International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 3
March 2018

Weak Form Efficiency of Gold Prices in the Indian Market

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Abstract
With the increased number of investment avenues, market efficiency is an important concept for investors. In this paper we have test the weak form efficiency of gold market in India. For this the daily MCX (Multi Commodity Exchange) spot prices of gold form the period June 2005 to Dec 2016 is tested. The evidence of Runs Test, Autocorrelation and Variance Ratio Test suggests that the series follows Random Walk Model and the Indian Gold Market is weak form efficient.

I. Introduction

Efficient market hypothesis (EMH) is an important concept of capital market. It is based on the idea that investors have no opportunity of having abnormal gains. The only way to earn higher profits is to rather invest in more and more risky securities. According to the theory of efficient market hypothesis it is difficult to predict the future price movement of the security on the basis of any new information released in the market regarding that security, as the new information gets instantaneously absorbed in security's price. The concept of market efficiency was first introduced by Fama (1965) and Samuelson (1965) by arguing that price of an asset fluctuates randomly around its expected value. Fama (1970) elaborated the concept of Efficient Market Hypothesis and also discussed about the three forms of the market efficiency, namely, weak form, semi-strong form and strong form market efficiency. Weak from market efficiency refers to a market where there is no correlation between the past prices and predicted future prices. Semi-Strong form market efficiency refers to a market in which prices are instantaneously adjusted to any publicly declared information like announcement of dividends, stock splits etc. without any bias. Finally a market is said to be strong from efficient when an investor cannot earn excess returns even on the basis of access to some inside information, which is, related to security. These three forms of market efficiency are great area of interest for finance experts globally and are widely tested in case of equity shares. However empirical investigation of this phenomenon is limited in case of gold which has emerged as the important asset class these days. Gold having observed historically low correlation with other asset classes (World Gold Council, 2010) offers considerable diversification benefits. The present research paper aims to empirically test the weak form efficiency of gold prices in India. The paper is divided in five sections. First section gives a brief overview of the study. The following section reviews existing empirical literature related to the weak form efficiency of securities, particularly gold. Section three describes data and methodology followed in the study. Fourth section comprises results and analysis and finally the last section summarises the findings and brings conclusions of the present study.

II. Literature Review

The concept of market efficiency is of great importance for investors from many decades. Fama (1970) discussed the idea of EMH and till now it has been under study by many other authors. The three forms of market efficiency were given by Fama (1970). Weak form efficiency in EMH shows that the current prices of

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stock are not dependent on their past prices. In India various studies were conducted to test the weak form of market efficiency. There are some studies which showed the market to be weak form efficient Ramasastri (1999), tested Indian stock markets using ADF test and concluded the markets to be weak form efficient. Gupta and Yang (2011) had applied ADF, PP and KPSS test on the BSE and NSE stocks and found very interesting results as the monthly data supported the randomness whereas the daily and weekly data rejected the weak form efficiency. Similarly there are various other studies on Indian markets which have not supported the random walk hypothesis Poshakwale (1996), used daily BSE Index data for the period 1987 to 1994 and found the market to be inefficient. Srinivasan (2010), applied ADF and PP test on market return of two major Indian Indices S&P CNX NIFTY and SENSEX but the results showed the market to be inefficient. Arora (2013), tested daily stock market returns of S & P CNX NIFTY using ADF, Autocorrelation& Ljung Box test and found the stock market to be inefficient. Other studies like [Gupta and Basu (2007); Hamid et. al. (2010); Gupta and Yang (2011)].

A number of efficiency tests were conducted by various researchers on different data and in different markets. Cooper (1982), applied correlation analysis, spectral analysis and runs test on daily, weekly and monthly data of 36 countries but found the markets to be non- random. Borges (2008) studied the weak form efficiency applied to stock market indexes of France, Germany, UK, Greece, Portugal and Spain from January 1993 to December 2007. A number of tests like Serial Correlation, Runs test, Augmented Dickey Fuller test and the Multiple Variance Ratio test were used on the daily and monthly data for a period of five years from 2003 to 2007. The paper concluded that out of six countries Greece and Portugal have positive serial correlation and hence these two countries have not followed random walk. On the other hand the remaining four countries met all the conditions of random walk behaviour. In the same way Watanapalachaikul and Clark (2005) had applied Runs test and Autocorrelation Function test on Thai Stock Market which showed that during post crisis period there was an Autocorrelation in the Thai Stock Market returns. Further, the runs test rejected the null hypothesis which rendered the stock market to be inefficient. Hamid.et.al. (2010) tested the weak form efficiency of the stock returns of Pakistan, Sri Lanka, China, India, Korea, Indonesia, Hong Kong, Philippine, Malaysia, Singapore, Taiwan, Australia, Thailand and Japan. Data of monthly prices of stocks of these countries were taken from January, 2004 to December, 2009. Autocorrelation, Runs test, Unit Root test and Variance ratios were used to conclude that the stock markets have not followed a random walk and hence the investors could have earned the arbitrage benefits due to market inefficiencies. Siddiqui and Gupta (2010); Mishra (2011) applied a number of Parametric and Non- Parametric tests but found the markets to be inefficient.

The concept of efficient market is mostly applied to the stock markets instead of commodities. Gold being the most attractive investment alternate specially in a developing economy like India. The price rise is not followed by the proportionate increase in value of asset classes in our country. But, Gold is considered as a hedge against inflation. So, the need arises to study the market efficiency of Indian Gold Market.

III. Data and Methodology

Data used for the purpose of study is secondary in nature. Data of daily gold prices has been collected from MCX India Ltd. for the period June, 2005 to December, 2016. To compute the daily gold returns the following formula is used:

$R_t = \text{Ln } P_t - \text{Ln } P_{t-1}$

Where, R_t represents daily returns of gold for period t, P_t and P_{t-1} denote gold prices for period t and period t-1. Normality of the data is tested using descripitive statistics and also by applying Jarque Bera and Shapiro Wilk test. To test the relationship of time series data within its own values at different lags Auto Correlation and Ljung Box Statistics is computed. The formula to calculate Ljung Box Statistics is:

$$Q_k = n(n+2)\sum_{k=1}^{m}\frac{p^2k}{n-k}$$

Where,

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www.ijetsr.com
ISSN 2394 – 3386
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P (k) = 0, Q_k = asymptotically Chi-squared distributed with m degrees of freedom, m is the lag length and n is the sample size.

After that to test the presence of unit root in the data we will use Augmented Dickey-Fuller Test. It is used to test the stationarity of the time series as it is an important condition in random walk and it is tested as follows:

$$\Delta R_t = b_0 + b_1 + \pi_0 R_{t-1} + \sum_{t=1}^{j} \Psi_i \Delta R_{i-1} + \epsilon_t$$

Where, R_t = Price at time *t*

ΔR_t = Change in price

Finally to check the existence of randomness in daily gold price data Runs Test is applied. The following hypothesis is set for this purpose:

H_0: Sequence of daily gold returns is random.

H_a: Sequence of daily gold returns is not random.

Since the value of observations in the run test for randomness is larger than twenty, the distribution of the observed number of runs would approximately follow normal distribution and the value of z, that is, the value of standard normal variate of the observed number of runs is given by:

$$Z = \frac{\omega - \mu_\omega}{\sigma_\omega} \approx N(0,1)$$

Where

$$\mu_\omega = \frac{2m_+m_-}{m} + 1 \text{ and } \sigma_\omega = \sqrt{\frac{2m_+m_-(2m_+m_- - m}{m^2(m-1)}}$$

Here ω refers to observed number of runs, μ_ω refers to expected number of runs, σ_ω is the standard deviation in observed number of runs, m denotes the number of observations, m+ refers to number of observations that fall above mean value and m- refers to number of observations that fall below mean value. In last the Variance Ratio Test is also applied to check the variation of data from its mean value over different lags.

IV. Analysis and Interpretation

Table 1.Test of Normality of Gold Price Returns:

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
X	2852	-0.07512	0.09996	0.00053	0.010609	-0.174	0.046	6.801	0.092
Valid N (listwise)	2852								

Value of coefficient of skewness is (-.174) with standard error 0.046. The value of Z (Skewness / Standard Error) comes to be -3.78; hence the daily return distribution of gold is very likely negatively skewed. It means that there are more negative extreme values and it has a long left tail. Further the Excess Kurtosis value is 6.801 with standard error 0.092. The value of Z (Excess Kurtosis / Standard Error) comes to be 73.92; hence the daily return distribution of gold is highly Leptokurtic. In nutshell the descriptive statistics indicates that the data of daily gold returns is not normally distributed.

Further the results of Jarque Bera test also support the finding that daily gold return data is not normally distributed. (Table 2).

Table 2.Test of Goodness of Fit:

Jarque-Bera Test	
JB (Observed value)	5483.405
JB (Critical value)	5.991
DF	2
p-value (Two-tailed)	< 0.0001
Alpha	0.05

The observed value of JB is 5483.405 as compared to the critical value of 5.991, and consequently the p-value is lower than the significance level alpha=0.05, implying the data is not normally distributed.

Since the daily gold returns data is also found to be asymmetrical thus to validate the argument of non normality of data we have also applied Shapiro Wilk Test. The results of Shapiro wilk test (Table 3) also support the argument of non normality of data.

Table 3.Table to test Goodness of Fit by using Shapiro Wilk test:

Shapiro-Wilk Test	
W	0.937
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Now, as the data is not normal so we have used non-parametric tests to test the weak form efficiency or randomness of the gold returns.

Tests of correlation and runs test is used to check the randomness of the market. Therefore to test the weak form efficiency following hypothesis has been assumed:

$H_{0:}$ Prices of gold market in India follows a random walk

$H_{1:}$ Prices of gold market in India do not follow a random walk

Table 4.Autocorrelation and Q-Statistics for Returns

Autocorrelations					
Series:X					
Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Chi- sq Value	df	p-value
1	0.024	0.019	1.605	1	0.205
2	-0.017	0.019	2.409	2	0.3
3	0.036	0.019	6.032	3	0.11
4	0.025	0.019	7.761	4	0.101
5	0.005	0.019	7.845	5	0.165
6	-0.026	0.019	9.77	6	0.135
7	0.031	0.019	12.573	7	0.083
8	0.035	0.019	16.143	8	0.04
9	0.018	0.019	17.02	9	0.048
10	-0.022	0.019	18.437	10	0.048

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As the above table shows that the correlation over different lags is near to zero and even there are negative correlations in lag 2, 6 and 10 which mean that the null hypothesis is accepted and we will reject the alternate hypothesis. The acceptance of null hypothesis shows that the data follows a random walk and hence the market is weak form efficient. Now, in case of Ljung – Box the p- value is compared with the significance level for each chi square statistic. A significance level at alpha 0.05 is used. The results show that the p- value is greater than the significance level over different lags till lag 7 and in lag 8, 9 and 10 the p- value is slightly less than 0.05. Hence, it is concluded that the residuals are independent and the data is random.

Along with this the data is checked for stationary by using ADF test.

Table 5.Unit Root Test

Augumented Dickey-Fuller Test	
Observed Value	-13.765
Critical Value	-0.867
p-value (one-tailed)	< 0.0001
Alpha	0.05

The above table shows that on the basis of following two hypotheses:

H_0: There is a unit root for the series.

H_a: There is no unit root for the series. The series is stationary.

As the computed p-value is lower than the significance level alpha=0.05. So, we will reject the null hypothesis H_0, and accept the alternative hypothesis H_a. Hence, we can conclude that our data does not follow a stochastic process or there is no particular trend followed by the gold returns. Hence, the gold returns follow a random walk.

To elaborate the authenticity of our results we are using Runs test Table (6) to check the randomness of the gold market in India. The Z statistic is compared with the critical region at particular level of significance and if the value of Z statistic is less than the critical value then we will accept the Null hypotheses and reject the alternate hypotheses.

Table 6.Runs Test at K= Mean Return

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Runs Test	
Test Value	0.0005
Cases < Test Value	1476
Cases > = Test Value	1376
Total Cases	2852
Number of Runs	1425
Z	-0.009
Asymp. Sig. (2- tailed)	0.993

On the basis of above table if compare the Z statistics with the critical value +_ 1.96 then the Null hypothesis is accepted as the value of Z is less than the critical value. So, we can conclude that the series follows the Random Walk and the Indian Gold Market is Weak Form Efficient. Further, to be more assure regarding the Randomness we are using Variance Ratio Test table (7):

Table7. Variance Ratio Test

Period	Var. Ratio	Std. Error	Z-Statistic	Probability
2	0.521073	0.039451	-12.13967	0
4	0.250246	0.066107	-11.34149	0
6	0.175713	0.08119	-10.15254	0
8	0.124075	0.092625	-9.456646	0
10	0.105294	0.102224	-8.752369	0
16	0.064356	0.124819	-7.495983	0

In the above table we have taken five lags at the interval of period 2, 4, 8, 10 and 16. The result shows that all the variance ratios calculated are less than unity. Hence, we can conclude that the data follows a random walk.

V. Conclusion:

As we have analysed gold daily returns data it is found that the data is peaked data and is little bit negatively skewed. But, we can say that in both cases data is not considered to be significantly normal or it significantly departures the normality. Further, we analysed the data to check if the gold returns follow a random walk or there is some trend followed by the gold prices. For this we have applied Autocorrelation, Unit Root (ADF), Runs Test and Variance Ratio. The above test shows that the daily Gold Returns follow the Random Walk and the market is Weak Form Efficient.

References

[1] Arora, H. (2013), "Testing Weak Form of Efficiency of Indian Stock Market", Pacific Business Review International. Vol. 5, Issue 12 (June, 2013) pp. 16-23.
[2] Borges, M.A. (2008), "Efficient Market Hypothesis in European Stock Markets", School of Economics and Management, Department of Economics, Technical University of Libson, Working Papers. ISSN No. 0874-4548, WP 20/2008/DE/CIEF.
[3] Cooper, J.C.B. (1982), "World Stock Markets: Some Random Walk Tests" Applied Economics, 14(5), pp. 515-531.
[4] Chan, K.C., Gup, B.E. and Pan, M.S. (1992), "An Empirical Analysis of Stock Prices in Major Asian Markets and the United States", Financial Review, 27(2), pp. 289-307.
[5] Fama, E.R. (1970), "Efficient Capital markets: A Review of Theory and Empirical Work", Journal of Finance, Volume. 25, Issue-2, Paper and Proceedings of the Twenty Eighth Annual Meeting of the American Finance Association, New York, NY December 28-30, 1969 (May, 1970), 383-417.
[6] Fama, E.R. (1991), "Efficient Capital Markets: II", Journal of Finance, Volume 46, Issue No.5, (Dec.1991), pp. 1575-1617.
[7] Gupta, R., Yang, J. (2011), "Testing Weak Form efficiency in the Indian Capital Market", International Research Journal of Finance and Economics, ISSN: 1450-2887, Issue 75 (2011).
[8] Hamid, K; Suleman, M T; Shah, S Z A and Akash, R. S. I. (2010). "Testing the Weak Form of Efficient Market Hypothesis: Empirical Evidence from Asia- Pacific Markets", International Research Journal of Finance and Economics, Issue 58 (2010), ISSN 1450-2887.
[9] Mishra, P.K. (2011), "Weak Form market efficiency: Evidence From Emerging and Developed World", The Journal of Commerce, 3(2), pp. 26-34.
[10] Mackinley, A.C; Lo, W.A; Campbell, J.Y. (2012). "The Econometrics of Financial Markets", Princeton University Press, Princeton, New Jersey, 28 March, 2012.
[11] Poshakwale, S. (1996), "Evidence on Weak Form Efficiency and Day of the Weak Effect in the Indian Stock Market", Finance India, 10(3), pp. 605-616.
[12] Ramasastri, A.S. (1999), "Market Efficiency in the Nineties: Testing Unit Roots", Pranjan, 28, pp. 155-161.
[13] Sardar,M.N.Islam, Sethapong watanapalachaikul and Colin, Clark. (2005). "Are Emerging Financial Markets Efficient? Some Evidence from the Models of the Thai Stock Market", Financial Modelling Program Centre for Strategic Economic Studies Victoria University, Australia.
[14] Siddiqui, S., Gupta. P.K. (2010), "weak Form of Market Efficiency- Evidences from selected NSE Indices" http://dx.doi.org/10.2139/ssrn.1355103.
[15] Srinivasam, P. (2010), "Testing Weak Form Efficiency of Indian Stock Markets", APJRBM, Vol. 1, Issue 2, Nov. 2010, ISSN. 2229- 4104.