Final Report

Composite Benchmark Construction and Performance Comparison

Report by
Akash Ringe

Goal

To determine the best benchmark for the iShares Short Maturity Bond ETF using the benchmark indices provided. The benchmark in this assignment is a composite benchmark derived using multivariate regression analysis of NEAR returns with the given indexes.

Data: A data file with total return price histories for the iShares Short Maturity Bond ETF and 5 indices.

Output:

- Rationale for your benchmark choice.
- Performance graphs of returns, prices and cumulative returns
- Comparative statistics on the fund and the benchmark including
    - Annualized return and volatility
    - Maximum drawdown
    - Under/outperformance of NEAR vs benchmark

Assumptions

- Daily, weekly and monthly versions of returns have been used as and when deemed appropriate for metric calculation.
- Calculations have been done only for the period of data that is available for the iShares ETF i.e 2013 to 2022. Previous timestamps have been ignored and dropped.
- The composite benchmark in this assignment is not an investment strategy. It can be only used for analysis. We have used the same data to construct the composite benchmark that is used for doing the performance breakdown.
- Price data that is given to us is assumed clean and does not require data engineering such as adjustment for corporate actions, dividends, outlier detection etc

Rationale for benchmark choice

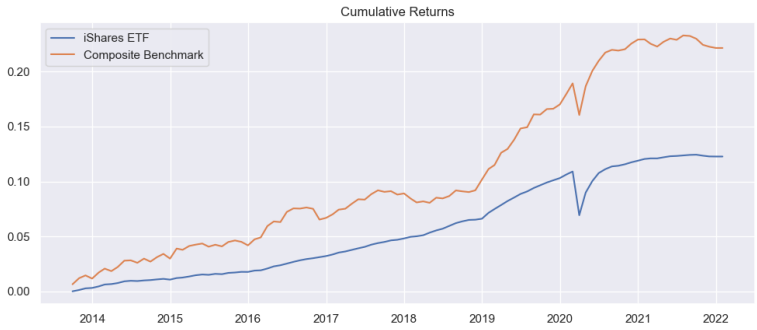
- We find that the correlations of monthly returns and prices both are maximum for *F0000113ET* Morningstar US 1-5Y Corp Bd TR USD.
- Using monthly returns reduces noise and short-term volatility, provides us a clearer view of long-term trends and correlations.
- Running OLS gives us statistically significant coefficients for all benchmarks vs the ETF. This implies that there is a clear relationship between ETF and all benchmarks.
- However even with OLS F0000113ET Morningstar US 1-5Y Corp Bd TR USD is the best benchmark out of all the options. The R-squared is maximum (0.97) for F0000113ET which implies that it explains 97% of the variance of NEAR returns.

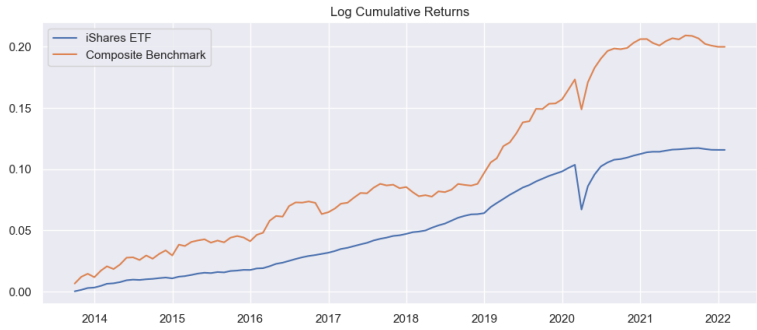
Construction of a composite benchmark

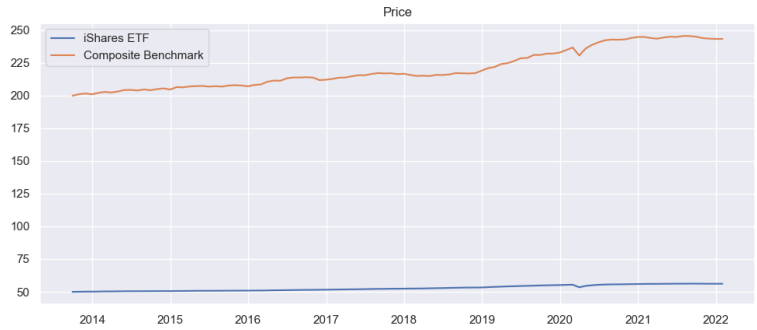
- Instead of just relying on a single index F0000113ET we can take this up a notch and construct a composite benchmark consisting of all the index
- For simplicity lets keep this composite benchmark static. If it's dynamic we would have to adjust for forward bias and introduce appropriate weekly/monthly rebalancing.
- We can use monthly, daily or weekly returns to determine the composite. The choice we have decided is weekly for the scope of this project.
- We run a multivariate regression of NEAR weekly returns against the weekly returns of all indexes.
- The composite can be constructed by weighing each index in the ratio of their respective coefficients

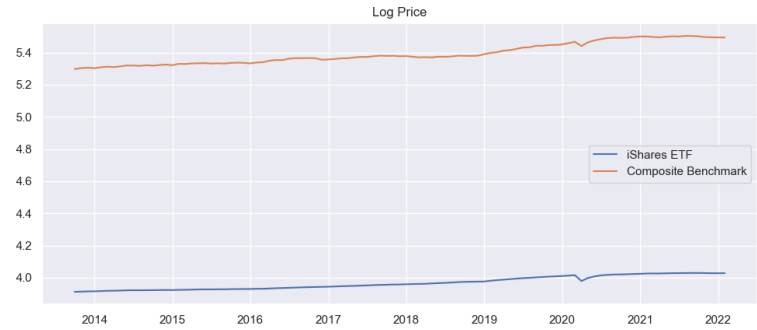
Performance Comparisons

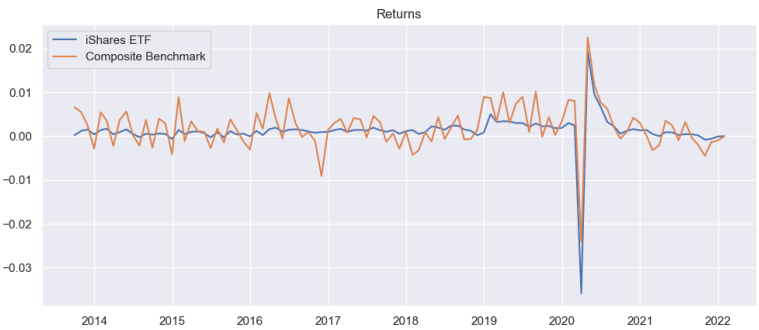
- The following plots are of returns, cumulative returns, and prices, and all their respective log counterparts.
- All metrics are monthly for the purpose of better interpretation.
- These give us a preliminary understanding of what to expect from the benchmark as compared to the ETF.

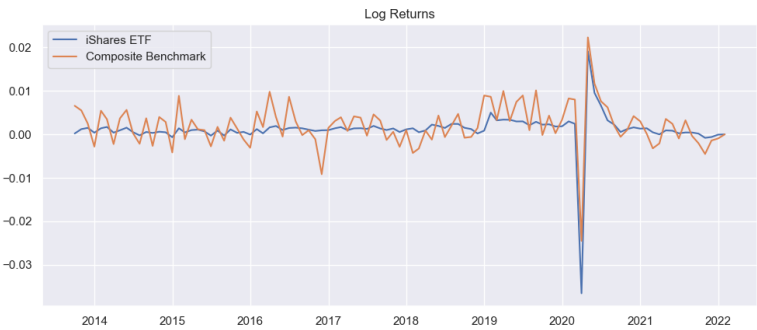








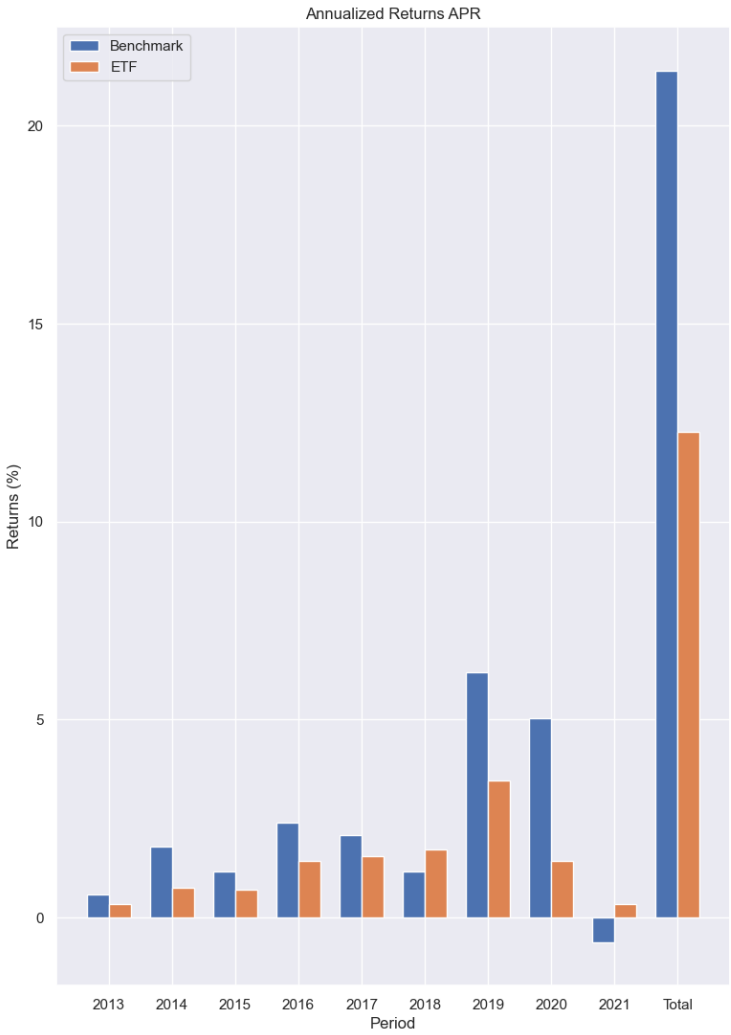


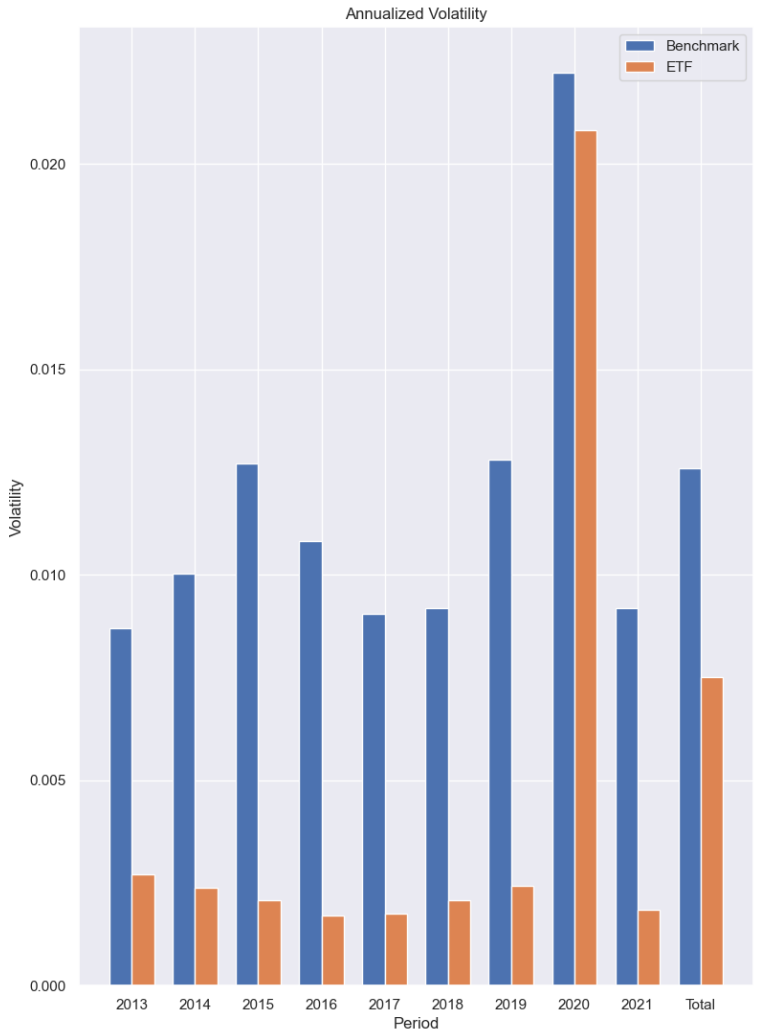


Comparative Statistic 1 - Annualized Returns and volatility

- Metrics are calculated for each year individually
- Since return series is daily, compounding is done daily for annual return calculations
- Annualized volatility is standard deviation of daily returns multiplied by sqrt(252) (year convention)
- Total returns are not in APR, these imply the total appreciation of the benchmark and ETF from 2013 to 2022
- *Insights*
    - **Returns** for both the benchmark and the ETF appear to be within a reasonable range for short-duration bond funds. However, the returns for the benchmark seem consistently higher than those for the ETF across most years, which could be due to various factors like fees, tracking error, or different asset compositions.

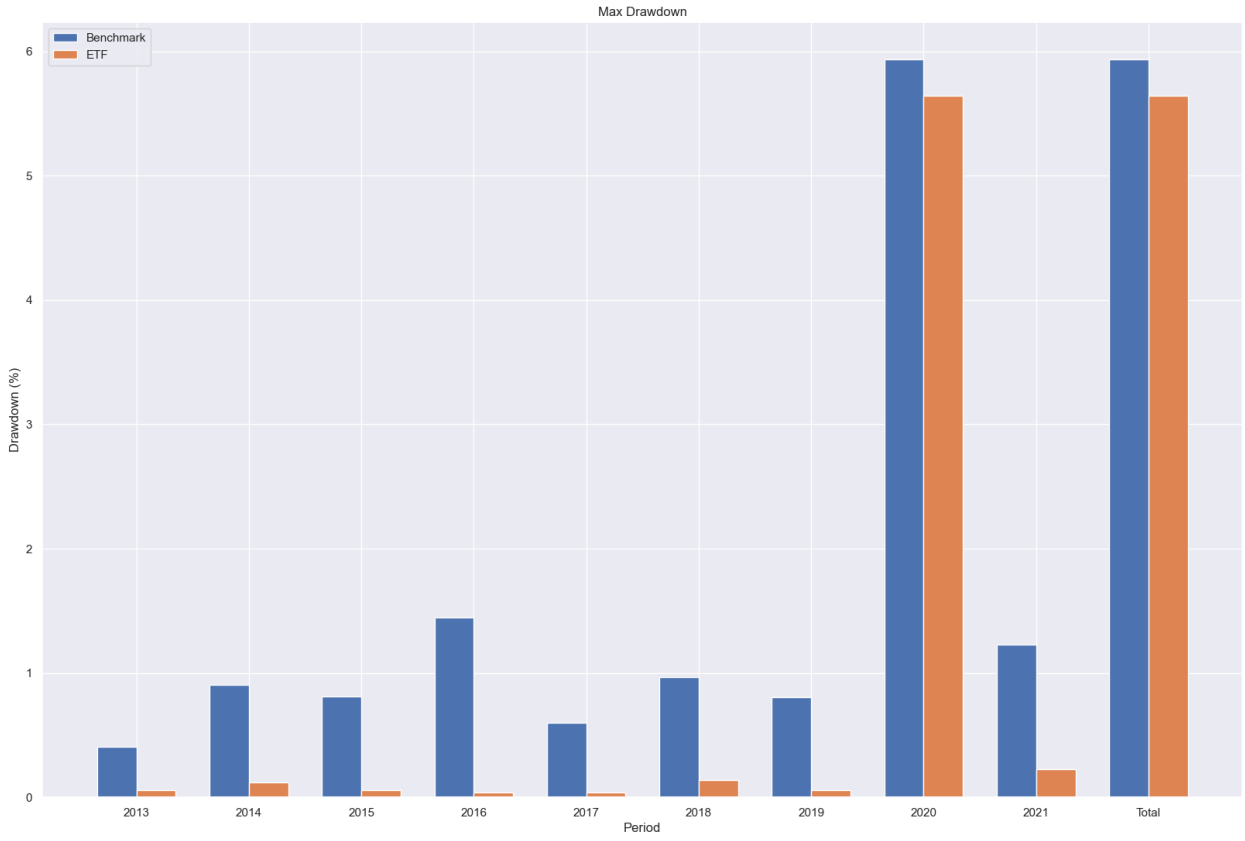
    - The **volatilities** are low, as expected for short-maturity bond funds, with the ETF typically showing lower volatility than the benchmark. This is consistent with what one might expect from a short-duration bond ETF, which is usually less risky.





Comparative Statistic 2 - Maximum Drawdown

- Drawdown is calculated for each year individually and total drawdown is from the year of 2013 to 2022.
- Daily price series is used for calculating drawdown
- To calculate max drawdown using price series following is the algorithm
    - Keep a track of max price i.e each time there is a price which is lesser than current update the max price
    - Keep a track of drawdown. drawdown = (Max_Price - Current_Price) / Max_Price
- *Insights* - The max drawdowns are particularly high for 2020, which is understandable given the market volatility during the COVID-19 pandemic.



Comparative Statistic 3 - Sharpe Ratio

- Ratios are calculated for each year individually and for 2013 to 2022 as a whole
- Risk free rate is assumed 0 - we can improve this by importing risk free rates from Kenneth French library
- Sharpe Ratio is R_{mean} / Vol where R_{mean} is the mean returns (Weekly) and Vol is the standard deviation of weekly returns
- *Insights*
    - The Sharpe Ratios are generally positive, indicating a risk-adjusted return above the risk-free rate. The higher Sharpe Ratios for the ETF in some years (like 2017) are notable, as this suggests better risk-adjusted performance compared to the benchmark.
    - Overall the benchmark generally has higher returns but also higher volatility and max drawdown, indicating a potentially higher risk profile compared to the ETF. This aligns with the general expectation that an actively managed benchmark might take on more risk than a short-duration ETF.