Columbus Asset Allocation Report

For Portfolio Rebalancing on 2017-08-31

Strategy Overview

Columbus is a global asset allocation strategy designed to adapt to prevailing market conditions. It dynamically allocates funds in up to 8 ETFs from a universe of 15 of the most liquid ETFs trading on the US markets. These represent the world's major asset classes including equities, fixed income, real assets and cash. See the appendix for a description of these ETFs. Columbus trades once a month.

The strategy attempts to minimize the probability of large portfolio drawdowns while capturing most of the positive returns offered by global asset classes. Since risk management is a top priority, short-term returns may sometime lag during equity bull markets. However, by minimizing large portfolio drawdowns, Columbus is expected to produce attractive long term returns on a risk-adjusted basis.

Columbus Performance and Key Benchmarks
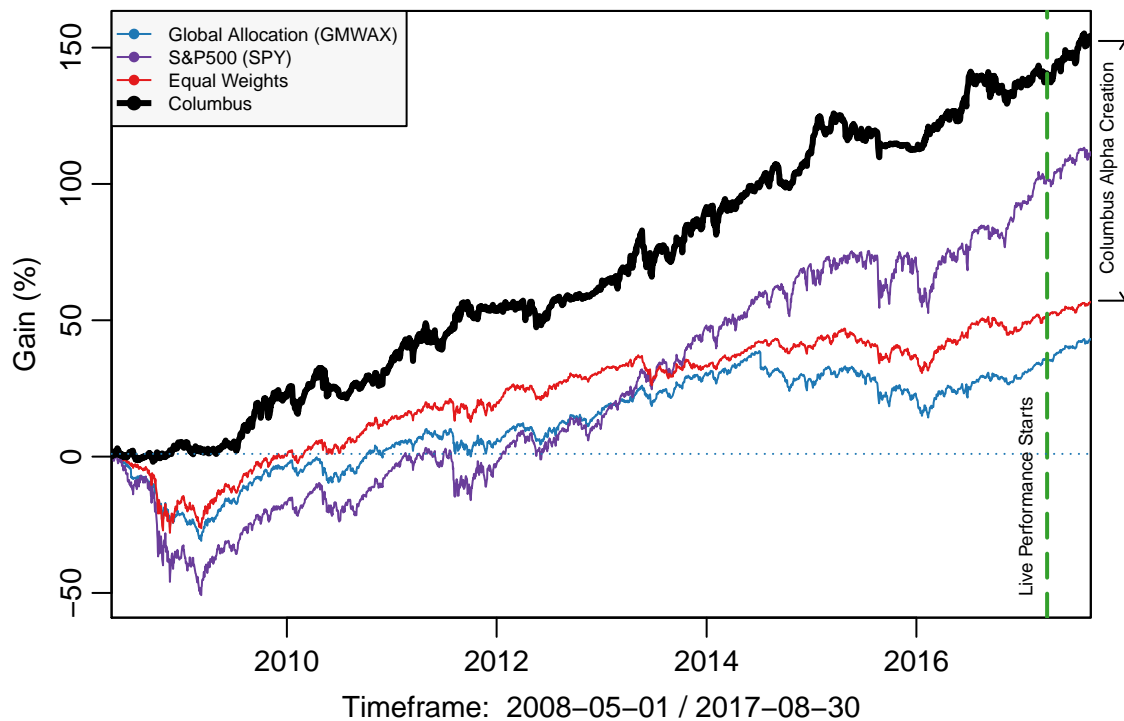
Timeframe: 2008–05–01 / 2017–08–30

	Columbus	Global Allocation	S&P500	Equal Weights
Annualized Returns (%)	10.51	3.92	8.37	4.94
Maximum Drawdown (%)	-9.29	-31.87	-51.49	-29.35
Positive Rolling Years (%)	97.47	74.36	90.32	85.65
Annualized Sharpe Ratio	1.13	0.38	0.41	0.48

    Global Allocation benchmark: GMO Global Asset Allocation Fund (GMWAX).
    S&P500 Market Index benchmark: SPDR S&P500 ETF (SPY).

The chart on the previous page illustrates the simulated and live historical performance for Columbus. Also shown are a Global Allocation Benchmark represented by mutual fund GMO Global Asset Allocation (GMWAX), the S&P500 Index ETF (SPY) and an Equal Weights benchmark based on all 15 ETFs in the Columbus universe. The alpha generated by Columbus over time can be seen by the vertical line located on the right side of the chart, which compares the Equal Weights benchmark (red) to Columbus (black).

Columbus uses a 100% quantitative algorithm to make its allocation decisions at the end of each calendar month. It selects ETFs and adjusts their portfolio weights based on price momentum, asset price volatility and correlation of asset returns. Since the algorithm considers risk and volatility as a top priority, it defaults to a conservative view whenever market conditions warrant it.

Columbus may be used to dynamically adjust the tactical portion of a client's portfolio. Although maximum exposure limits are imposed on each ETF, no such limit are used to constrain asset classes. In any given month, Columbus may therefore be fully invested in a single asset class such as equities. The Columbus strategy may therefore be suitable only for a portion of a client's portfolio. The maximum exposure weight limits are discussed in the next section.

Weight Allocations for This Month

The portfolio allocation weights for each asset are shown below for the current and the previous month. The current month weights are in **bold characters** and should be used to rebalance the portfolio. The Max. Weight column shows the maximum exposure weight limit imposed on each ETF. This represents the upper weight limit for that ETF during an ideal market situation, where momentum is high while volatility is low.

ETF	Max. Weight	Weight 2017-07-28	Weight 2017-08-30	Alloc. Change
SPY	50%	20%	**-**	-20%
VXF	35%	2%	**-**	-2%
EFA	35%	33%	**32%**	-1%
EWJ	25%	14%	**2%**	-12%
VWO	25%	20%	**21%**	1%
DBC	30%	-	**-**	-
GLD	35%	4%	**5%**	1%
VNQ	30%	-	**-**	-
TLT	40%	-	**32%**	32%
IEF	50%	-	**-**	-
LQD	30%	-	**2%**	2%
TIP	40%	-	**-**	-
PCY	30%	4%	**4%**	-
UUP	50%	-	**-**	-
SHY	100%	2%	**2%**	-
Total		*99%*	*100%*	

Totals may not add up to 100% due to rounding errors. The model portfolio trades Market-on-Close (MOC) on the last trading day of the month, which is the market close on the trading day after this report is sent out to subscribers.

The maximum weight limits shown in the table above have been chosen to limit the exposure to specific ETFs in the portfolio. Only on fairly rare occasions will the Columbus algorithm invest in an ETF at its maximum exposure level. Such situations would require high positive momentum combined with low volatility to create a relatively high return and low risk environment. For certain clients, such exposure levels may be too aggressive. Should that be the case, the client's advisor is urged to consider reducing exposure to better suit the client's situation.

Allocation Changes Since Last Month

For September, Columbus is out of US equities entirely. It is maintaining its positions in international equities (EFA), and emerging market stocks (VWO), but it is greatly reducing its position in Japanese stocks (EWJ). The position in gold (GLD) is slightly increased reflecting its recent upward trend.

In the fixed income domain, a new and substantial position in 20+ years US treasuries (TLT) is opened along with a small position in investment grade corporate bonds (LQD). Last month's position in emerging markets sovereign bonds (PCY) stays as is.

The algorithm continues to favor a cautious risk taking approach with a 55% allocation to equities. However, a strong position in fixed income and cash (40%), along with a small gold hedge (5%) seems to indicate the winds may be shifting.

Momentum - Volatility Bubble Chart

The chart below locates each asset in the Columbus universe on the momentum-volatility plane. The colors of the dots represent the asset class each ETF belongs to, while the dot size shows the relative allocation weights of each ETF. An empty dot means the asset was not selected for the current month.

The Columbus algorithm selects and weighs assets in its universe based upon their relative volatility and momentum. It attempts to find the optimal combination of assets to get the most momentum at the lowest volatility, while also considering correlation between the assets selected.

The momentum-volatility plane does not explicitly show correlations. Some assets may therefore be more (or less) emphasized based upon their level of correlation compared to the overall portfolio.

**Momentum – Volatility Bubble Chart**
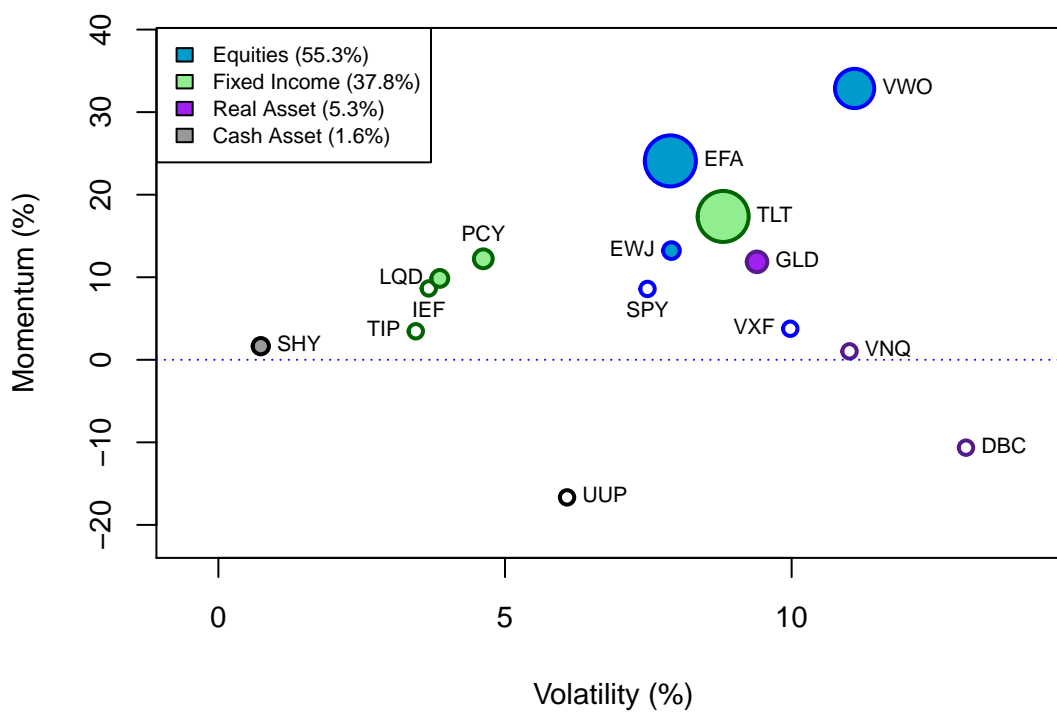
Optimal Weight Allocation

The chart below shows the optimal weight allocation for each ETF in the portfolio for the upcoming month. The green bars correspond to the optimal weights for each ETF. The value of these are identical to the weights in the table on page 2.

The wide grey bars show the maximum weight limits for each ETF. These represent the theoretical maximum weight that each ETF could hold in the portfolio in an ideal situation of relative momentum, volatility and correlation. These limits are useful because they show the optimal weights in the context of current market conditions.

More specifically, this chart tells us where Columbus finds the most optimal risk/return tradeoff for the upcoming month. When an ETF weight approaches its theoretical weight limit, it tells us Columbus greatly favors that asset class and its geographical region. Conversely, when the allocated weight is small, then Columbus shuns that asset class and/or its region, but may still want some exposure because it offers a de-correlation benefit to the overall portfolio.
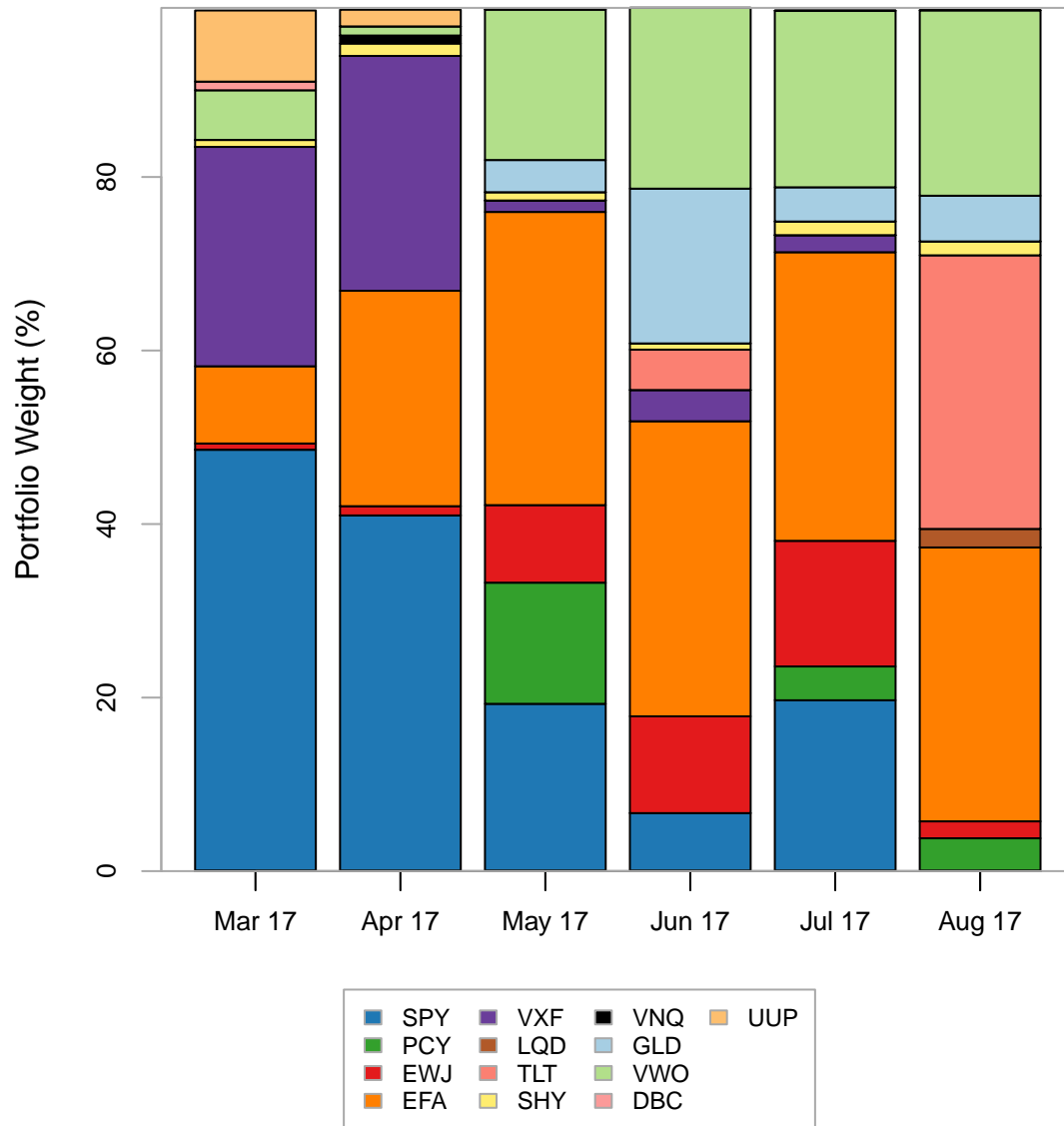
Optimal Portfolio Weights
Compared to Maximum Weight Limits
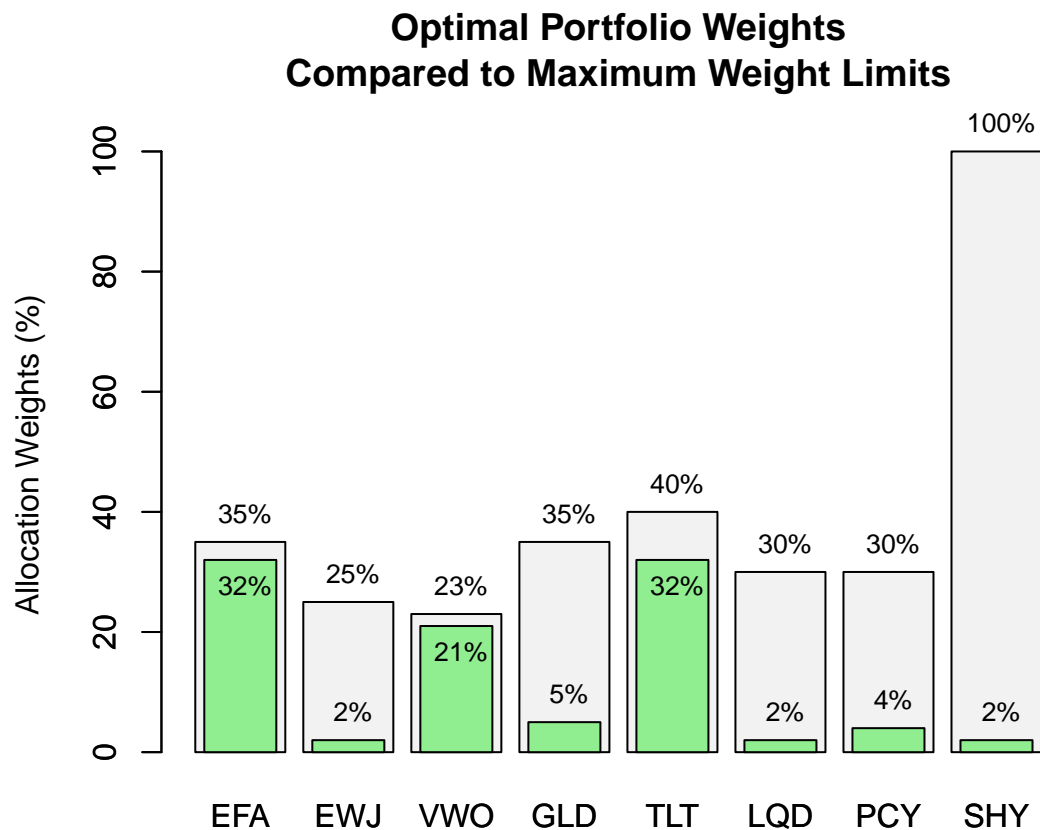
See the appendix for a description of each ETF in the Columbus universe.

Asset Allocation During the Most Recent 6 Months

The following chart shows the relative asset allocation during the most recent 6 months.

Asset Allocation During Latest 6 Months
Number of Securities Traded: 13

# APPENDIX A - Columbus Detailed Performance Analysis

Below is a detailed analysis of the risk/return performance of Columbus compared to the following benchmarks:

- The **S&P 500 Index** using the SPDR S&P500 ETF (SPY)
- A **Global Allocation benchmark** using the GMO Global Asset Allocation Fund (GMWAX)
- The **Equal Weights portfolio**, which consists of equally weighting all 15 assets in the Columbus universe and rebalancing daily. The Equal Weights portfolio includes 5 equity ETFs, 5 fixed income ETFs, 3 real assets ETF and 2 cash equivalent ETFs, implying the following asset class mix: 33% equities, 33% fixed income, 20% real assets and 13% cash or equivalents.

The chart below illustrates the performance of Columbus since 2008 compared to these benchmarks. Comparing Columbus (black curve) to the Equal Weights portfolio (red curve) illustrates how the Columbus algorithm consistently adds value over time by distancing itself from the performance of its universe. This can be seen as the growing divergence between the two curves over time. It essentially shows how the algorithm consistently produces excess return (alpha creation) above its equivalent no-skill portfolio, the Equal Weights portfolio.

The table shows certain key performance metrics for Columbus and the same benchmarks.

Columbus Performance and Key Benchmarks
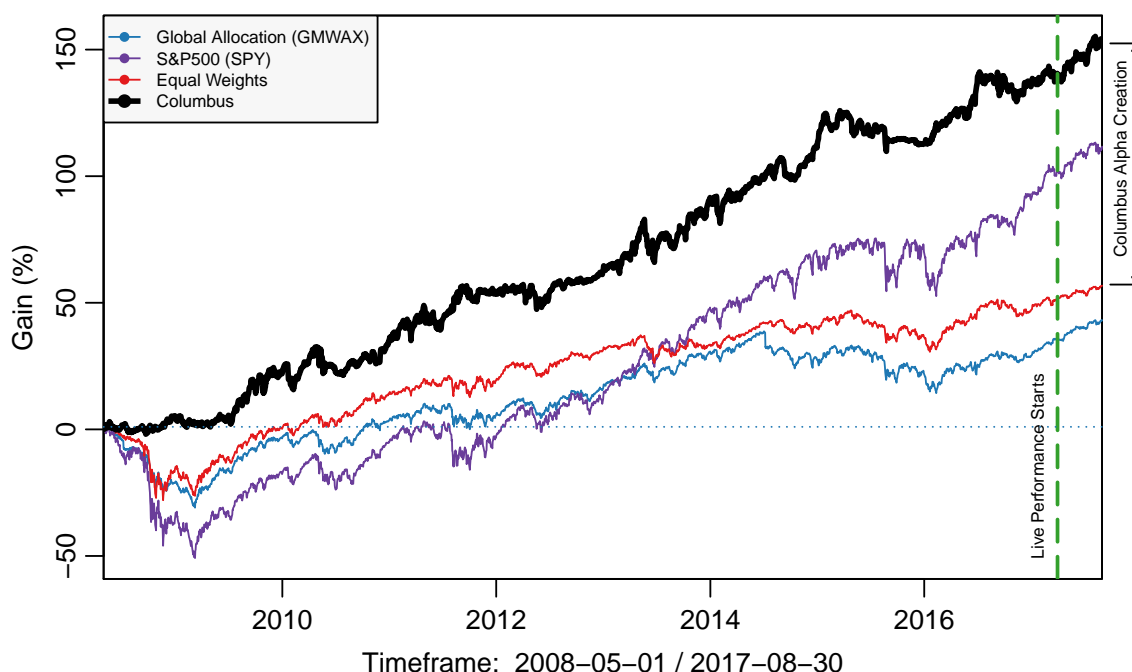
Timeframe: 2008−05−01 / 2017−08−30

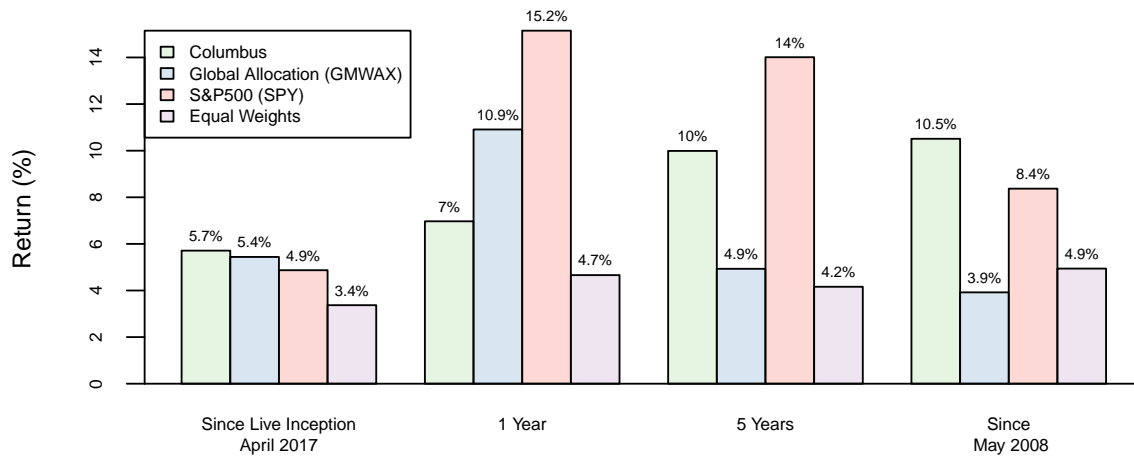|	Columbus	Global Allocation	S&P500	Equal Weights
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Annualized Sharpe Ratio	1.13	0.38	0.41	0.48
Annualized Standard Dev. (%)	9.26	10.25	20.62	10.38
MAR Ratio	1.13	0.12	0.16	0.17

Returns and Drawdown Analysis

The top bar charts below shows the returns over various timeframes. All returns are annualized (compounded annually) except for the returns shown since the live Columbus inception in our model account, which is a simple return since the beginning of April 2017.

The bar charts at the bottom show the maximum drawdowns for Columbus and the benchmarks, along with the number of trading days it took to fully recover from this drawdown. Note that there are 252 trading days in a year, so in the case of SPY, 740 days implies that it took 2.9 years to recover from its 51.5% drawdown.

Also note that this analysis starts on May 1, 2008 after the market peaked in late 2007. This is because certain ETFs in the Columbus universe were not available earlier.

We performed a similar analysis using mutual funds with a longer history as a proxy for the Columbus ETF universe. This enabled us to analyze the performance of the algorithm going back to 1998. This analysis was especially informative because it included the dot-com bust. Please contact us if you are interested in receiving a copy of this report.
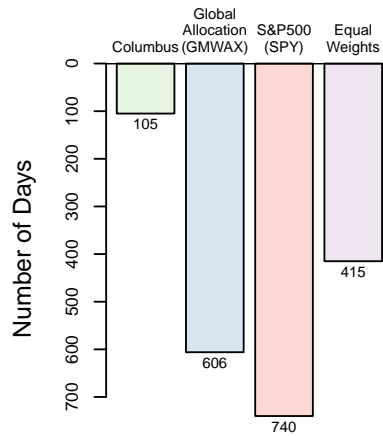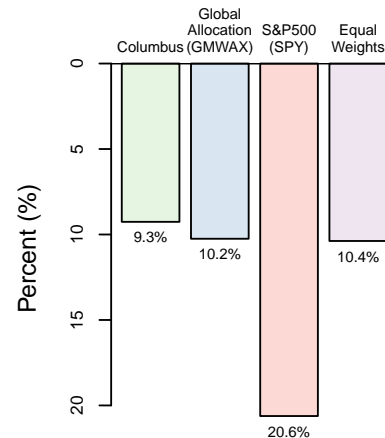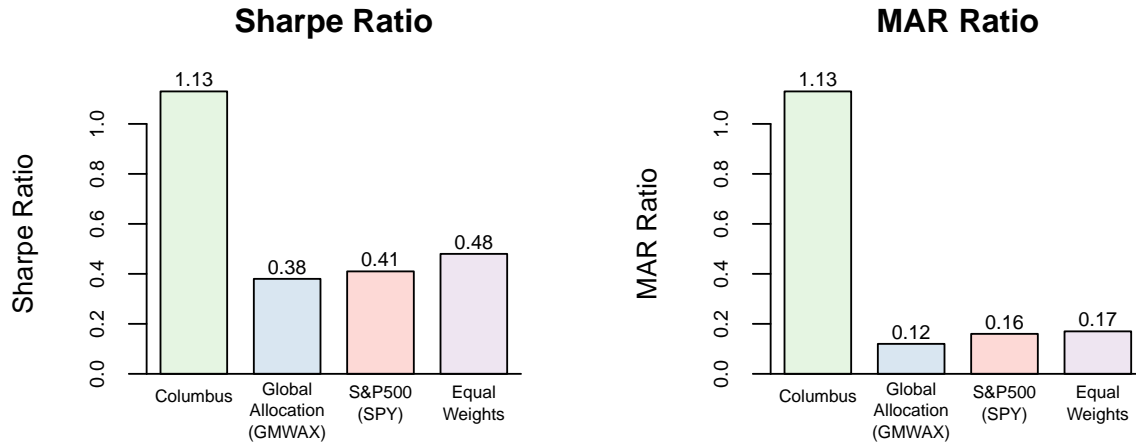
Columbus Performance vs. Key Benchmarks

Sharpe, MAR and Rolling 12 Months Analysis

The bar chart below on the left shows the Annualized Sharpe ratio for Columbus and its benchmarks. The Sharpe ratio is calculated assuming a risk-free interest rate of 0%. Also shown on the right is the MAR ratio for Columbus and its benchmarks.
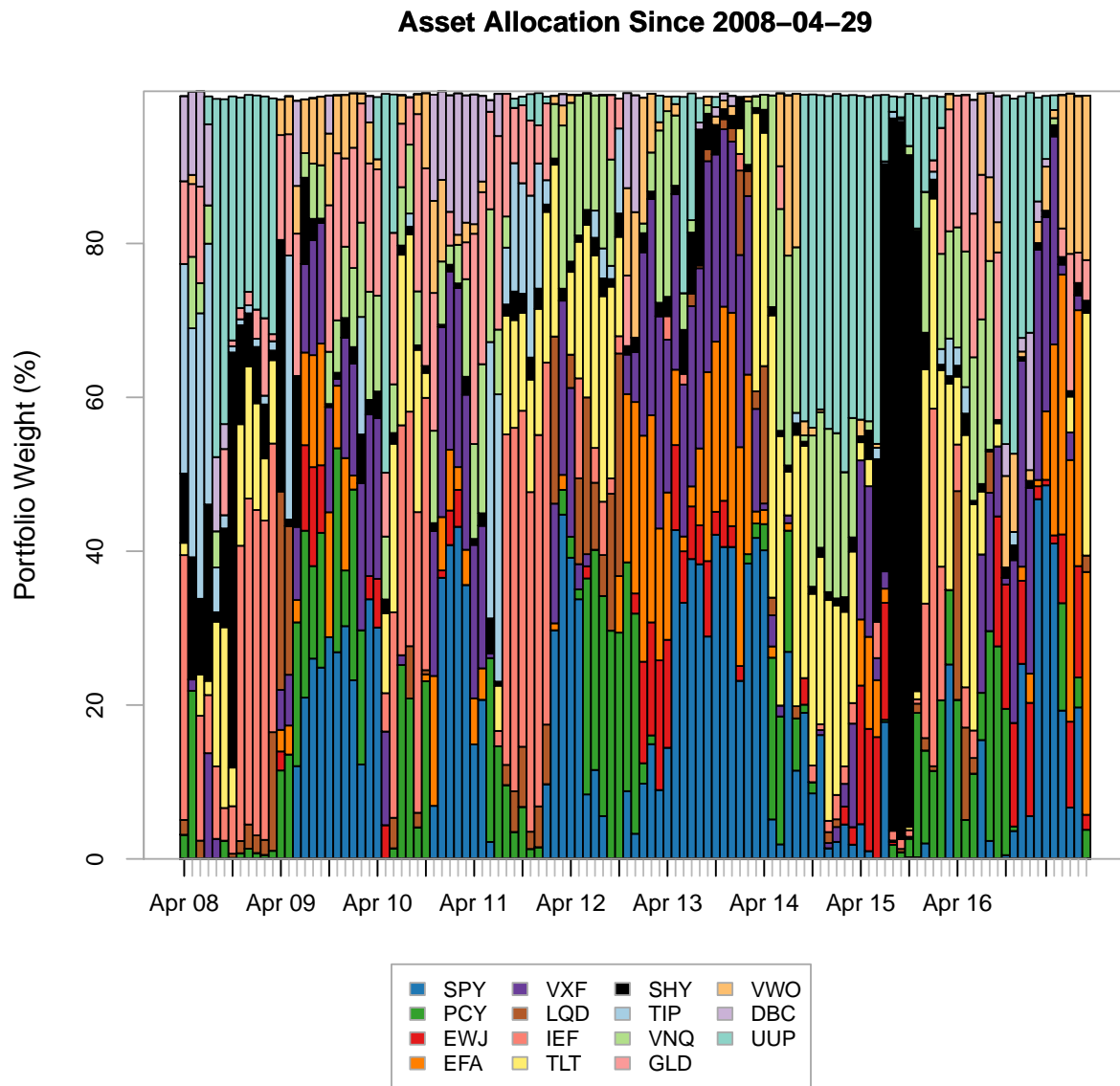

The next chart shows the rolling 12 months performance. This illustrates how an investor would have fared 12 months out assuming that investor had invested at any given time during the time frame.
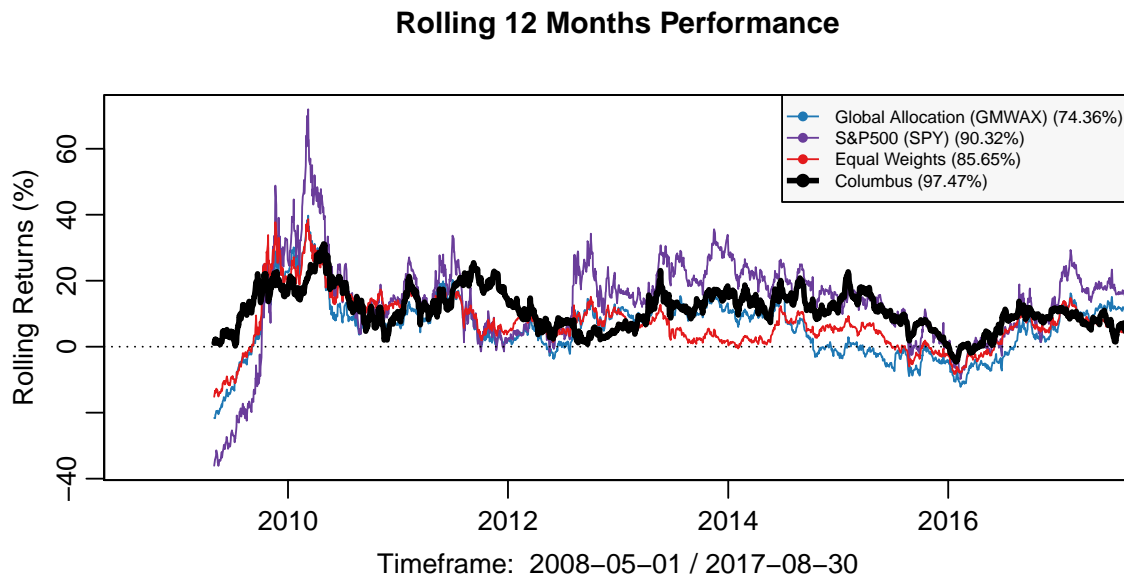
APPENDIX B - Historical Weight Allocations

The following chart shows the historical Columbus asset allocation since 2008.

**Asset Allocation Since 2008–04–29**

APPENDIX C - Columbus Performance vs. Assets in its Universe

Extracting alpha from an investment universe requires an algorithm that can consistently allocate the right amount of funds to the most optimal assets at the proper time. The objective is to minimize drawdowns during downturns while capturing most of the positive returns offered by these assets during an upturn.

The following plot illustrates how Columbus compares against all assets forming its investment universe. The Columbus equity curve is shown as the thick black line.

Columbus vs. All Assets in its Universe

Timeframe: 2008−05−01 / 2017−08−30
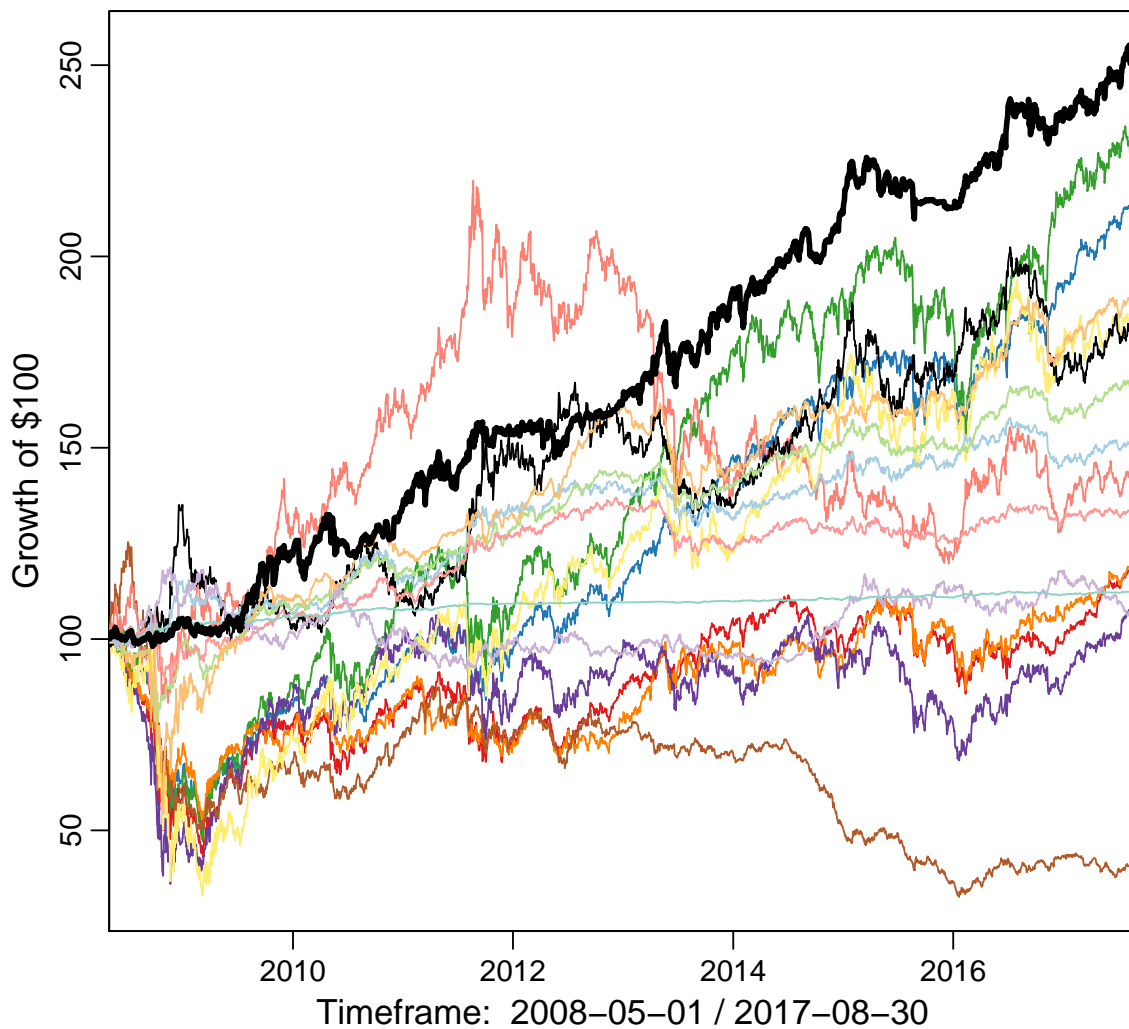
APPENDIX D - Columbus ETF Universe

Symbol	Assets	ETF Name and Description
SPY	$ 242B	SPDR S&P500 Index ETF
EFA	$ 79B	iShares MSCI EAFE Index ETF
VWO	$ 82B	Vanguard FTSE Emerging Markets ETF
VXF	$ 58B	Vanguard Extended Market ETF (US small and mid caps, ex-S&P500)
EWJ	$ 17B	iShares MSCI Japan ETF
VNQ	$ 65B	Vanguard REIT Index ETF
GLD	$ 32B	SPDR Gold Shares
DBC	$ 1.9B	PowerShares DB Commodity Index Tracking Fund
IEF	$ 7.3B	iShares 7-10 Year Treasuries Bond ETF
TLT	$ 7.4B	iShares 20+ Year Treasuries Bond ETF
TIP	$ 23B	iShares TIPS Bond ETF
LQD	$ 38B	iShares iBoxx $ Investment Grade Corporate Bond Fund
PCY	$ 4.7B	PowerShares Emerging Markets Sovereign Debt Portfolio
UUP	$ 515M	PowerShares DB US Dollar Bullish Index Fund
SHY	$ 11B	iShares 1-3 Year Treasuries Bond ETF (Primary Cash Asset)

The Columbus ETF universe was designed based on the following criteria:

- Include all major tradable asset classes available in global finance
- Each ETF must be tradable on the US markets and provide ample liquidity through its size
- Ensure the level of correlation between each ETF is generally low enough to provide diversification

Certain asset classes were large enough to warrant being covered by two separate ETFs. This is the case with US stocks, where SPY provides exposure to the large capitalization stocks while VXF provides exposure to small and mid-sized capitalization stocks.

Similarly, EFA provides exposure to international large capitalization stocks, which includes a wide range of countries. However, we also added Japanese stocks as a separate ETF (EWJ) despite some exposure to the Japanese market through EFA. This choice is justified because Japan is a major global equity market that is generally uncorrelated with other major developed equity markets. Thus, adding Japan to the mix provides an additional de-correlation component to the universe.