

## Executive Summary

In this python project, our team used top-down method to first drop ETFs with more than 100 missing value, which gave us 751 ETFs. Then we picked 3 factors including momentum, size and value as our main measurement to measure the performance of these ETF collections. After running regression based on these 3 factors, we selected the top 10 ETFs in each section based on the value of beta, which shows the exposure to each factor. The higher the beta, the higher the exposure to the selected factor. Since an important step to check if these ETFs truly carry out their responsibilities, we manually typed each ETFs and their tickers into search box to see if they fully implement what they claimed to do. Take URTY, an ETF belongs to size section, as an example; From the website, we found that it contains small capitalization company's stocks, which offers investors high yield compared to big firms. In this way, we reached the conclusion that URTY successfully tracks size factor. By the same token, we checked the rest 29 ETFs and found out that they all did pretty well in implementing the factors they claimed to deal with.

In terms of how cheap these ETFs track the factors, we used the matrix called "per unit of exposure to the factor", which can be measured by taking the expense ratio divided by factor beta. By using this methodology, we screened out 7 ETFs, and only top 3 ETFs with lowest cost were left.

Next step to push us further is to construct an optimal portfolio. Among each factor, we implement Mean Variance Efficiency, Minimum Variance, and Equal Weighted method to construct 3 type of portfolios. Then to combine these 3 individual portfolios together, we also choose these 3 ways, which gave us a total 9 possible outcomes of potential optimal portfolios. In order to figure out which one can yield the highest return, we chose to plot a graph of sharp ratio, which indicates the portfolio return of per unit risk. According to the graph, we can clearly see that MVE-MVE provide us the highest Sharp Ratio, which perfectly matches what we learned in class that MVE portfolio yields the highest SR. The cumulative product graph also shows that the MVE-MVE outperform other possible combination.

Now, let's think out of the box, and make a comparison between the strategy of trading the factors directly and ETF portfolios. In this section, we constructed an MVE portfolio just based on momentum, size and value factors. The output shows that we have 0.18 on momentum factor, 0.43 on size factor and 0.39 on value factor, which in general are all different with the allocation we had based on ETFs. To figure out which strategy can provide higher return, we ran regression on ETF portfolio and factor portfolio, implying that the return from ETF is way better than pure factor portfolio.

In terms of which factor can be implemented cheapest, we dug a little bit deeper in ratio of alpha to beta and tracking error to give us a full picture from cost-benefit perspective. After running regression on each factor's portfolio, we found that both the cost and volatility of value factor are smallest, which is a strong proof that trading value is more profitable among all 3 factors.

For your reference, here is the link of the video: <https://youtu.be/PoKSqZ05WfU>