Examining market efficiency: A view from the silver futures market

Alan Harper
South University

Zhenhu Jin
Valparaiso University

Raufu Sokunle
CLS Group

ABSTRACT

This study evaluates whether the silver futures market is efficient in the weak form by examining if silver future prices follow a random walk. We use parametric and non-parametric tests and find that the silver futures market was efficient in the weak form during the examination period. The results indicate that silver prices in the silver futures market reflect all the information contained in the past prices and suggest that no one can consistently predict the future price movements by finding a pattern in the historical prices.

Keywords: precious metals, market efficiency, futures, investments, random walk

INTRODUCTION

The concept of efficient markets is well documented in the finance literature (Fama, 1998; Fama, 1970). The theory states that past asset price movements cannot be used to predict future asset price movements. In this paper, we test the weak form hypothesis of market efficiency for the silver futures market by examining whether silver future prices follow a random walk. The findings from our research has implications for investors because if the silver futures market is not efficient and price movements are independently and identically distributed random variables, some investors can exploit the inefficiency in the silver futures market by gaining abnormal rates of returns as opposed to just earning normal rates of return. This may be beneficial to investors that engage in alternative trading strategies in the futures market by correctly predicting future price movements. There are not many studies testing the Efficient Market Hypothesis (EMH) in regards to the silver futures. This study attempts to fill this void.

In this study, we analyze the daily future silver price returns from Jan 2008 to December 2012 to determine whether the futures market for silver is weak form efficient.

Silver future contracts trade on many U.S. exchanges with the largest being the Chicago Board of Exchange (CBOT) and the Chicago Mercantile Exchange (CME). As of June 2012 per the Bank of International Settlements (BIS), the notional value of commodity exchange traded contracts was $2,933 billion.

The paper proceeds as follows. Section II provides a brief overview of the literature. Section III provides the data collection details, while section IV discusses a commonly used methodology. The paper concludes with an evaluation of the empirical results which is then followed by the conclusion.

RELATED LITERATURE

Testing market efficiency in commodity markets has received a great deal of attention in the literature. Ever since the seminal works of Workings (1953), researchers have tested the efficiency of the futures markets by examining the relationship between spot prices and future prices of commodities. The results of these tests have important implications for investors who hold commodities in a portfolio context. As investors seek a diversified portfolio, understanding the price movements of commodities becomes important. Several researchers have examined price movements in commodities markets for precious metals. For instance, Solt and Swanson (1981) examined the efficiency of gold and silver markets. They found the market for gold and silver does exhibit some positive dependency but this dependency may not be easily exploited by investors. In contrast, Aggarwal and Sundararaghavan (1987) found the silver futures market to be inefficient in the weak form and investors could make modest excess returns using appropriate trading strategies.

In a more recent study, Charles, Darne, and Kim (2014) tested the weak form market efficiency for gold, platinum and silver. Using daily spot data retrieved from Thomas Financial DataStream from 1977 to 2013 and employing the automatic portmanteau and automatic variance ratio test, they find gold and silver markets displayed a downward trend of predictability indicating that gold and silver markets have become more efficient over time. In a prior study, Bird (1985 used filter techniques to test for weak-form efficiency for copper, lead tin and zinc of both daily and future prices listed on the London Metal Exchange. They sampled data from 1972 to 1982. They found that only copper was inefficient. Elder and Serletis (2008) used daily data from the New York Mercantile Exchange on spot-month futures prices for crude oil, gasoline, heating oil, natural gas, and propane. They time frame sampled was January 3, 1984 to June 30, 2005. They found energy prices displayed long memories and anti-persistence, as well as the variance of each commodity series being dominated by high frequency components. This indicates the time series for crude oil, gasoline, heating oil, natural gas, and propane suggest weak form inefficiency.

METHODOLOGY

In testing the weak form market hypothesis of the silver futures market, both parametric and non-parametric tests are used to examine if the time series are independently and identically distributed random variables. We use autocorrelations, which is a parametric test, along with a runs test, which is a non-parametric test in order to be scientifically sound of our results. Autocorrelations and runs tests have been used in numerous studies to examine randomness in asset prices (Harper and Jin, 2012; Harper and Jin, 2013). Our study uses daily silver future prices from January 2008 to December 2012 retrieved from Bloomberg. We seek to test the hypothesis that the series of returns are i.i.d. (independently and identically distributed) random variables. If significant auto-correlations are found in the data, then silver future returns may not exhibit randomness and the silver futures market can be classified as a weak form inefficient. However, if silver price returns do exhibit randomness, then investors may not be able to successfully predict future returns and silver futures may be characterized as a weak form efficient.

DATA

Data for this study was retrieved from Bloomberg database and spans from January 2008 to December 2012. We use daily data in order to capture the temporal movements of future silver prices. The returns of future prices are converted to daily returns using the following estimation:

$$R_t = Log_{pt} \;/\; Log_{pt-1} \qquad (4)$$

Where, R_t is the return at time t of future silver prices, Log_{pt} is the logarithmic price of silver at time t and Log_{pt-1} is the logarithmic price of silver at time $t-1$. We transform time series data to ensure that the data is stationary and does not wander through time. Working with data that wanders through time can cause model misspecification and provide erroneous results.

EMPIRICAL RESULTS

Table 1 depicts the calculation of 1,064 daily statistics. The summary of statistics indicate the range for silver future prices is .3174 respectively. The mean for the daily future prices is .0738%. Interestingly, silver future prices exhibit more kurtosis than a normal distribution and indicate a negative skewness of -.837. The reported kurtosis for future prices is 5.330. A kurtosis of 3 is considered to be associated with a normal distribution. In this case the kurtosis for future silver prices is well above 3. Kurtosis also explains where the standard deviation originates.

Table 1

Descriptive Statistics

		Future	Valid N (listwise)
N	Statistic	1064	1064
Range	Statistic	.3174	
Minimum	Statistic	-.1955	
Maximum	Statistic	.1220	
Mean	Statistic	.000738	
	Std. Error	.0008086	
Std. Deviation	Statistic	.0263754	
Variance	Statistic	.001	
Skewness	Statistic	-.837	
	Std. Error	.075	
Kurtosis	Statistic	5.330	
	Std. Error	.150	

The results of table 2 display the futures market for silver is efficient which is consistent with the findings of Zunino, Tabak, Serinaldi, Zanin, Perez, & Rosso, (2011). There are 16 lag periods associated with the autocorrelation test. The first lag depicts an autocorrelation of .039, a standard error of.031 and a Box-Lung value of 1.630 and is not significant at the 99% confidence level. This indicates that the silver futures prices do follow a random walk. Lags 2 through 13 and 15 all exhibit negative autocorrelations and are not significant, which also indicates that silver futures prices are random. The autocorrelations test is a parametric test and assumes that the data is normally distributed. In order to be scientifically sound, we conduct a runs test which is a non-parametric test that does not assume normality in the data.

Table 3 displays the results of the Runs test which is a non-parametric test. The z value is indicated to be .061 and lies outside of the range of 99% confidence level that future silver prices do follow a random walk. Also, the p value is not significant at the 99% confidence level. Our results from both the autocorrelations and runs tests indicate that the silver futures market does not possess significant serial correlation.

Table 2: Autocorrelations

Autocorrelations
Series:Futures

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic Value	df	Sig.[b]
1	.039	.031	1.630	1	.202
2	-.015	.031	1.865	2	.394
3	-.001	.031	1.866	3	.601
4	-.022	.031	2.386	4	.665
5	-.010	.031	2.490	5	.778
6	-.035	.031	3.769	6	.708
7	.040	.031	5.488	7	.601
8	-.010	.031	5.593	8	.693
9	.019	.030	5.962	9	.744
10	-.013	.030	6.141	10	.803
11	-.028	.030	7.005	11	.799
12	-.006	.030	7.041	12	.855
13	-.026	.030	7.764	13	.859
14	.018	.030	8.115	14	.883
15	-.046	.030	10.413	15	.793
16	.032	.030	11.538	16	.775

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

Table 3: Runs Test

Runs Test

	Futures
Test Value[a]	.0035
Cases < Test Value	532
Cases >= Test Value	532
Total Cases	1064
Number of Runs	534
Z	.061
Asymp. Sig. (2-tailed)	.951

CONCLUSION

This paper answered the question of whether the silver futures market is efficient in the weak form. The literature contains a vast amount of studies that have been performed to test the efficiency in the weak form on financial markets but the results have been inconclusive. There is an apparent debate in the literature where some studies find the futures market efficient but others find the market inefficient. In this study, we use parametric and non-parametric tests to analyze daily silver future price returns from January 2008 to December 2012. The results indicate that the silver futures market is efficient in the weak form during our examination period and imply that no one can consistently predict the future price movements by finding a pattern in the historical prices.

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