency, Capital Markets, Volatility, Asset Pricing Models, Investor Behavior, Emerging Markets

JEL Codes G11, G12, G14

1. Introduction: Market Efficiency

1.1. Definition

Fama (1965) coined the phrase “efficient markets” and defined market efficiency as follows:

> *"In an efficient market, competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take place in the future. In other words, in an efficient market at any point in time, the actual price of a security will be a good estimate of its intrinsic value."*

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A market is efficient with respect to information set if it is impossible to make economic profits by trading on the basis of information set. (Jensen, 1978)

Efficient markets do not imply that investors cannot earn a positive return in the stock market. But, efficient markets do imply that on average, investors will earn a return that is appropriate for the risk undertaken and there is no bias in prices that can be exploited to earn excess returns.

1.2. Forms of Market Efficiency

1.2.1. Weak Form Efficiency

In weak-form efficiency, future prices cannot be predicted by analyzing prices from the past. Excess returns cannot be earned in the long run by using investment strategies based on historical share prices or other historical data. Technical analysis techniques will not be able to consistently produce excess returns, though some forms of fundamental analysis may still provide excess returns.

1.2.2. Semi-Strong Form Efficiency

In semi-strong-form efficiency, it is implied that share prices adjust to publicly available new information very rapidly and in an unbiased fashion, such that no excess returns can be earned by trading on that information. Semi-strong-form efficiency implies that neither fundamental analysis nor technical analysis techniques will be able to reliably produce excess returns. Neither technical nor fundamental analysis can be used to beat the market consistently on risk-adjusted basis.

1.2.3. Strong Form Efficiency

In strong-form efficiency, share prices reflect all information, public and private, and no one can earn excess returns. It implies that even insiders cannot beat the market consistently. Evidence is usually against strong form efficiency even in developed markets.

1.3. Salient Implications

- People process data appropriately and correctly.
- People view all decisions through the transparent and objective lens of risk and return.
- People are guided by reason and logic and independent judgment.
- Market price of a security is an unbiased estimate of its intrinsic value.
- Market prices reflect rational expectations.
- Ex ante, expected abnormal returns are zero.

- Current price reflects all current information. Price changes must be due to new unexpected information arriving. Unexpected information is a chance event, i.e. random and hence price changes away from expected values are also random.

2. Evidence on Efficiency in Developed Markets

2.1. Literature in Favor of Market Efficiency

In the early years of Efficient Market Hypothesis (EMH), Jensen (1978) exclaimed that there is no other proposition in economics which has more solid empirical evidence supporting it than the EMH. That hypothesis has been tested and, with very few exceptions, found consistent with the data in a wide variety of markets: the New York and American Stock Exchanges, the Australian, English, and German stock markets, various commodity futures markets, the Over-the-Counter markets, the corporate and government bond markets, the Options market, and the market for seats on the New York Stock Exchange.

In favor of market efficiency, Fama (1998) concludes that consistent with the market efficiency hypothesis that the anomalies are chance results, apparent overreaction to information is about as common as under reaction and post-event continuation of pre-event abnormal returns is about as frequent as post-event reversal. Most importantly, consistent with the market efficiency prediction that apparent anomalies can be due to methodology, most long-term return anomalies tend to disappear with reasonable changes in technique.

He further argues that in an efficient market, apparent under reaction will be about as frequent as overreaction. If anomalies split randomly between under reaction and overreaction, they are consistent with market efficiency.

Jensen (1968) analyzing 115 mutual funds over the period 1955-64 concludes that on a risk-adjusted basis, any advantage that the portfolio managers might have is consumed by fees and expenses. Even if investment management fees and loads are added back to performance measures, and returns are measured gross of management expenses, Jensen concludes that on average the funds apparently were not quite successful enough in their trading activities to recoup even their brokerage expenses.

Roll (1994) observes that it is remarkably hard to profit from even the most extreme violations of market efficiency. Stock market anomalies are only too often chance events that do not persist into the future.

If anomalies can be exploited, then the expert fund managers and analysts shall be able to beat the market often enough. Using bootstrap simulations, Fama & French (2010) investigated 3,156 funds in their sample and suggested that few funds produce benchmark-adjusted expected returns sufficient to cover their costs. Some do extraordinarily well and some do extraordinarily poorly just by chance.

In another study, Odean (1999) finds that momentum investors do not realize excess returns.

In general, RWM of returns had not been refuted in most studies. Even where it had been refuted, the evidence has to be interpreted with a grain of salt because of the dual hypothesis problem discussed in next section. There has been favorable evidence for weak form & semi strong form based on event studies. Fama (1998) surveys the considerable body of empirical work on "event studies" that seeks to determine if stock prices respond efficiently to information. The "events" include such announcements as earnings surprises, stock splits, dividend actions, mergers, new exchange listings, and initial public offerings.

We must appreciate that the notion of efficiency encompasses informational efficiency and not necessarily transactional and operational efficiency.

Regarding the existence and evidence in favor of market and behavioral anomalies, one must note that an anomaly discussed means that it is known. It is less likely to do the same next time because others will be watching for it as well.

Anomalies are empirical results that seem to be inconsistent with maintained theories of asset-pricing behavior. They indicate either market inefficiency (profit opportunities) or inadequacies in the underlying asset-pricing model. After they are documented and analyzed in the academic literature, anomalies often seem to disappear, reverse, or attenuate. This raises the question that whether profit opportunities of the past have since been arbitraged away, or whether the anomalies were simply statistical aberrations that attracted the attention of academics and practitioners.

According to EMH proponents, the random errors of investors cancel out in the market. This requires individual errors (departures from individual rationality) to be cross-sectionally independent or at least only weakly correlated.

Fama (1998) finds that apparent under reaction to information is about as common as overreaction, and post-event continuation of abnormal returns is as frequent as post-event reversals. He also shows that many of the return "anomalies" arise only in the context of some very particular model, and that the results tend to disappear when exposed to different models for expected "normal" returns, different methods to adjust for risk, and when different statistical approaches are used to measure them. For example, a study, which gives equal-weight to post-announcement returns of many stocks, can produce different results from a study that weight the stocks according to their value. Certainly, whatever momentum that is displayed by stock prices, it does not appear to offer investors a dependable way to earn abnormal returns.

Momentum strategies, which refer to buying stocks that display positive serial correlation and/or positive relative strength, appeared to produce positive relative returns during some periods of the late 1990s, but highly negative relative returns during

2000. It is far from clear that any stock-price patterns are useful for investors in fashioning an investment strategy that will dependably earn excess returns.

2.2. Literature in Opposition of Market Efficiency

Even in empirical studies done for developed markets, the hypothesis about strong form efficiency is not accepted. There is ample evidence of insider trading even in developed markets. Asymmetric information is not something that can be easily resolved through market forces.

The argument that speculators will lead the stock price to reach its fundamental value is also incomplete explanation. If information set is widely available and that cannot detect price anomalies, then, how come speculators know about situations where stock is trading away from its fundamental value?

Grossman and Stieglitz (1980) argued that because information is costly, prices cannot perfectly reflect the information which is available, since if it did, those who spent resources to obtain it would receive no compensation, leading to the conclusion that an informationally efficient market is impossible.

Next, we discuss the literature that challenges the notion of efficiency both on theoretical and empirical grounds.

2.2.1. Dual Hypothesis Problem

The market efficiency hypothesis says nothing about the structure of stock prices. Inefficiency would imply that abnormal returns can be consistently achieved. We can define abnormal return as the difference between actual and expected return.

This means that we have to know the expected return. For that, we use different asset pricing models like CAPM to find a risk-adjusted return that the market will be rewarding.

Defining abnormal return inherently involves assuming a pricing model. If we find abnormal returns, we conclude that the market is inefficient. But then, we can also say that the pricing model we used is invalid.

The challenge here is: testing market efficiency inevitably involves testing a joint hypothesis:

- H_0: Both market is efficient and the pricing model is valid.
- H_1: EITHER market is inefficient OR the pricing model is invalid.

Jensen (1978) points out that in most cases our tests of market efficiency are, of course, tests of a joint hypothesis; market efficiency and, in the more recent tests, the

two parameter equilibrium model of asset price determination. The tests can fail either because one of the two hypotheses is false or because both parts of the joint hypothesis are false.

2.2.2. Problem with Return Based Argument of Efficiency

The hypothesis has two parts: the no-free-lunch part and the price-is-right part. After the current financial crisis, the first part has been strengthened as we have learned that some investment strategies are riskier than they look and it really is difficult to beat the market. The idea that the market price is the right price, however, has been badly dented.

As per EMH, correct prices imply that there is no free lunch. However, if there is no free lunch, it does not mean that prices are right. In extremely volatile markets, it is difficult to earn consistent abnormal returns; however, excess volatility in prices is not necessarily always based on changes in fundamentals of the companies.

Stating it in another way, if there is mispricing in the market, it does not necessarily imply predictability of price patterns and opportunity to earn abnormal returns. But, if prices remain unpredictable and do not easily allow profit opportunities, it is not a sufficient condition that prices are always right.

3. Market Efficiency at KSE

3.1. KSE 100 Index composition

On November 1, 1991 the KSE 100 Index was introduced. It is a capital weighted index and consists of 100 companies. The selection criteria for stock inclusion comprise sector rule and capitalization rule. Under the sector rule, companies with the largest market capitalization in each of the 34 sectors of the exchange are selected. Under the capitalization rule, the remaining 66 companies are taken up on the basis of market capitalization of companies in descending order.

3.2. Literature Review on Market Efficiency Studies in Pakistan

Mehmood et al. (2012) using the historical data of KSE-100 Index from 2001 to 2011 conclude that KSE-100 Index follows the RWH and EMH. They argue that KSE is an efficient financial market that can adjust to any new information very quickly and efficiently and the prices of the securities listed for trading at KSE-100 Index cannot be predicted from past prices.

Mustafa and Nishat (2007) argue that the KSE is efficient for the overall period of study (1993-2003) correcting for thin trading and non-linearity. The results did not change when the efficiency test is conducted on weekly and monthly data after adjusting for thin trading during the overall study period.

Riaz et al. (2013) investigates the weak form efficiency for Karachi stock market by taking monthly index data for the period 1997-2011. The results showed that KSE is not weak form efficient.

In addition to that, Hameed & Ashraf (2006) using the data for 1998-2006, rejects the weak-form efficiency hypothesis and concludes that past information helps in predicting future prices.

This contradictory evidence highlights the fact that sample period selection is important and it may provide contradictory evidence in different studies using the same inferential and analytical methods. EMH proponents argue that from a large pool of data, it is always possible to find sub-sample periods where inefficiency may get support. However, for rejecting EMH, the evidence has to persist in all time periods consistently rather than being a sample specific result or a statistical aberration.

4. Analysis of Volatility & Mispricing

Volatility or mispricing does not strictly imply inefficiency. But, these two factors had been observed in Pakistan's premier stock exchange.

The possible reasons of mispricing could be as follows:

1) Low participation of investors due to low per capita incomes and savings.

2) Liquidity shortage and high cost of leverage. Short selling regulations came in 2002 and margin financing regulations came in 2004. Still, not all companies are eligible for margin financing.

3) Noise traders dominate rational investors and market makers.

4) Overreaction and herd behavior among small to medium investors.

5) Short term trading horizons and representative and anchoring bias in investors.

5. Weak Form Market Efficiency Tests for KSE

5.1. Random Walk Model for KSE-100 Returns

Figure 1 below shows movement of KSE 100 index from January 1997 to May 2013.

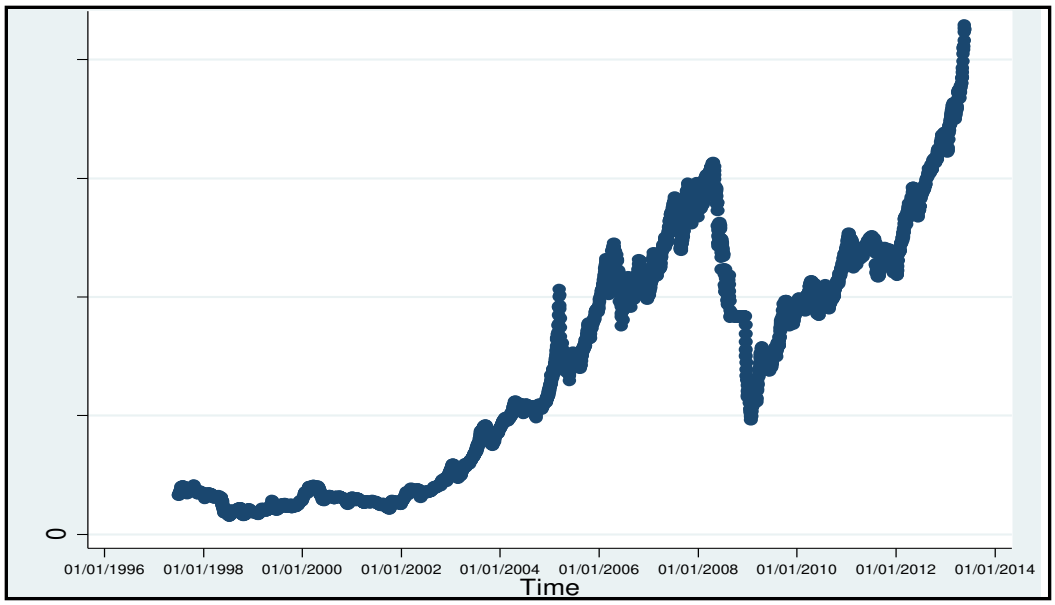

Figure 1: KSE 100 Index Values (1997-2013)

Figure 2 below shows the daily returns distribution on KSE-100 index. It plots the normal and kernel density functions. Both represent close to normal distribution of returns.

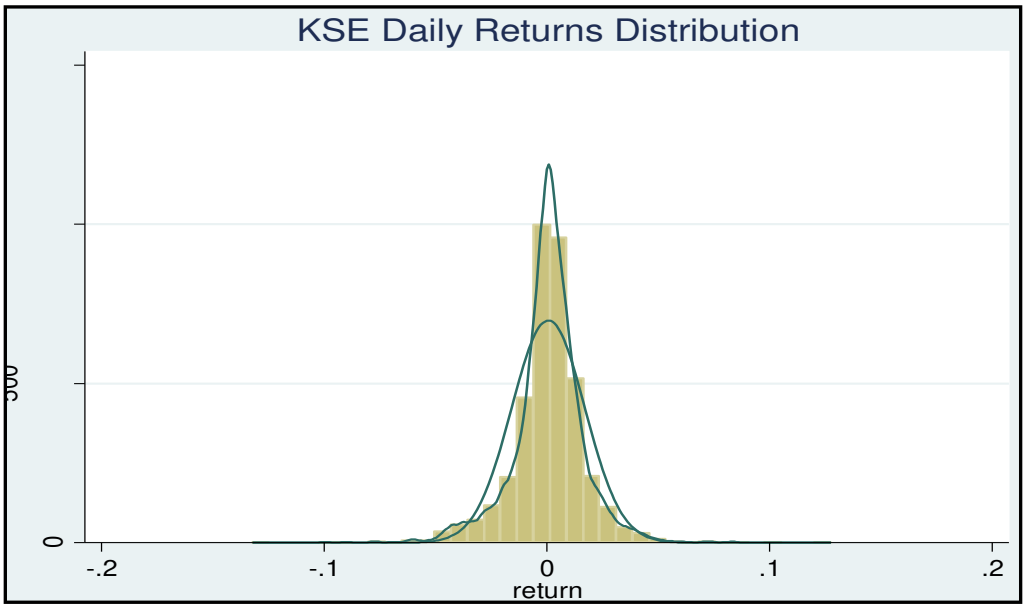

Figure 2: KSE Daily Returns Distributiom

Table 1 below gives result of regression of daily returns on single lagged value of daily returns with and without Drift.

VARIABLES	(1) return	(2) return
dreturn	0.0930***	0.0945***
	(5.816)	(5.910)
Constant	0.000598**	
	(2.273)	
Observations	3,875	3,875
R-squared	0.009	0.009

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1: RWM With & Without Drift (Regression of Return on Lagged Returns)

From the Random Walk Model without Drift, residuals are estimated. In figure 3, Plot of estimated residuals versus lagged values of estimated residuals gives preliminary confirmation of possibly no serial correlation in disturbances.

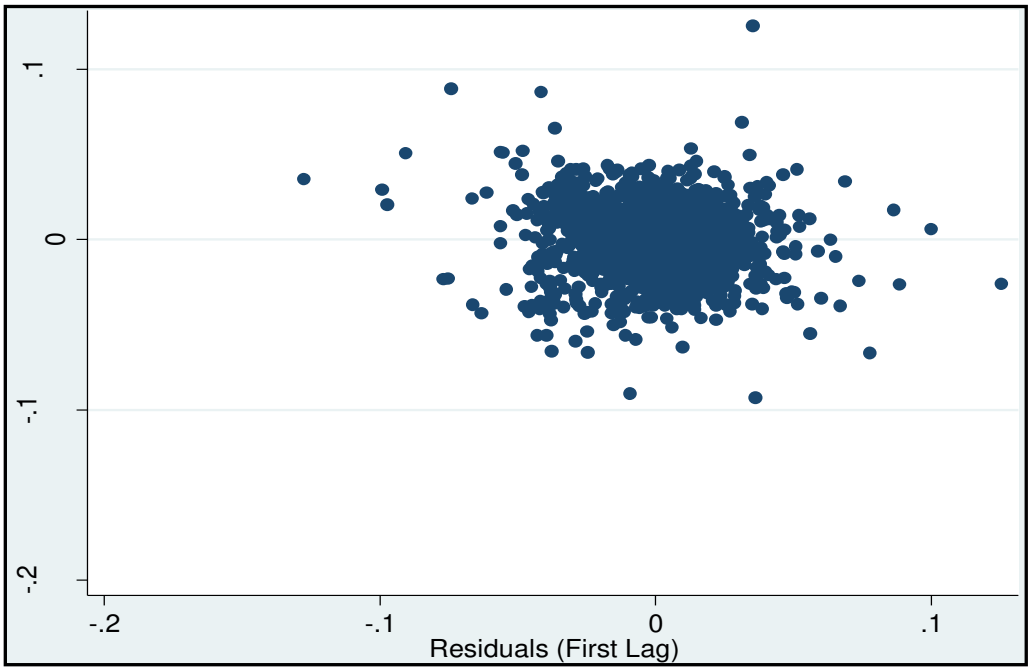

Figure 3: Plot of Estimated Residuals &Lagged Estimated Residuals

Figure 4 plots returns distribution across time which exhibits a random pattern.

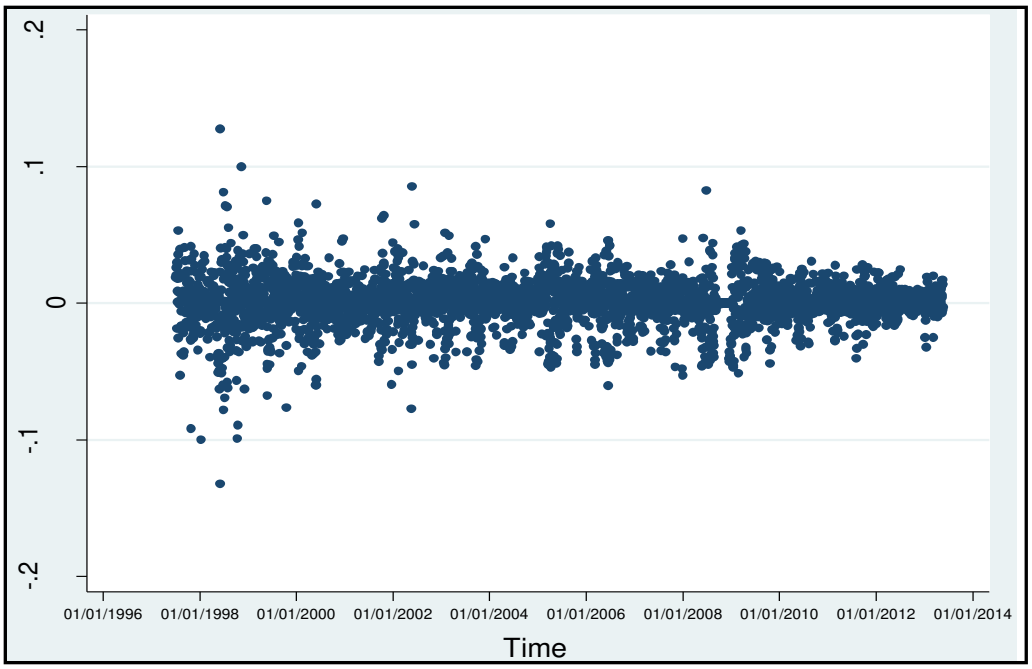

Figure 4: Daily Returns Sorted on Time

Finally, unit root tests, i.e. Dickey-Fuller and Philips-Perron confirm that the returns series is stationary and unit root does not exist.

```
. dfuller return

Dickey-Fuller test for unit root                    Number of obs   =      2976

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -58.104           -3.430            -2.860           -2.570
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. pperron return

Phillips-Perron test for unit root                  Number of obs   =      2976
                                                    Newey-West lags =         8

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(rho)         -3060.828          -20.700           -14.100          -11.300
 Z(t)             -57.587           -3.430            -2.860           -2.570
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

Table 2: Unit Root Tests on Daily Returns Using DF & PP Tests

5.2. Runs Test for Serial Correlation in Errors

To further confirm presence of serial correlation in errors inferentially, we conduct Runs test.

H_0: the sequence was produced in a random manner
H_a: the sequence was not produced in a random manner

The test statistic is

$$Z = \frac{R - \bar{R}}{S_R}$$

Where R is the observed number of runs, $\bar{R}$, is the expected number of runs, and s_R is the standard deviation of the number of runs. The values of $\bar{R}$ and s_R are computed as follows:

$$\bar{R} = \frac{2n_1n_2}{n_1 + n_2} + 1$$

$$S_R^2 = \frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)} + 1$$

With z-value of -0.54 reported in Table 3, we could not reject null hypothesis of randomness.

```
. runtest r, thresh (0)
 N(r <= 0) = 1787
 N(r >  0) = 2088
       obs = 3875
   N(runs) = 1910
         z = -.54
  Prob>|z| = .59
```

Table 3: Runs Test

5.3. Performance Comparison of Equity Funds & KSE 100 Index

Mutual funds have expert analysts who are trained to make informed investments on the behalf of people. If market is efficient, then, two types of traders could be able to earn above average market returns, the fund managers and the insiders. In Figure 5, we see a comparison of returns on equity funds and KSE 100 index for the recent 10 year period (2003-12).

The graph shows that the peak of equity funds return is much higher than the market index while the trough of market is further lower than equity funds returns. It might be an indicator that in bullish market, equity funds perform better than the market index and in bearish markets, the equity funds are more resilient than the market index.

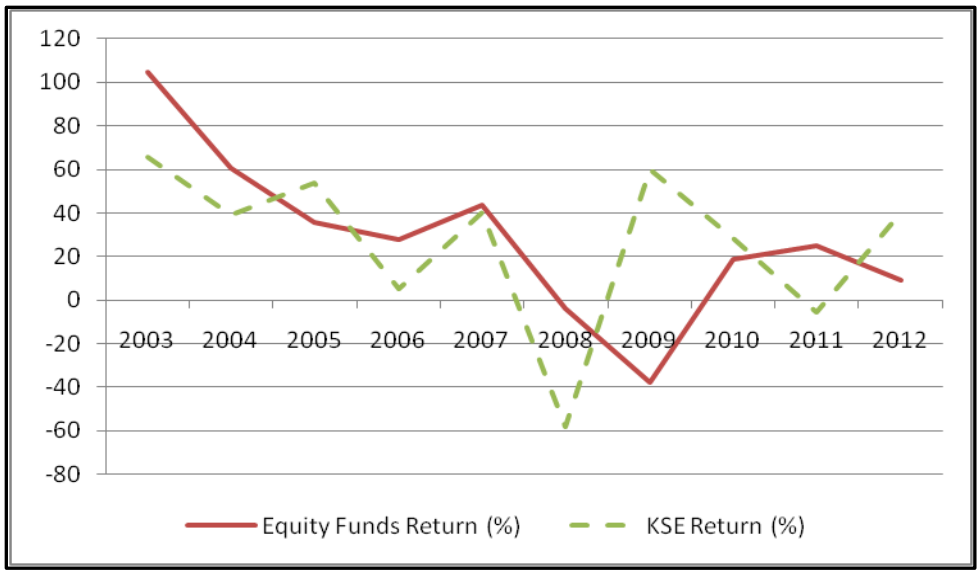

Figure 5: Comparison of Equity Funds and KSE-100 Index Returns

But, interestingly, in Table 4, the correlation in two returns series is weakly positive.

Descriptive Statistics	Equity Funds Return (%)	KSE Return (%)
Mean	28.306	26.79247015
Standard Deviation	38.04879943	37.43254934
Correlation	0.324264312	

Table 4: Comparison of Equity Funds and KSE-100 Index

It indicates that equity funds do not necessarily mimic market index and they are more active and ambitious to beat the market. However, on a long term basis, the mean return as well as the deviation seems to be same for both returns series. Hence, equity mutual funds seem to be unable to consistently provide market beating returns which goes well with the efficient market hypothesis.

Taking another example, we compare the return on Islamic and conventional mutual funds. Islamic funds can not exactly mimic the market index as they are prohibited to engage in investments with conventional banks, conventional insurance companies, conventional investment banks, conventional mutual funds, interest based bonds, notes and derivatives. They also have trading restrictions which stop them from using short selling, margin financing, futures sale etc. Finally, based on other criteria such as maximum allowable non-compliant income and interest based leverage, they could not

invest for a considerable time during the period in blue chip non-financial companies like HUBCO, FFBL, ENGRO, DGKC, APL, PACKAGES, NML etc.

That is the reason why, it will be interesting to compare the returns on two types of funds to see whether indexing or mimicking the market is the most mutual fund managers could do or they could deviate from the market portfolio (like Islamic funds) and still earn above average returns.

In Table 5, we present average annualized return of Islamic and non-Islamic open ended mutual funds during the last 365 days computed on July 12, 2012.

Fund Category	Return on Islamic Funds (%)	Return on Other Funds (%)
Aggressive Fixed Income	10.94	7.01
Asset Allocation	9.76	8.48
Balanced Funds	18.00	11.59
Capital Protected Funds	14.64	5.68
Equity Funds	24.67	17.67
Income Funds	10.44	9.32
Money Market Funds	10.47	11.25
Average Return	14.13	10.14

Table 5: Annualized Return for last 365 Days (%)

It can be seen that apart from money market funds category, Islamic mutual funds have had higher returns than conventional mutual funds.

In Table 6, we present average annualized return of Islamic and non-Islamic voluntary pension funds in various categories during the last 365 days computed on July 12, 2012.

Fund Category	Return on Islamic Funds (%)	Return on Non-Islamic Funds (%)
Debt Funds	8.86	10.67
Equity Funds	24.10	19.54
Money Market Funds	9.45	10.37

Table 6: Annualized Return for last 365 Days (%)

It can be seen that equity funds in Islamic voluntary pension schemes have performed better than their counterparts. But, in debt and money market category, Islamic voluntary pension funds fall behind conventional funds marginally.

However, it can be argued that looking at returns alone without incorporating risk, the analysis will be incomplete. Hence, we compute the Sharpe ratio for Islamic equity funds and conventional funds using the following standard formula:

$$= \frac{\overline{r_p} - r_f}{\sigma_p}$$

Where,

$\overline{r_p}$ = Expected portfolio return.
r_f = Risk free rate.
σ_p = Portfolio standard deviation.

We find that for FY-12, 11 out of 29 conventional equity funds had negative Sharpe ratio. It implies that investment in a risk-less asset will have been better than investment in these funds. For 5 Islamic equity funds, not only the Sharpe ratio was positive for all, but, average un-weighted Sharpe ratio for Islamic was more than conventional mutual funds.

Coming to the strong form efficiency, there are three exceptions to strong form market efficiency in recent past.

1) In 2005, the KSE witnessed the worst-ever crash in the country history, which caused a loss of $13 billion in market capitalization and primarily affected small investors. Big players were able to use the inside information that they possessed and went out of the market at the right time. This information was not available to the small investors who herd and didn't offload quickly enough.

2) In 2008, market plunged by 55% in four months despite limited change in fundamentals during the period.

3) Volumes of the market have declined considerably from the historic peaks. Few major stocks contribute significantly to market movements and active stocks universe has shrunk a great deal. Furthermore, FPI (Foreign Portfolio Investment) from hedge funds had significantly influenced market movements.

In light of these, the institutions especially the brokers, foreign hedge funds and to an extent, the mutual funds had been able to withstand panic selling.

Conclusions & Recommendations

Using different inferential techniques, weak form efficiency test could not be rejected for KSE and the returns distribution is stationary and follows a random walk. Hence, past prices cannot be used to predict future prices and earn excess returns. However, mispricing, crashes, panic selling, herd behavior and institutional manipulation of markets with insider information does not provide enough reason to stretch the efficiency argument further in the territory of strong form efficiency.

Finally, we provide recommendations for moving towards an informationally and operationally efficient market.

- Investment banks need to become an effective channel between liquidity rich commercial banks especially Islamic banks to support Initial Public Offering (IPOs) in the market.

- With new IPOs and Seasoned Equity Offerings (SEOs), primary market activities will increase. Therefore, increase in listed companies will expand the market and diversify trading opportunities for investors.

- New memberships can be given to encourage competition, sound market practices and to bring brokerage commissions down. It will make stock as well as commodity markets run efficiently in the operational sense with decrease in transaction costs.

- Information processing must be transparent. The role of Central Depository Company (CDC), Stock Exchange and SECP is to ensure that there is no insider trading, market manipulation and that rules, regulations and procedures are designed with an objective to protect investors, ensure their participation and increase their confidence. There must be strict check on broker's activities and membership must be cancelled if any broker is convicted of a manipulation or fraud.

- Investor education and awareness programs shall be started and academia shall also get involved in market forecasts so that market consensus becomes a summary statistic of many informed participants including the speculators, fund managers and academic scientists.

References

Fama, Eugene F. (1965). Random Walks in Stock Market Prices, *Financial Analysts Journal*.

Fama, Eugene F. (1998). Market Efficiency, Long-Term Returns, and Behavioral Finance, *Journal of Financial Economics*, 49(3), pp. 283-306.

Hameed, Abid & Ashraf, Hammad (2006). Stock Market Volatility and Weak-Form Efficiency: Evidence from an Emerging Market, *Pakistan Development review*, 45 (4), pp. 1029–1040.

Jensen, Michael C. (1968). The Performance of Mutual Funds in the Period 1945-1964, *Journal of Finance*, 23, pp. 389-416.

Jensen, Michael C. (1978). Some Anomalous Evidence Regarding Market Efficiency, *Journal of Financial Economics*, 6 (2/3), pp. 95-101, 1978.

Mehmood, Mian Saqib, Mehmood, Asif and Mujtaba, Bahaudin G. (2012), Stock Market Prices Follow the Random Walks: Evidence from the Efficiency of Karachi Stock

Exchange, *European Journal of Economics, Finance and Administrative Sciences*, Vol. 51, pp. 71-80, 2012.

Mustafa, Khalid & Nishat, Muhammad (2007). Testing for Market Efficiency in Emerging Markets: A Case Study of the Karachi Stock Market, *Lahore Journal of economics*, 12 (1), pp. 119–140.

Odean, Terrance (1999), "Do Investors Trade Too Much?" *American Economic Review*, 89, 1279-1298.

Riaz, Tabassum, Hassan, Arshad & Nadim, Muhammad (2013). Market Efficiency in its Weak-Form; Evidence from Karachi Stock Exchange of Pakistan, *The Journal of Commerce, 4(4)*, pp. 9–18.

Roll, Richard (1994). What Every CEO Should Know About Scientific Progress in Economics: What is Known and What Remains to be Resolved, *Financial Management*, 23, pp. 69-75.