COMM 4710 - Intermediate Investments (Fall 2021)
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Active Management Strategy Memo

Since internet virality has become increasingly relevant in stock market investing over the past year, we investigated whether actively managing a portion of the Harvard equity portfolio using Google Trends search data would allow Harvard Management Company to optimize their portfolio according to the latest market trends. In addition to virality, news nowadays is dispensed faster through digital platforms like Google relative to legacy media, thus we hypothesize that optimizing portfolio weights using Google trends should help our portfolio perform better than our benchmark portfolios.

From Google Trends, we individually acquired monthly data for "Interest over time" for the following stock tickers: AMZN, AAPL, TSLA, NVDA, from 2011-01 to 2020-12. The corresponding stock market price data for these tickers was acquired from Yahoo Finance. One flaw of using search terms as a data source is that there might be overlap between two search terms. For example, the stock ticker for Taiwan Semiconductor Manufacturing Company (TSM) overlaps with the name of a popular eSports team, so the data may not be relevant. The above stock tickers have been chosen to avoid such an overlap.

We calculated the Month-over-Month Change in Interest over time for each ticker for each month over the 10-year period, and normalized it so that the sum of the MoM change for all the tickers in a month added up to 1. These normalized values represented the portfolio weights for that stock ticker for that particular month. Since these were monthly values, we did not introduce any additional time lag because we expected that the market would not need more than a month to react.

The normalized portfolio weights for each stock ticker were multiplied by the return (rate of change of prices) for that stock for that month, and the sum of these products represents the total portfolio return for that month. These portfolio returns are compared against the Benchmark and Weighted Benchmark portfolios in *Appendix Chart 1*. The Benchmark portfolio represents equally-weighted returns from AMZN, AAPL, TSLA, and NVDA over the same 10-year period. The Weighted Benchmark portfolio represents the average weighting of the normalized portfolio weights, from our Google Trends strategy, passively held for the 10-year period. These portfolio weights are displayed in *Appendix Table 3*.

As *Appendix Chart 1* shows, our Google Trends-based Strategy underperformed compared to both our benchmark portfolios. *Appendix Chart 2* compares the Google Trends strategy performance relative to that of the Benchmark portfolio, showing a steep drop off after August 2012 with no recovery until late 2018. The recovery becomes much sharper at the end of 2020.

Appendix Table 1 shows significantly higher variance for the Google Trends-based Strategy, thus HMC would be exposed to increased volatility. The significantly higher kurtosis also shows that the Google Trends strategy has heavy outliers. The Return-Risk comparison chart

(*Appendix Chart 3*) shows that the Google Trends-based Strategy provides a slightly lower return for much greater risk, so it is overall worse. The Weighted Benchmark portfolio has the best risk-return profile out of the three portfolios.

Based on our analysis of historical data and HMC's portfolio requirements, we **do not recommend this strategy for the HMC portfolio**, but it provides a lot of insights to dig deeper into. For instance, the recovery from late-2018 onwards in *Appendix Chart 2*, could be explained by the increasing internet virality of stock trading as platforms like Robinhood gamified trading and made it more accessible. This is further supported by the sharp increase in the second-half of 2020, when an increasing amount of retail investors were stuck at home looking to invest their increased disposable income due to stimulus. Thus, the Google Trends strategy might be more effective post-COVID-19, as finance and stock-market investing has become a bigger part of the internet.

All things considered, we hypothesize that the Google Trends strategy would perform much better with more recent data (2019-present) as investing has become more popular on the internet since the COVID-19 pandemic. Since there are not enough monthly observations to test that, it would be interesting to study more granular data at the daily level to see if that improves performance, as the internet reacts quickly.

<u>**Appendix (Charts)**</u>
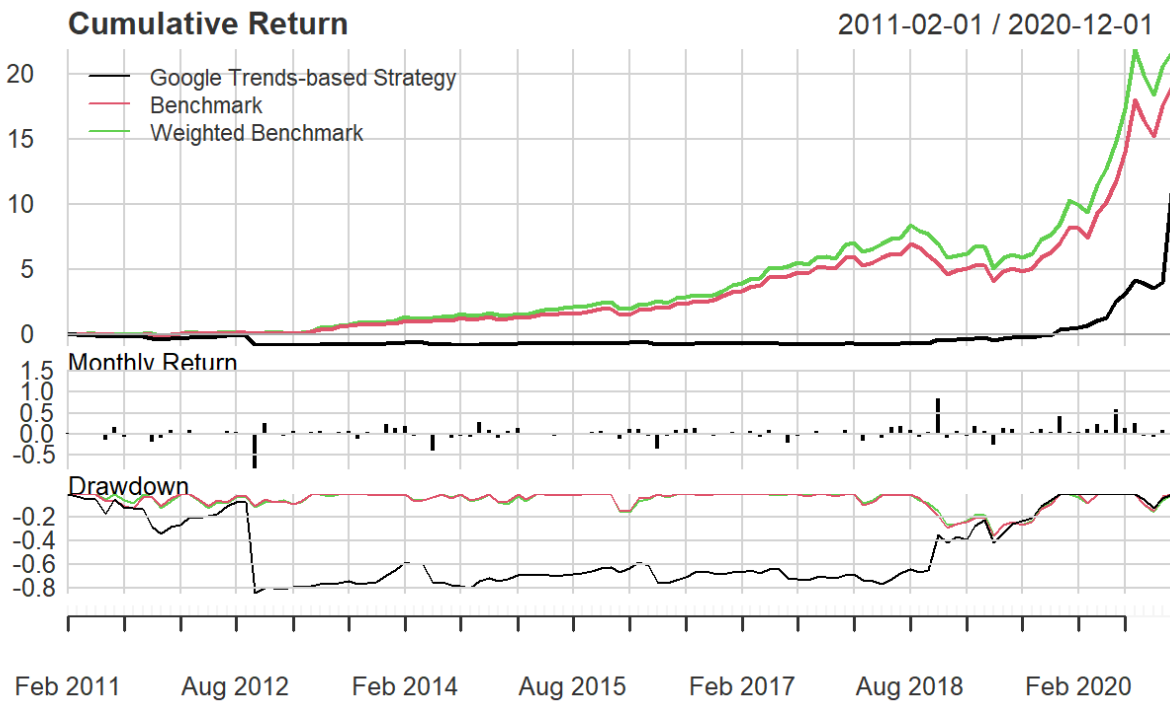
Chart 1

Google Trends-based Strategy Performance

Chart 2: Relative Performance of Google Trends-based Strategy to Benchmark Portfolio
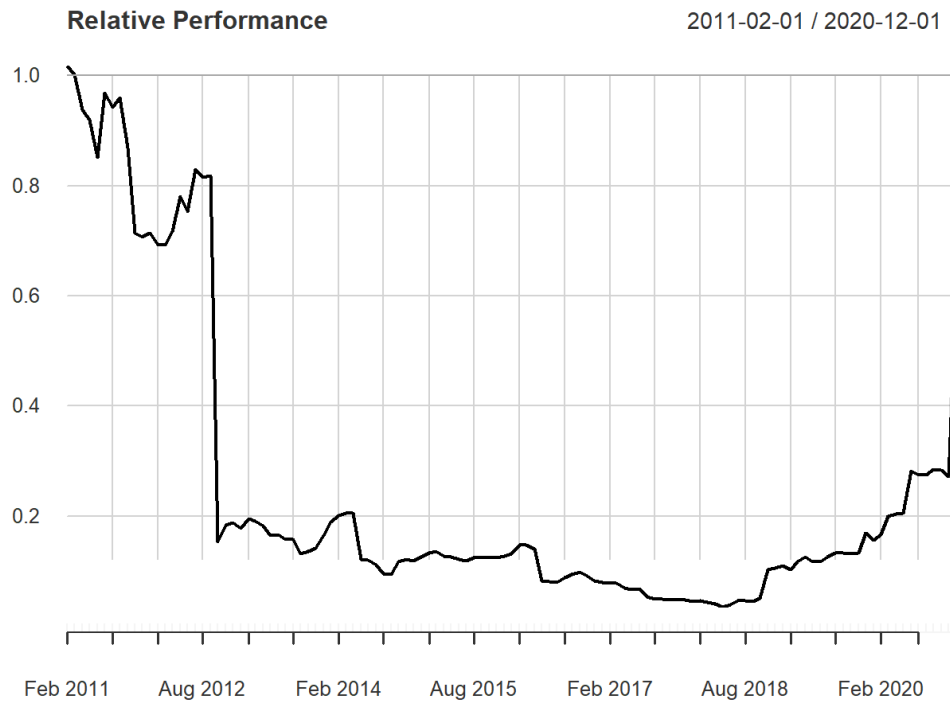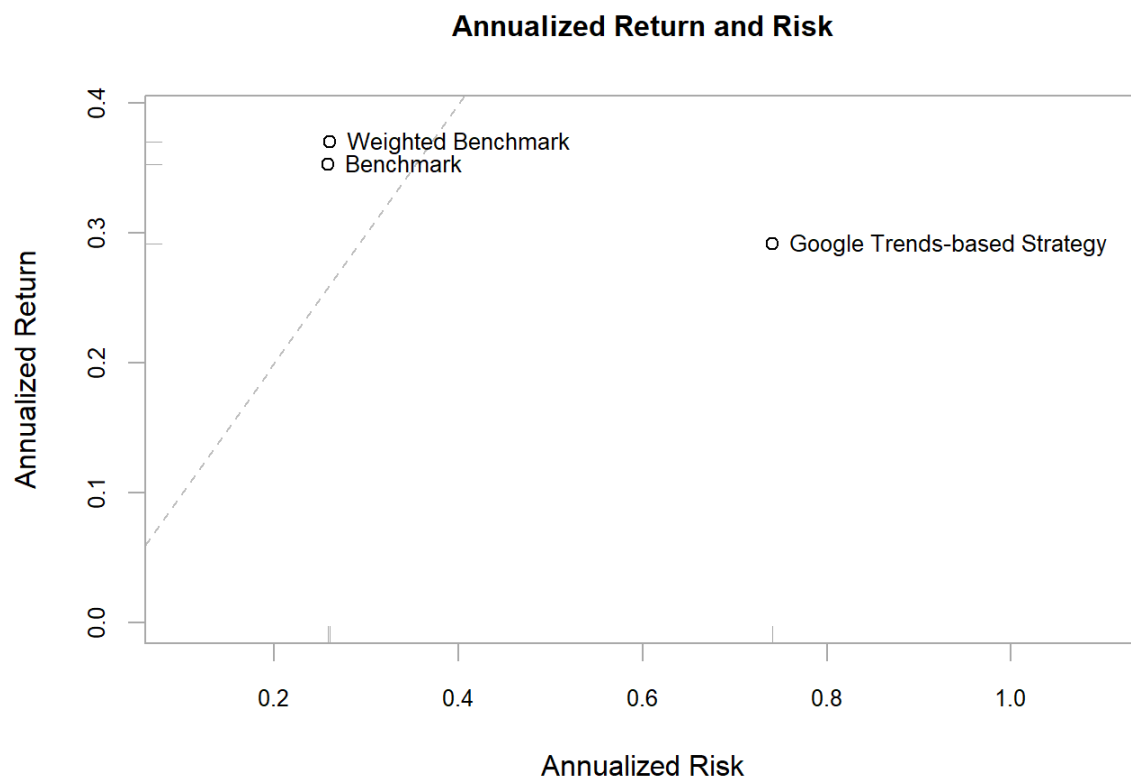
Relative Performance   2011-02-01 / 2020-12-01

Chart 3: Return and Risk Comparison

Annualized Return and Risk

Appendix (Tables)

Table 1: Statistical Comparison of Google Trends-based Strategy relative to Benchmarks

	Google Trends-	Benchmark	Weighted Benchmark
Observations	119	119	119
Minimum	-0.8285	-0.1905	-0.2169
Quartile 1	-0.0332	-0.0146	-0.0153
Median	0.0311	0.026	0.0252
Arithmetic Mean	0.0439	0.0282	0.0293
Geometric Mean	0.0216	0.0255	0.0266
Quartile 3	0.0893	0.0727	0.0712
Maximum	1.516	0.2667	0.2502
SE Mean	0.0196	0.0068	0.0069
LCL Mean (0.95)	0.0051	0.0147	0.0157
UCL Mean (0.95)	0.0827	0.0417	0.043
Variance	0.0457	0.0055	0.0056
Stdev	0.2139	0.0745	0.0751
Skewness	2.6707	0.1567	0.0947
Kurtosis	21.0889	0.5699	1.0869

Table 2: Drawdown Risk Comparison across portfolios

	Google Trends-	Benchmark	Weighted Benchmark
Semi Deviation	0.1207	0.0513	0.052
Gain Deviation	0.2063	0.0535	0.0541
Loss Deviation	0.1432	0.0421	0.0453
Downside Deviation (MAR=10	0.1062	0.0408	0.0416
Downside Deviation (Rf=0%)	0.1032	0.0369	0.0379
Downside Deviation (0%)	0.1032	0.0369	0.0379
Maximum Drawdown	0.8406	0.3566	0.3561
Historical VaR (95%)	-0.1599	-0.0848	-0.0806
Historical ES (95%)	-0.3698	-0.1224	-0.1296
Modified VaR (95%)	-0.0256	-0.0896	-0.09
Modified ES (95%)	-0.4571	-0.1222	-0.1296

Table 3: Benchmark Portfolio Weights

	Benchmark	Weighted Benchmark
AMZN	25.00%	37.80%
AAPL	25.00%	28.65%
TSLA	25.00%	14.55%
NVDA	25.00%	19.00%