Index Tracking in the Structure of Fund of Funds based on Cointegration

# Abstract

Index tracking funds have grown significantly in previous decade and attracted more and more investors as an outperforming passive investment vehicle. There are two main different ways to track indices. One is called full replication, funds can take long position on all the constituents as the same weights of an index. The other tracking method is known as sample replication, funds only buy part of the stocks from a family of index stocks using different analytics tools like correlation, mixed integer programming and cointegration. In this paper, our goal is to construct a portfolio to track S&P 500 in a structure of fund of funds (FoF) using cointegration analysis. In contrast with traditional index funds, we do not buy constituent stocks directly to mimic index, we buy sector ETFs. S&P 500 consists of 11 different sectors and industries, there are numerous sector ETFs on the market. We can construct an index fund by purchasing sector funds to track S&P 500 deploying cointegration analysis to make sure long run equilibrium. In FoF structure, we can cut transaction cost enormously and reduce turn over rate, which are essential for an index fund. Index funds hold stocks directly for both full and sample replication methodologies.

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# Introduction

In investment industry there are two opposite equity portfolio management philosophies, active portfolio management and passive management. Active investment is aiming to beat the benchmark index based on professional analytics and fund manager’s judgment in picking securities and determining the right moment to long and short them. Hedge fund is a typical active management portfolio. However, it is not as easy as planed in theory for active funds to outperform respective benchmarks. Based on SPIVA® U.S. Scorecard, around 83.18% of all domestic funds underperformed their benchmark for the 10-year period by middle year of 2015 in the US. Besides us stock market, many active funds failed to beat the targeted indices over the 10-year period in other major capital markets. On the contrary, passive investment pursues the same performance as targeted index over a long period of time instead of trying to beat the benchmark. A tracking fund is a classic passive product whose mission is to mimic a specified benchmark passively with buy-and-hold strategy, the benchmark can be a stock index, a commodity, bonds, even bitcoin. As opposed to underperformed active funds, index tracking funds attracted more and more investors and grown significantly through nearly a decade bull market since the worst situation in early 2009. Plenty of capital flow into passive funds rapidly. For 2017, investors poured more than $692 billion into index funds across all asset classes. For the same period, actively managed funds experienced $7 billion in outflows. Now the total asset in index funds including index mutual funds and index ETFs is about 1112 trillion in the US.

There are two main conventional methods to track indices.

One is called full replication, the fund can take long position on all the constituents of an index in the respective weights with buy-and-hold strategy, which is straightforward to implement and can achieve the precise tracking performance as long as fund managers rebalance the weights once a while. Even though full replication can closely track indices in theory, it has a few nonnegligible flaws. Full replication funds need to rebalance quite often with high volatility stock weights, which could lead to inflated costs. Liquidity is another issue, especially for small capitalization stocks, this may affect fund construction and increase the transaction costs. Low cost is a signature characteristic of passive management funds, but full replications funds cannot bring out this feature.

The other traditional tracking method is known as sample replication. Some indexes may contain large number of constituents, such as S&P Global 1200, Russell 2000. In those cases, full replication approach is not efficient to conduct, however, sample replication methodology can be appropriate. Sample replication funds need to long part of total stocks that could represent the underlying index based on correlations, risks and returns. As the funds trade a relative fewer constituents, which could significantly reduce the costs, but this may potentially cause higher tracking errors. <此处应有引用谁是最早提出了各种tracking 方法>

In additional to traditional physical funds holding a portfolio of assets, there is another alternative approach so called synthetic portfolio to replicate the performance of an index by using corresponding derivative and swaps instead of holding stocks directly. Proponents claim that synthetic funds are a better financial instrument than traditional tracking funds to track illiquid indexes at a low cost and small tracking error. However, the synthetic portfolios are born with a few risks involving counterparty risk, liquidity risk, and collateral risk. Synthetic funds are not popular in US markets due to regulation by US Securities and Exchange Commission.

In this paper, our goal is to construct a portfolio to track S&P 500 in a structure of fund of funds (FoF) by using cointegration analysis. As an approach of sample replication, we buy sector ETFs to mimic S&P 500 consists of 11 different sectors and industries, there are numerous sector ETFs on the market. We can construct an index fund by purchasing sector funds to track S&P 500 deploying cointegration analysis to make sure long run equilibrium.

In FoF structure, we can cut transaction cost enormously and reduce turn over rate, which are essential for an index fund.

There are 11 individual sectors under S&P 500, Consumer Discretionary, Consumer Staples, Utilities, Technology, Health Care, Financial, Energy, Telecom, Industrials, Material, and Real Estate. Those sectors make up the S&P 500 as a whole; naturally, we consider tracking S&P500 through a combination of sector tracking funds which target individual sector index specifically. Such a structure is called Fund of Funds. There are many ETFs for every sector traded on market. For every sector, we can select about 10 outperforming ETFs to form a sampling pool, so total we have about 110 ETFs. Our goal is to create a portfolio of ETFs to mimic S&P 500 based on cointegration analysis. Cointegration is a powerful econometrics tool that could ensure the long run equilibrium relationship between ETF portfolio and S&P 500.

Better utilize the data, and increate the robustness of our portfolios.

Our portfolios have many better characteristics than other indexing funds.

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