Comparative Analysis of ETF Arbitrage Strategy in Efficient and Inefficient Markets

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Abstract. This paper analyzes the different performance of an ETF arbitrage strategy in efficient and inefficient markets, the markets of the United States and Russia. It would initiate from the ETFs and their importance to the global financial market. Then, the paper introduced what the arbitrage strategy is, and how it works. Then, by comparing the key factors, it classifies efficient market, the U.S. market, and the inefficient market, the Russian market. In the paper, the S&P 500 ETF represents the U.S. market, and the VanEck Russia ETF (RSX) represents the Russian Market. The paper analyzes the performance in these two markets from 2016 to 2021 and ignores the transaction costs. The paper concluded that the ETF arbitrage strategy performed better in the inefficient market (Russia) compared to the efficient market (U.S.). Limitations are acknowledged in the paper, such as the effect of transaction costs, which would reduce the actual profits and returns, and that the historical market data might not strong enough in predicting the future performance of the market. These would lead to future research and further analysis to enhance the overall effectiveness of the project and make it aligns more closely with the real-world conditions.

Keywords: ETF, Arbitrage, Efficient Market, Inefficient Market, Mispricing.

1. Introduction

In the modern financial market, the Exchange-Traded Funds (ETFs) have become as important instruments for investors for profiting due to their astonishing growth and the arbitrage opportunities they provide. “While the growth in active mutual funds plateaued in 2006, the growth in ETFs has been exponential. To what extent this exponential growth affects market efficiency is at the forefront of discussion among academics as well as regulators”, suggested by In Ji Jang and Namho Kang in their article, ETF and Corporate Reporting [1]. That “ETFs facilitate informed arbitrage, increasing the informativeness of underlying stocks” was mentioned in the articles by Antoniou and Huang [2].

The efficiency of a market is the degree of the accuracy that the stock prices reflect information. In an efficient market, prices would always change quickly to demonstrate the information, which means that investors in this kind of market would not gain higher returns consistently unless they take higher risk. According to the result from the research done by Russell J. Lundholm, there are three important factors that would affect the efficiency of a market. The first one is the information dissemination, which can significantly increase market efficiency by making sure that the participants in the market would receive the same information. The second factor is the market structure. More competition results in higher efficiency in the market since it motivates pricing and allocation. The third factor is the aggregate certainty of the market. Lundholm, in his paper, suggests that “reducing the amount of uncertainty regarding other traders’ motives for trading increases the efficiency of the market”, which means higher market certainty leads to higher efficiency [3].

Arbitrage is a strategy when it mentions a high return with a low risk. As it mentioned in the article, “the natural question is, whether the investor has arbitrage opportunities, i.e. whether he can get non-risky profits” [4]. Arbitraging focuses on the price discrepancies between markets and financial instruments. For example, when an asset is underrated for its price, the arbitrageurs would buy it, and when it’s overrated for the price, they would sell it and earn the profit from the price difference. The opportunities of arbitrage usually rely on the efficiency of the market. The more efficient the market is, the fewer opportunities there are for arbitraging. On the contrary, the less efficient the market is, the more opportunities there are for arbitraging. The reason is that in a more efficient market, prices

that are not on the reasonable level would adjust quickly to eliminate the discrepancy due to the rapid spread and assimilation of information. The participants in the market would immediately respond and correct the mispricing and move the price back to the normal level based on the given information.

This paper would use the historical data from 2016 to 2021 for the U.S. market and the Russian market to compare the performance of the arbitrage strategy, since the duration of a 6-year period would provide a relatively comprehensive result of the research [5,6].

2. Efficient Market and Inefficient Market

In the following paragraphs, markets with high efficiency and low efficiency will be demonstrated and will explain what factors lead these markets to be high or low efficient. According to what Eugene Fama pointed out in the 1970's, efficient market is the market which its price fully and instantly represents the market's information. Markets with different level of efficiency would generate various results when investor applies certain strategies. To understand the efficiency of a financial market, noticing its determining factors would be important. Generalized factors influencing the efficiency of the market was introduced in the previous paragraphs, which are in the information dissemination, the market structure, and the aggregate certainty. Using the comparison between the Russian market and the U.S. market would clearly demonstrate the differences. In the following paragraph, the author will analyze specific factors that more accurately and directly cause the Russian market's inefficiency and the U.S. market's efficiency.

2.1. Russian Market

Geopolitical Instability: Geopolitical instability contains war, boarder conflicts, terrorism, etc. All these elements would make the market uncertain and volatile. Furthermore, the investment and liquidity would reduce, making the price more difficult to reflect the market's information accurately and instantly. Investors would shift their interest to safer and more stable market instead of a market filled with uncertainty.

Sanctions: Sanctions include restriction on the international markets, reduction in the amount of foreigner investors, currency volatility, etc. With the loss of foreign investors and the increase in the difficulty for exporting and importing, these factors caused the Russian market to reduce the total capital available for business, which make the Russian market to be inefficient.

Regulatory and Bureaucratic Obstacles: The Russian market has a more complexed regulatory framework with heavy bureaucracy, which means it's more difficult for investors to process in the market and investing in the market often comes with more operational costs. Needs for approvals and permissions slow down the investing process and could lead to a missing for opportunities.

Corruption and Lack of Transparency: Heavy bureaucracy brings corruption to the Russian market. With corruption, the operation and allocation of the resources would be disturbed which cause the unfairness and inefficiency since the market operates based on preferences but rules. Another reason corruptions exist in Russian market is the lack of transparency. Lacking the access to accurate and direct information decreases the efficiency of the market and makes investors hard to gain their profits and returns on the investment.

Dependency on Natural Resources: Russia heavily depends on the natural resource, so its market is vulnerable to the change of the price. It also reduces the interests in innovation, which further slows down the economic growth.

2.2. U.S. Market

Strong Regulatory Framework: The U.S. market has a strong regulatory framework which supports its efficiency level keeping in a high level. The reason is that the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC) supervise the transparency and the fairness to ensure the efficiency of the market. Participants in the market can

get access to the same information at the same time, therefore, it will attract more investors coming into the market.

Innovation and Technology: The field of technology innovation is also obviously advanced compared to the other financial markets globally. Consequently, trading-related platforms, strategies, algorithms, models, would all be advanced, and those technologies can also adjust price shifting back to the normal level when a mispricing happens. The liquidity of the market is also strengthened with the stabilized price, the increase in market participants, and the quicker adaption of the new information.

Open Trade Policies: Open trade policies applied in the U.S. market allows more access for participants in the global market. Therefore, foreign investors bring capital, technologies, and experiences to the U.S. market, which further booster the operation and stabilization of the U.S. market. With more participants involved, risks are diluted with a larger base. As long as the current participants are steadily benefiting from the investment in the U.S. market, it will attract more investors to get into the market.

Dynamic Labor Market: Labors in the U.S. market promotes the efficiency of the market. It is because in the U.S. market, labors are more flexible, so that they can quickly adapt the changes and conditions in the economic environments. They have formed a flexible labor pool to provide enough productivity on improving the performance of the market.

3. ETF Arbitrage Strategy

As Ben R. Marshall, Nhut H. Nguyen, and Nuttawat Visaltanachoti mentions in their paper, the price deviations which result in the creation and removal of arbitrage opportunities are caused by purchases and sales of the ETFs in normal trading hours [8]. The ETF arbitrage strategy in this research focuses on the price gap between the price of the index and the price of the ETF. When the price of the ETF drops below the price of the index, the participants should buy the ETF since it would be adjusted by the participants and the market back to the normal price level which means the price will increase. Therefore, the participant can earn profit with really low risk. However, the time needed for the adjustment is different based on the efficiency of the market. When the efficiency of the market is high, there should be fewer opportunities for the ETF to drop below the normal level and when it happens, the low price would be adjusted back to the normal level quickly. For the low efficient market, there might be more arbitrage opportunities and the time needed to adjust the low price would be longer since the spread of the information is relatively slow. The author could hypothesize that the arbitrage strategy performs better in the Russian market.

4. Historical Data and the Performance Comparison

This part demonstrates the processing of the data and the results. For the U.S. market, data includes the price of S&P 500 index and the price of the S&P 500 ETF, which is the SPY. For the Russian market, the author chose the MVRSX as the index and the RSX as the ETF. At the beginning, the author was trying to get the data for the daily NAV (Net Asset Value) as the index and compare it to the price of the ETF. However, the author failed to get access to the data, and instead, the index itself was chosen since they are close in the value. The period is from 2016 to 2021, the reason is that the author initially tried to use the data until 2024, but the RSX was liquidated in 2022 so there are no more data for the Russian market. This could also reflect the unstable of the Russian market.

4.1. U.S. Market

In an excel worksheet, the author found the lowest ETF price for each day. The author calculated the difference between the lowest price of the ETF and the price of the index to see whether there exist days with significant difference to generate an opportunity of arbitraging. The result is shown in Figure 1:



Figure 1: Difference between the S&P 500 index and the daily minimum.

As it shows in the figure, there is no significant value in the chart as the author expected. However, it shows a decreasing trend for the value of the gap over time. This could be resulted from the increasing of efficiency for the U.S. market, since the increase in the efficiency would shrink the price gap between the index and the ETF.

To find the more accurate relationship between the index and the ETF, the author used regression to find the linear relationship. The author took the price of the index as the X value and the price of ETF as Y value. After doing the regression data analysis in Excel, the author found the equation:

$$Y_{Price\ of\ SPY} = 1.03961095 \cdot X_{Price\ of\ S\&P\ 500} - 346.25464 \quad (1)$$

Due to the high efficiency of the U.S. market, the coefficient is very close to 1, and this means that the price of the index and the price of the ETF increase and decrease at almost the same pace, showing a strong linear relationship between these two variables in Figure 2. There is a constant difference of -346.25464, which means that the price of the ETF is always 346.25464 dollars less than the price of the index.

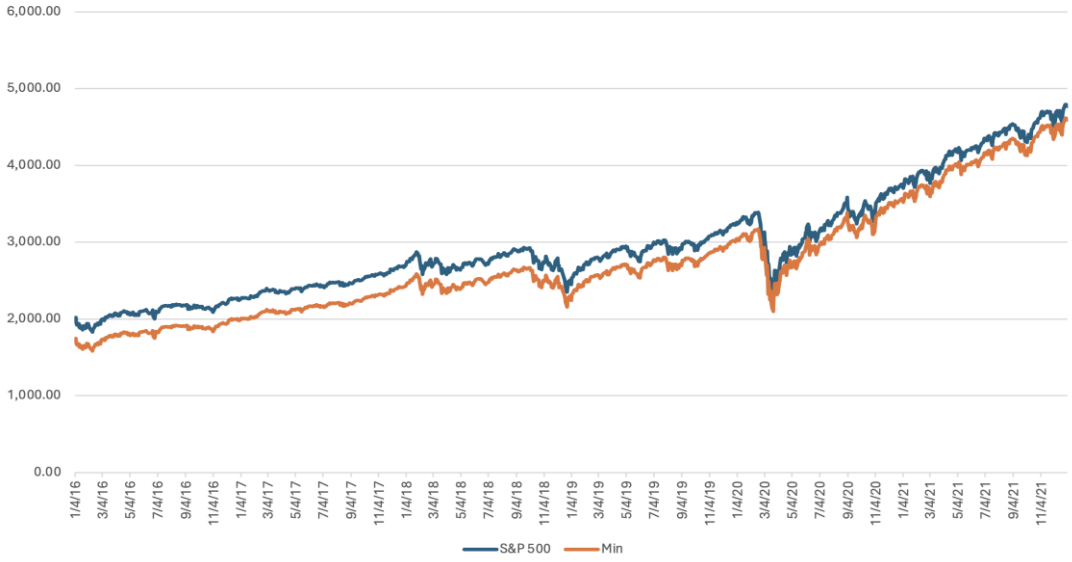


Figure 2: Relationship between S&P 500 index and the daily minimum SPY.

After finding out the equation for the price of the index and the ETF, the author could use it to find the estimated price of the ETF with the given price of the index. Then, the author compared the

estimated price of the ETF with the real price of the ETF by using the estimated price abstracts the real price. If the result is positive, it means that the real price is higher than the estimated price, and vice versa. The author then filters out the all the positive value and divides the estimated value to find how many percentages it is lower than the estimated value. It is demonstrated in Table 1:

Table 1: Price gap.

Date	S&P 500 Index	Minimum of SPY	Estimated SPY	Difference	Percentage Below Est
1/4/16	2012.70	1740.43	1746.17	5.74	0.003
1/5/16	2016.70	1743.38	1750.33	6.95	0.004
1/6/16	1990.30	1721.38	1722.88	1.5	0.001
1/7/16	1943.10	1680.09	1673.81	-6.28	-
1/8/16	1922.00	1661.64	1651.88	-9.76	-
1/11/16	1923.70	1663.29	1653.64	-9.65	-

The author then used a histogram chart to demonstrate the price gap. If the percentage is higher than 5%, it means that there could exist an arbitrage opportunity.

As it shows in Figure 3, there are very few times that the gap is larger than 2% of the estimated price. Therefore, there are few chances for participants to arbitrage in the U.S. market.

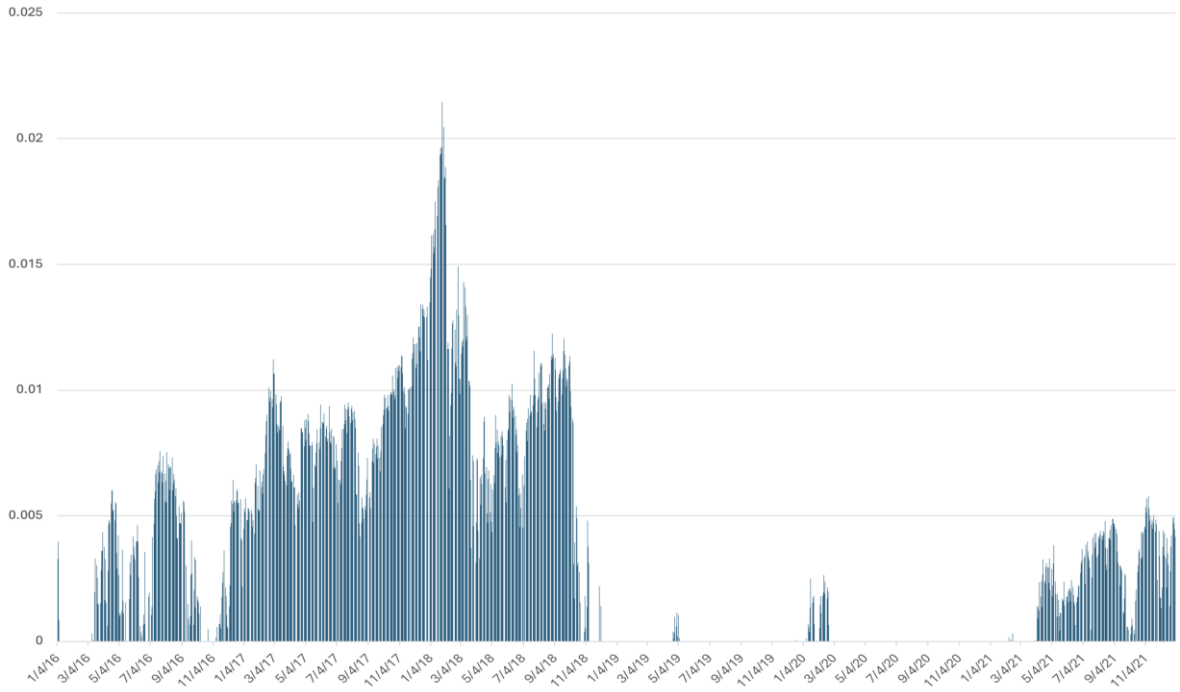


Figure 3: The percentage by which the SPY falls below the estimated value daily

4.2. Russian Market

The Russian market is very different from the U.S. market. Since according to the data, the price of the MVRSX starts with the number greater than 300, while the price of the RSX is only about 10. The author used linear regression to find out the relationship between the price of the MVRSX and the RSX, and the author found the following equation:

$$Y_{Price\ of\ RSX} = 0.04386823 \cdot X_{Price\ of\ MVRSX} - 6.5719661 \quad (2)$$

Different from the equation for the U.S. market, the coefficient for the Russian market is only 0.04386823, which means that there is a huge difference between the price of the ETF and the price of the index. And this huge gap could be resulted from the inefficiency of the Russian market. After finding the equation above, the author calculated the estimated RSX price, and calculated the

difference between the estimated values with the real value by using the estimated value to abstract the real value. If the difference is negative, it means that the real value is greater than the estimated value, and vice versa. The author kept only the positive value and calculated how many percentages is the real value lower than the estimated value. It is demonstrated in Table 2:

Table 2: Price gap.

Data	MVRSX	Minimum of RSX	Estimated RSX	Difference	Percentage Below Est
3/14/16	388.32	11.05	10.51	-0.54	-
3/15/16	384.12	10.67	10.33	-0.34	-
3/16/16	388.62	11.10	10.53	-0.57	-
3/17/16	406.08	11.38	11.30	-0.08	-
3/18/16	409.57	11.27	11.45	0.18	0.02
3/21/16	409.93	11.42	11.46	0.04	0.003

After finding out the percentage difference, the author made a histogram chart (Figure 4) to demonstrate the percentages of the price of RSX lower than the price of the MVRSX:

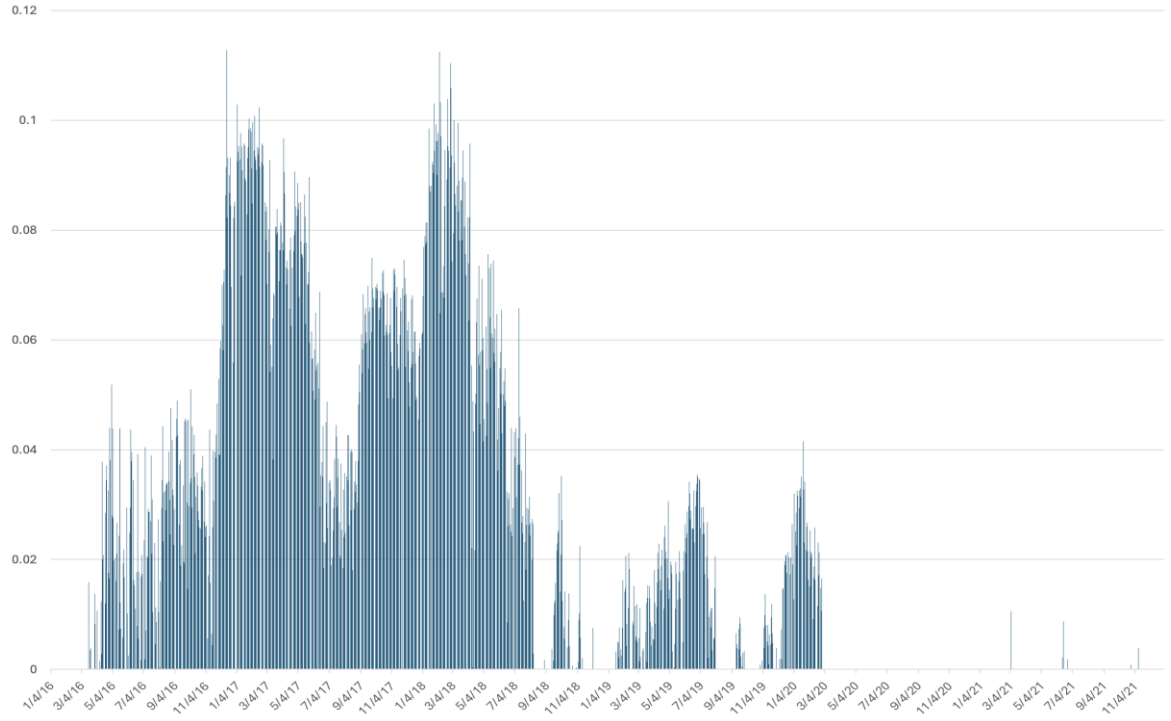


Figure 4: The percentage by which the RSX falls below the estimated value daily.

It can be inferred from the chart that there are many times that the percentage is larger than 2%, this means that there are a bunch of opportunities for a participant to arbitrage in the Russian market.

5. Conclusion

According to the above analysis of the ETF arbitrage strategy for the two markets, the efficiency of the market appears to play an important role in the performance of the strategy. The author can conclude that for the U.S. market, which is the high efficiency market, there are very few opportunities to arbitrage. For the Russian market, which is the market with low efficiency, there are a lot of chances to arbitrage. Briefly, the strategy performs better in the inefficient market. These results could be explained well since the market with high efficiency would immediately adjust the price gap between the ETF and the index.

Noticing the limitations in research is crucial since it helps the author, or the research people, keep the drawbacks in mind when the research is done. Improving on those drawbacks would lead to more

accurate and useful result in the future study. In this paper, the transaction costs are ignored for simpler and more convenient calculation of the result. However, they are unavoidable in the real-world financial market. Transaction costs include bid-ask spreads, commissions, taxes, market impact costs, etc. They reduce the investors' earnings and returns, and they make a strategy fails to work in certain circumstances. As it mentioned in book, "a big part of the performance penalty borne by individual investors can be traced to transaction costs" [8]. Besides, dynamic changes could also affect the result from this research since in different time periods and contexts, the research could be difficult to be generalized in the market environment. Future studies or research should focus on these limitations to process and produce more generalized and accurate results to make them become more practical and applicable.

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