Ukrainian Catholic University

Faculty of Applied Sciences

Business Analytics

Oil Market Efficiency

Finance course

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1 Introduction

Market efficiency, a term created by Eugene Fama, is nowadays an important criteria for investors all over the world, which helps them to make much more sustainable decisions. Talking about oil market, this is one of the most important markets for the reason that from 1950s oil is a product that plays a role of one of the most valuable sources of energy. In this investigation the main goal was to test whether the USA oil market is efficient providing the proofs why or why not. The empirical tests and observations were used and are dedicated mainly to test the market on weak-form of efficient market, which states that the stock prices reflect all information contained in historical trading data.

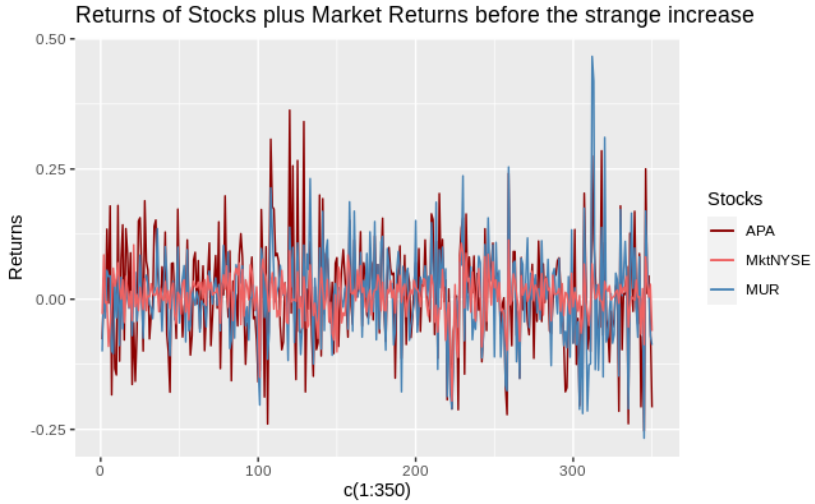
2 Historical Data Overview

As was already mentioned in an introduction section, the investigation is dedicated to the USA oil market. For that reason, there were a bunch of top USA oilgas stocks checked and 16 different stocks' historical data were taken into consideration. Those are Apache Corporation (APA), Baker Hughes Company (BKR), BP p.l.c. (BP), Cabot Oil Gas Corporation (COG), Callon Petroleum Company (CPE), Devon Energy Corporation (DVN), Enbridge Inc. (ENB), Halliburton Company (HAL), Marathon Oil Corporation (MRO), Murphy Oil Corporation (MUR), Noble Energy, Inc. (NBL), Nabors Industries Ltd. (NBR), Occidental Petroleum Corporation (OXY), RPC, Inc. (RES), Schlumberger Limited (SLB), Southwestern Energy Company (SWN). The time gap for investigation is April 1990 - April 2020. The stocks trade on New York Stock Exchange. For the particular tests the SP 500 Index and NYSE Composite were needed.

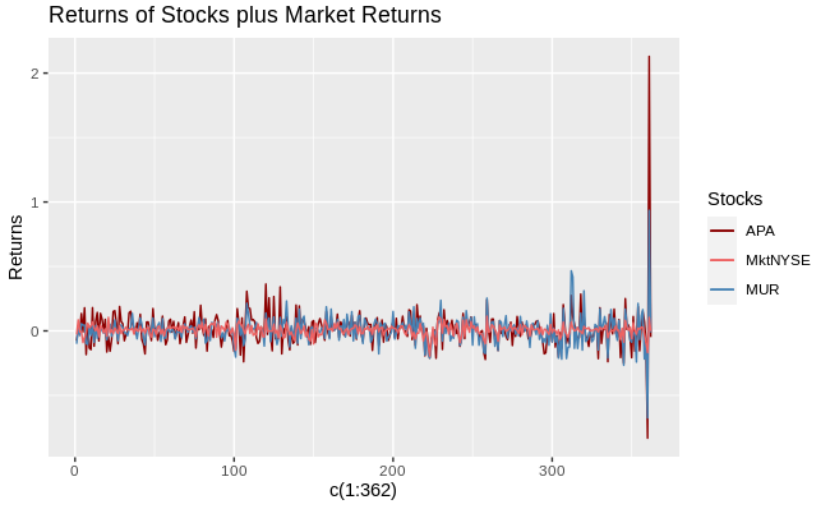
3 Testing the Efficient Market Hypothesis

After forming the data sets we can easily work with, we need to analyze the raw data. As we gathered the prices of sixteen stocks, we had to calculate the returns for each stock. Later on we have calculated the standard statistics to have the general overview of the stocks separately. The statistics used were mean, standard deviation and using those - Sharpe Ratio. The highest Sharpe Ratio regardless the NYSE Composite belongs to COG stock, but

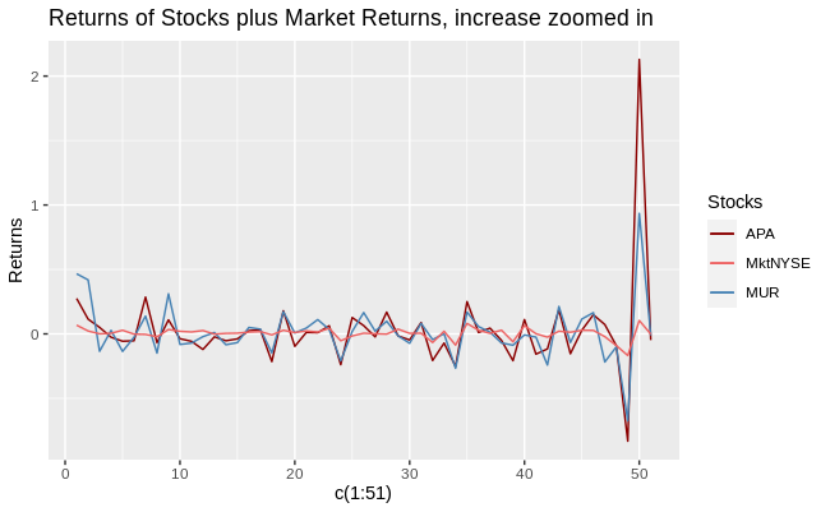
the mean value of the stocks are relatively small. The biggest mean value is 0.28, but the stock itself has extremely high volatility of approximately 3.87. The smallest volatility belongs to the market index with the value 0.04. To visualize the results of computed statistics we have randomly chosen two stocks and plotted their returns along with the market returns. The plot we obtained:



Somehow it has happened that we have already came across some strange situation, as can be seen on the plot above. We observe some strange behavior of return of APA, so let's plot separately all the data before drastic increase in returns and then zoom in the period with the drastic return.



Here we can observe, that the market returns are pretty much stable and more so to say calm in comparison to the two stocks. It is an obvious visual result, because we have already computed the volatility of each stock as well as market returns and found out that the market returns are the least volatile among stocks chosen.



The strange thing is, that the oil stocks could have more than 200% of return during the last months, because considering the situation in the whole world, where the most logical and the best consequence of the crisis would be to keep approximately the same results of returns, here we observe a huge increase. Still, the market flow is smooth and has no unexpected reactions on the outside information.

In case of efficient market, the stock price is the best estimate of its value, but it does not need to be always equal to true value. The main thought is that the prices can deviate from the true value as long as those deviations are random. One can think about the historical data just following the random walk, but here we have to remember, that the presence of random walk (with or without drift) does not imply the market efficiency. Random Walk Theory is actually another hypothesis, that also says that the prices cannot be predicted as in EMH, but while according to EMH the prices reflect all of the information, in Random Walk Theory the prices can be also influenced by some irrelevant information. However, we have decided to test our stocks on following a random walk and found out that the majority of the stocks do not follow the random walk. By running a linear regression to check if

the random walk hypothesis is true, we observe that the stocks like MUR, MRO and APA can be assumed to follow it because of the significance of regression results. It cannot deny the possibility of oil market be efficient for the reason that we have keep in mind, that Random Walk Theory suggests, that the price at time t contains all the information from the price at time t - 1, whereas the EMH states that the price reflects the information, where all the prices are conditioned on the information available at that time t.

According to EMH the stock prices cannot be predicted that is why it lessens the chances for investors to earn abnormal returns or simply to create an arbitrage. To check whether the abnormal returns could be generated from our data, we ran CAPM model regression for each of the stocks and analyzed the significance of alpha (intercept) of the linear models. To perform this test we gathered risk-free rate historical data and market risk premium dependent on SP 500 Market Index. The results of the regressions showed that none of the stocks have significant estimates of abnormal returns, which can lead us to the thought the market can be of a weak-form efficiency.

One more ratio regardless Sharpe Ratio to measure the performance of the portfolio is Treynor Ratio, which has some similarities with Sharpe Ratio (it helps investors to determine how much excess return can be created for a unit of risk), but the key difference between those two ratios is that Treynor Ratio uses estimated beta from CAPM model as the measure of volatility. Calculating the ratio for all stocks we observe that BKR and NBR stocks have the highest results equal to 0.2 and 0.3 respectively. Yet this ratio can be biased because of main dependence on the past.

It is believed that in an efficient environment random diversification or just following the market index would be better than diversifying using some costly strategies. That is why we have formed three different portfolios using strategies like Mean-Variance, Min-Variance and Equal Weights, calculated their returns and then compared to random diversification and to the returns of the market as all. For this problem we used a sliding window of 120 months, which is 10 years. Here we assumed no transaction costs included. Then, having the returns, we calculated mean, standard deviation and Sharpe Ratio and compared the performance. The results of the statistics are included below.

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Mean of  Min Variance  portfolio:  -0.01626583
Standard deviaton of  Min Variance  portfolio:  0.2898288
Sharpe ratio of  Min Variance  portfolio:  -0.194413


Mean of  Mean Variance  portfolio:  -0.08589855
Standard deviaton of  Mean Variance  portfolio:  1.082377
Sharpe ratio of  Mean Variance  portfolio:  -0.2749148


Mean of  Equal Weights  portfolio:  0.02711727
Standard deviaton of  Equal Weights  portfolio:  0.2701143
Sharpe ratio of  Equal Weights  portfolio:  0.3477675


Mean of  Random  portfolio:  0.02341037
Standard deviaton of  Random  portfolio:  0.2138733
Sharpe ratio of  Random  portfolio:  0.3791773


Mean of Market Index portfolio:  0.005736274
Standard deviaton of Market Index portfolio:  0.04191337
Sharpe ratio of Market Index portfolio:  0.4740978
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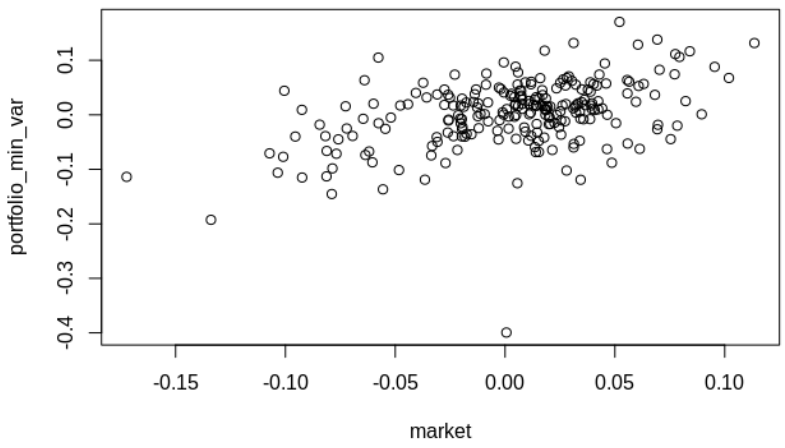
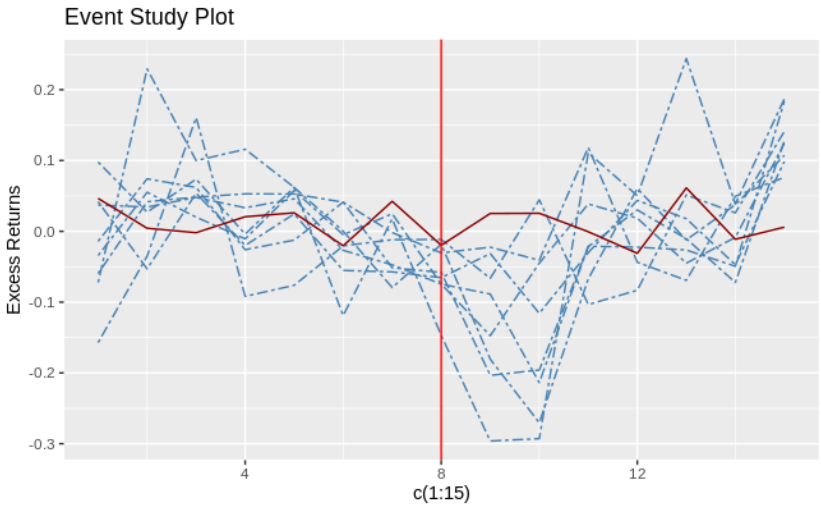
Having the returns of each portfolios, we ran CAPM model regression to see the overall market performance and checked on the presence of abnormal returns. Fortunately, for every portfolio the abnormal returns are equal to zero because of insignificance of the intercept estimates.



The last testing we have performed was an event study. At first the excess returns were calculated for each stock separately by the formula $ER_t =$

$R_t - \beta * R_t^m$. Then after a couple of papers and websites we have decided what event to take into consideration. On the 11th of September 2014 International Energy Agency (IEA) published monthly report, which contained the forecasting information of demand. It was said that the demand will decrease from 92,9 to 92,6 barrels a day. After this type of announcement the prices should have gone down and we are aiming to see particularly the picture of decrease of returns. For analysis, we take seven months before the announcement and seven after to see the reaction of the prices and excess returns.



On the plot above the blue dashed lines are the stocks' returns, the dark red curve is the returns of the market. The timeline of pre- and after-treatment is divided by orthogonal to X axis red line. We obviously see, that after September 2014 the returns decreased. Moreover, all of the stocks were influenced almost in the same way. In comparison to the market returns, the stocks' ones went down below the market returns. The intuitively expected and simultaneous reaction can suggest that the market is efficient and absorbs the information given in the announcements quickly and effectively.

4 Conclusion

After a couple of tests and manipulations we can assume that the oil market during the period 1990 - 2020 could be an example of a weak form of market

efficiency. in such a market there is an equal probability of buying or selling an overvalued or undervalued stock that is no investment strategy could beat the performance in long-term. As we have seen in our testing on abnormal returns, no additional returns were created that do not include the market return per Se. The immediate reaction on the outer information was also observed. Obviously, the better results to prove this assumption can be gained by performing some other event and portfolio studies, analysing P/E ratio and searching for other possible solutions.

5 Literature

Short Notes

- Market Efficiency Explained
- Top Oil Stocks
- Random Walk Theory