Columbus October 2019 Allocation Report

For Portfolio Rebalancing on **2019-09-30**

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1. Overview

Columbus is Laplace Insights™ adaptive asset rotation strategy trading on the US markets. It selects up to 8 assets from a universe of 15 low costs, highly liquid ETFs, each representing one of the world's major asset classes. Columbus uses a quantitative Algorithm to continuously monitor and adapt to market conditions. The Algorithm selects assets and adjusts their portfolio weights to optimize for the best risk/return tradeoff. It is designed to emphasize capital preservation during turbulent markets while capturing gains during bull markets.

Columbus benefits investors by enforcing a disciplined and rigorous methodology. Free of human emotions, the Columbus Algorithm delivers consistent performance over a wide range of historically different market conditions. It is designed to limit portfolio drawdowns during bear markets while producing returns in line with global equity markets during bull markets.

The Columbus 15 ETF universe was selected to represent the most relevant global asset classes. The strategy trades monthly on the last trading day of the calendar month.

2. Performance Summary

Figure 1 on the next page illustrates the Columbus simulated and live historical performance along with three key benchmarks:

- A Global Allocation Benchmark represented by mutual fund GMO Global Asset Allocation (GMWAX).
- The S&P500 Index ETF (SPY) represents the US equity markets.
- A no-skill Equal Weights benchmark based on equal weighting all 15 ETFs forming the Columbus universe.

The investment value-add (alpha) created by Columbus over time is shown by the double arrow located on the right side of the chart (Columbus Alpha Creation). This double arrow compares Columbus (shown in black) to the no-skill portfolio represented by the Equal Weights benchmark (shown in red). Comparing these two curves over the timeline shows how Columbus consistently generates returns every year above and beyond the Equal Weights no-skill portfolio. This excess return is readily seen as Columbus keeps distancing itself from its Equal Weights benchmark over time.

Columbus selects ETFs and adjusts their portfolio weights based on a combination of momentum, volatility and correlation of asset returns. Since the algorithm considers risk and volatility as paramount, it defaults to a conservative view whenever market conditions warrant it.

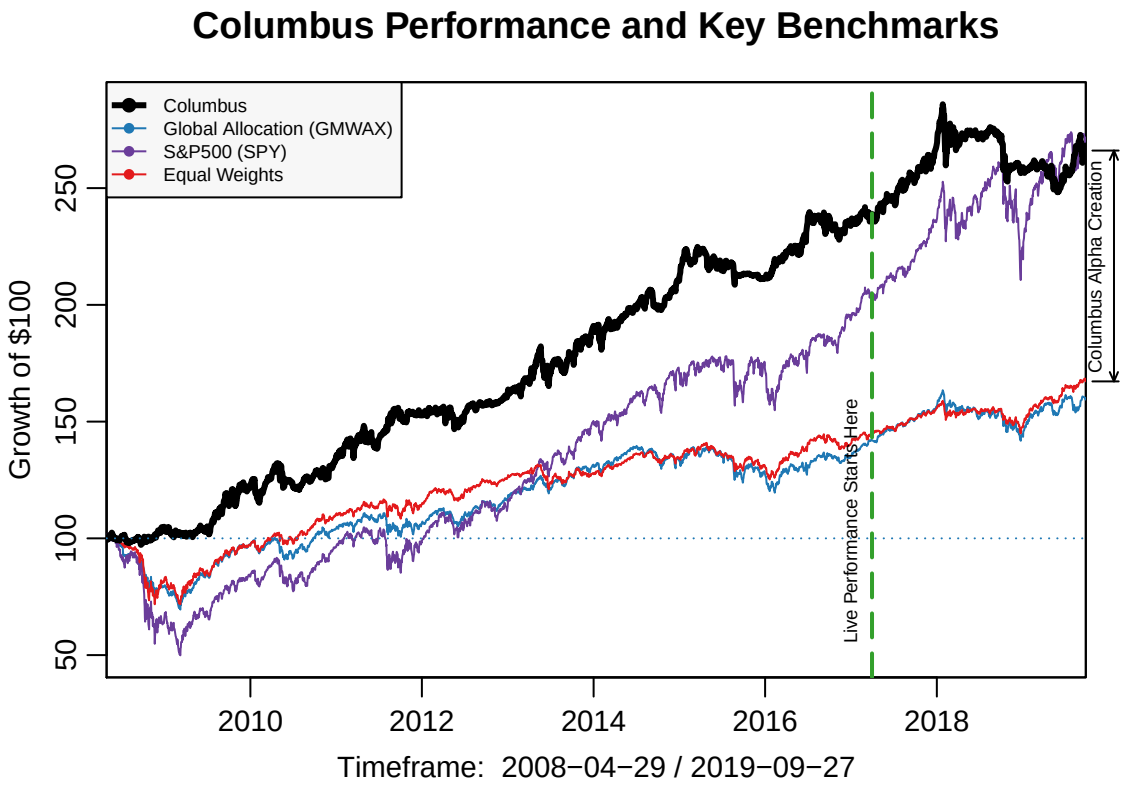

Figure 1

	Columbus	Global Allocation	S&P 500	Equal Weights
Annualized Returns (%)	8.96	4.17	9.07	4.61
Year-to-Date Return (%)	3.33	10.18	19.85	13.16
Maximum Drawdown (%)	-13.18	-31.87	-51.49	-29.77
Positive Rolling Years (%)	88.98	78.72	90.88	85.09
Annualized Sharpe Ratio	0.97	0.43	0.46	0.49

The Columbus Algorithm has been extensively tested for resilience and statistical robustness using dozens of different mutual fund universes ranging from 13 to over 80 assets, and going back 20 years to 1998. In every case, the Columbus Algorithm consistently produced compelling risk-adjusted returns. More information on the technical details of our statistical testing methodology is available upon request.

Columbus may be used to adjust the tactical portion of a client portfolio. Since it is not constrained by asset class allocation, Columbus may be 100% invested in a single asset class in any given month. For example, during a low volatility equity bull market, it may be mostly weighted towards equities. On the other hand, it can also be expected to be heavily into cash assets or fixed income during times of high market uncertainty or stress. **The Columbus strategy is therefore suitable only for a portion of a client's portfolio that allows for full flexibility on asset class selection.**

Although the weights for each asset class are not constrained, a maximum exposure limit constraint is imposed on each ETF. For example, the maximum exposure to the iShares MSCI EAFE Index ETF (EFA) is 35%, as shown in the table on page 3 (the Max. Weight limit). Thus, in an ideal bull market condition, the algorithm will never be allowed to exceed a 35% exposure to this ETF. Such constraints force the algorithm to maintain a minimum level of diversification among multiple ETFs, no matter what the market conditions may be.

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3. Upcoming Month's Allocations

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

ETF	Max. Weight	Weight 2019-08-29	Weight 2019-09-27	Alloc. Change
SPY	50%	4%	**-**	-4%
VXF	35%	-	**-**	-
EFA	35%	-	**-**	-
EWJ	25%	-	**-**	-
VWO	25%	-	**-**	-
DBC	30%	-	**-**	-
GLD	35%	22%	**21%**	-1%
VNQ	30%	5%	**17%**	12%
TLT	40%	30%	**25%**	-5%
IEF	50%	4%	**5%**	1%
LQD	30%	19%	**18%**	-1%
TIP	40%	-	**1%**	1%
PCY	30%	16%	**11%**	-5%
UUP	50%	-	**-**	-
SHY	100%	1%	**2%**	1%
Total		*101%*	*100%*	

Totals may not add up to 100% due to rounding errors, in which case an adjustment is made to SHY or the cash balance. 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 occasions will the Columbus algorithm invest in an ETF at its maximum exposure level. Such situations require a market environment with compelling positive momentum combined with low volatility. For certain clients, such exposure levels may be too aggressive. Should that be the case, the client's advisor is urged to consider reducing the exposure to better suit his/her client's unique situation.

For a detailed discussion of the upcoming month's allocations, see Section 6.

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4. Asset Momentum and Volatility Analysis

Figure 2 below puts each asset in the Columbus universe on the momentum-volatility plane. The color of each dot represents the asset class each ETF belongs to, while the dot size shows the relative allocation weight for 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 a regularized momentum measure. 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.

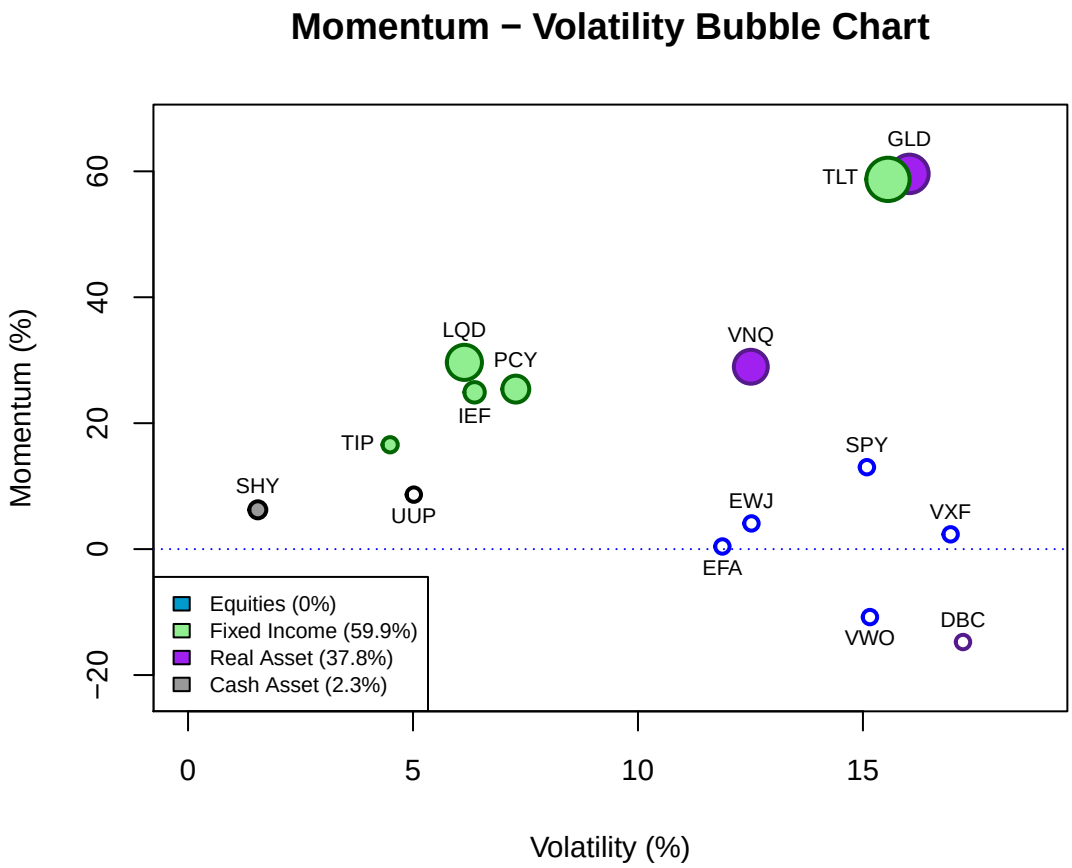

Figure 2

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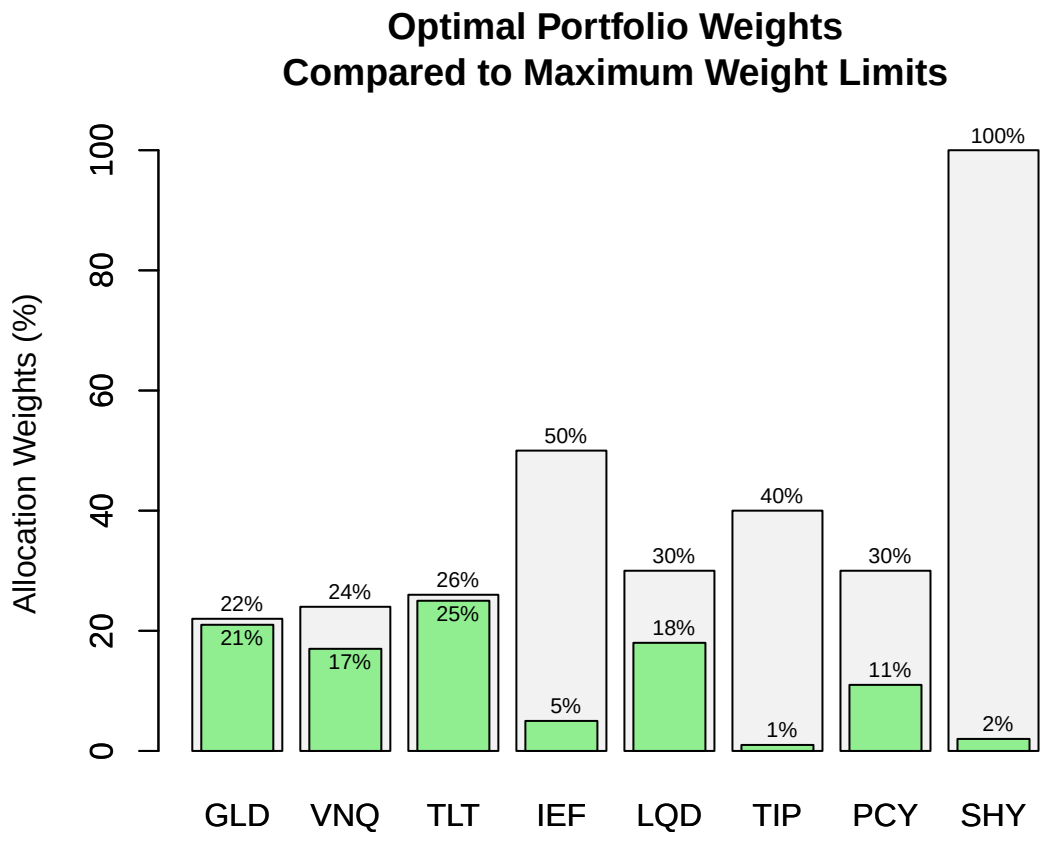
5. Constraints and Optimal Weights

Figure 3 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 as optimized by Columbus. The value of these are identical to the weights in the table on page 3.

The wider grey bars show the maximum weight limits for each ETF adjusted for the asset current volatility. In other words, it is the asset's theoretical maximum weight limit reduced by an amount related to the asset's recent volatility. This provides an important method for Columbus to contain portfolio volatility and control risk during turbulent market environments.

By overlapping the green bars over their associated grey bar, we can see how much Columbus chose to allocate to each asset vs. its allowable allocation limit. The allocation levels reflect the most optimal portfolio allocation for each asset.

More to the point, this chart tells us where Columbus finds the most optimal risk/return tradeoff for the upcoming month. When an ETF allocation (green bar) approaches its allocation limit (grey bar), Columbus is telling us that it greatly favors that asset class and its geographical region. Conversely, when the ETF weight is small compared to its limit, then Columbus shuns that asset class and/or its region, yet may still want some exposure because it offers a de-correlation benefit to the overall portfolio.



See the appendix for details on each ETF in the Columbus universe.

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6. Discussion on Upcoming Month's Allocations

Finding Balance in a World Driven by Tweets and Trade Disputes

"China will not ever by cowered by threats, or subdued by pressure", said China's Foreign Minister Wang Yi speaking at the UN General Assembly in New York last Friday. He added that "erecting walls will not resolve global challenges and blaming others for one's own problems does not work. Tariffs and provocations of trade disputes" are upsetting the global industrial and supply chain and risk undermining the "global economic and trade order." These statements exemplify China's position regarding the trade war and makes it clear that it will not back down any time soon to Trump's threats, irrespective of what the president may tweet or claim. Meanwhile, it's unlikely the president will back down from his own rhetoric unless some unforeseen dynamic emerges that would allow him to save face – an unlikely scenario in the short term.

In other words, the trade war is increasingly threatening the health of the global economy and is unlikely to come to a quick resolution. Meanwhile, the yield curve continues to be inverted, and the most recent ISM manufacturing report shows contraction for new orders and a notable decrease in business confidence.

Let's remember this bull market is the longest in recorded history while its growth was fueled by record low interest rates. This encouraged businesses to take on a lot of leverage, creating much potential future instability in the process. When the economic machine starts to go into reverse, possibly caused by a breakdown in confidence, a domino effect is likely to emerge that will drive a vicious cycle of economic damage. These issues were discussed by Ray Dalio, founder of Bridgewater Associates, the world's largest hedge fund, in a recently published article on LinkedIn entitled "The Three Big Issues and the 1930s Analogue". I highly recommend it as it illustrates the key drivers of a possible economic future.

Balance and Caution are Warranted

Given a sky-high stock market and all these negative forces at play in the background, what should a portfolio manager do? While much caution is warranted, we are nevertheless not there yet and so it's also possible for the markets to make new highs in the short term. The right answer is to find a balance between asset classes while paying much attention to risk management so as to buffer any sudden breakdown in the current market regime.

Columbus is doing just that for this month while staying away from equities. Figure 3 illustrates its approach of diversifying among many different assets, including gold (GLD), real estate (VNQ), long term treasuries (TLT and IEF), corporate bonds (LQD) and emerging market sovereign debt (PCY). It even made a small allocation to inflation protection bonds (TIP), which provides an early albeit interesting argument that inflation may be looming out there on the horizon despite the current backdrop of falling rates. Figure 2 shows how all these assets continue to demonstrate good momentum at reasonable risk, while equities as a group seem to be running out of steam. In other words, and assuming the current global geopolitics trajectory stays, we may very well see a stock market that rolls over while the Federal Reserve attempts to counter the negative forces by stimulating the US economy through lower rates. In any case, it's reasonable to expect stocks to remain rather unpredictable at this juncture. This is in contrast with interest sensitive assets such as bonds and real estate which offer a relatively more stable source of returns driven by a likely scenario of lower interest rates. Meanwhile, gold remains an important part of a portfolio in such an environment as it provides an insurance against a breakdown in the current economic regime, or economic paradigm shift as Ray Dalio illustrates in his article mentioned above and also in an earlier article also published on LinkedIn entitled "Paradigm Shifts".

Should you have any questions or concerns, please don't hesitate to contact me.

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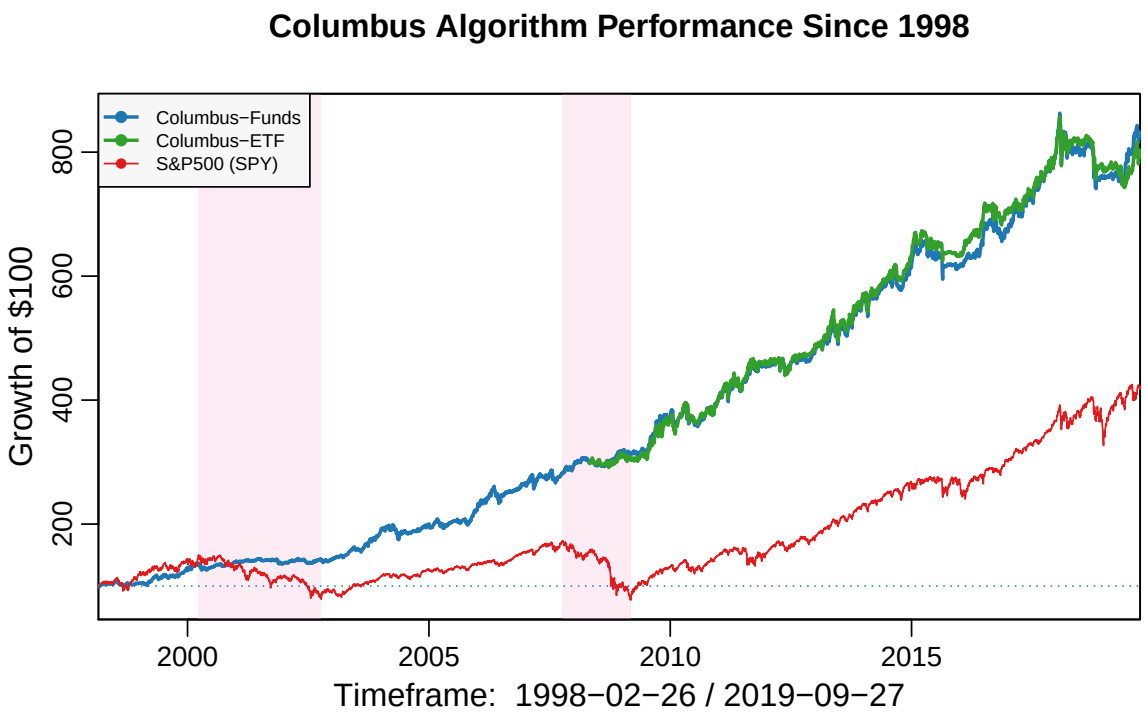
APPENDIX A - Columbus Algorithm Long Term Performance

The figure below illustrates the Columbus Algorithm performance since 1998 using two similar investment universes:

- The **Columbus-ETF** curve (in green) represents the Columbus Algorithm applied to our 15 ETF universe. This curve is identical to the Columbus curve in Figure 1 and is reproduced here for reference.
- The **Columbus-Funds** curve (in blue) is a very similar universe to the Columbus-ETF universe except that it uses mutual funds instead of ETFs. Although not ideal for trading, this universe has a longer history and is therefore useful to demonstrate the performance of the Columbus Algorithm going back 20 years to February 1998.

The two regions in pink represent the dotcom crash and the financial crisis bear markets.



	S&P 500	Columbus-Funds (1998)	Columbus-ETF (2008)
Annualized Returns (%)	6.7	10.07	8.96
Maximum Drawdown (%)	-55.2	-14.11	-13.18
Annualized Sharpe Ratio	0.35	1.22	0.97
Pos. Rolling Years (%)	76.89	91.21	88.98

Note: *Statistics for Columbus-Fund and the S&P 500 are calculated since February 1998. Statistics for Columbus-ETF are calculated since May 2008.*

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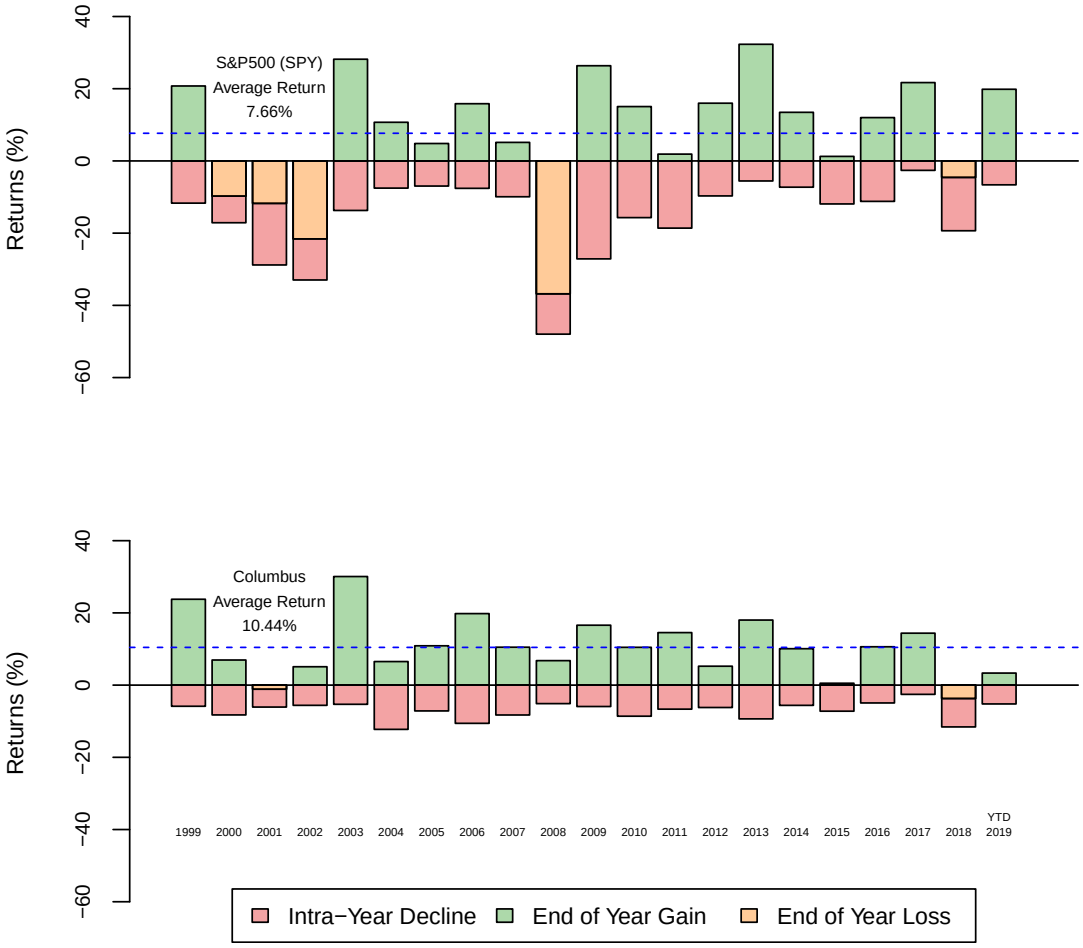
The following figure shows the annual performance of **Columbus-Funds** and the S&P 500 for each year since 1999. A green bar means a positive gain was achieved during the calendar year. An orange bar means a loss was endured during the calendar year. The red bar shows the maximum decline in value during the calendar year.

The average returns are the simple average return for the years shown. This is not the same as the annualized returns shown on the previous page.



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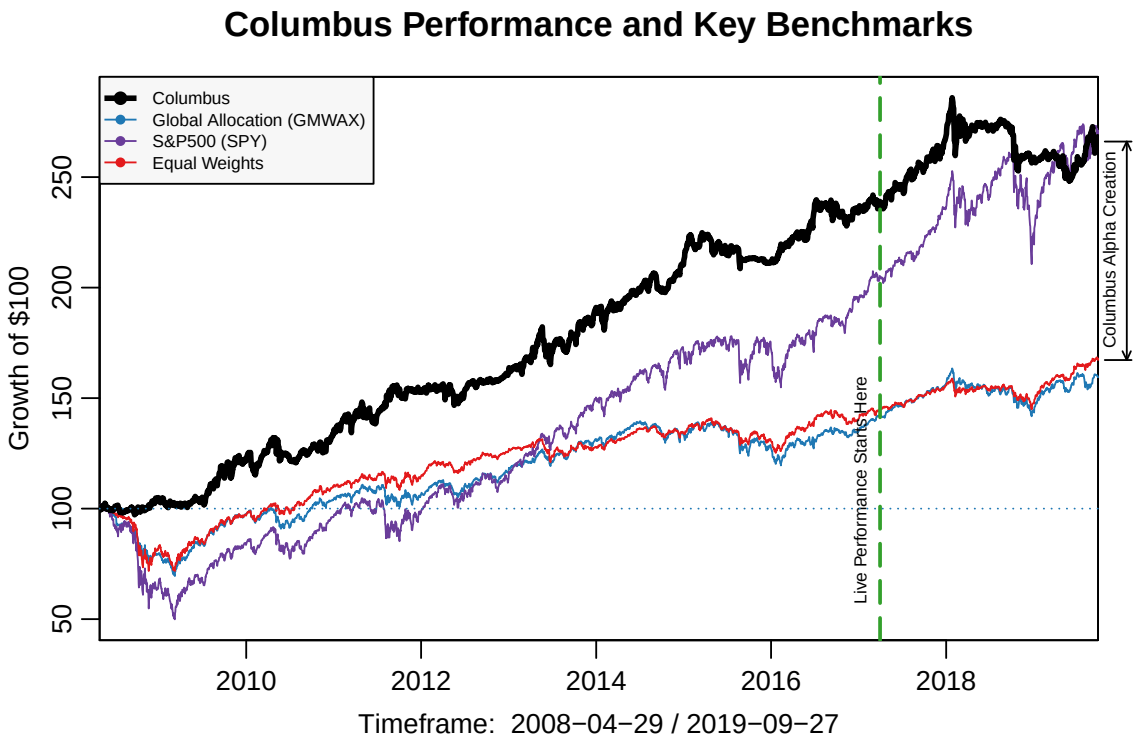
APPENDIX B - Columbus Detailed Performance Analysis

The chart below illustrates the performance of Columbus since 2008 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, creating the following asset class mix: 33% equities, 33% fixed income, 20% real assets and 13% cash or equivalents.

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 shows how the algorithm consistently produces an excess return (alpha creation) above its equivalent no-skill portfolio, the Equal Weights Portfolio.

The table below shows some key performance metrics for Columbus and these benchmarks.



	Columbus	Global Allocation	S&P500	Equal Weights
Annualized Returns (%)	8.96	4.17	9.07	4.61
YTD Gain / Loss (%)	3.33	10.18	19.85	13.16
YTD Annualized Gain/Loss (%)	4.52	13.96	27.63	18.13
Maximum Drawdown (%)	-13.18	-31.87	-51.49	-29.77
Annualized Standard Dev. (%)	9.2	9.67	19.65	9.34
Positive Rolling Years (%)	88.98	78.72	90.88	85.09
Annualized Sharpe Ratio	0.97	0.43	0.46	0.49
MAR Ratio	0.68	0.13	0.18	0.15

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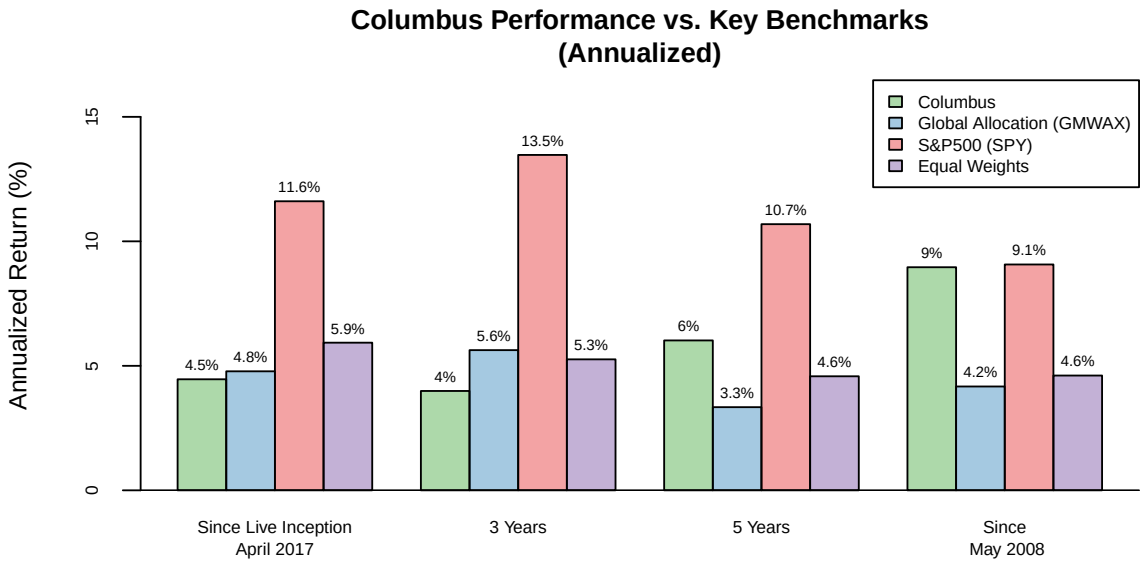
Returns and Drawdown Analysis

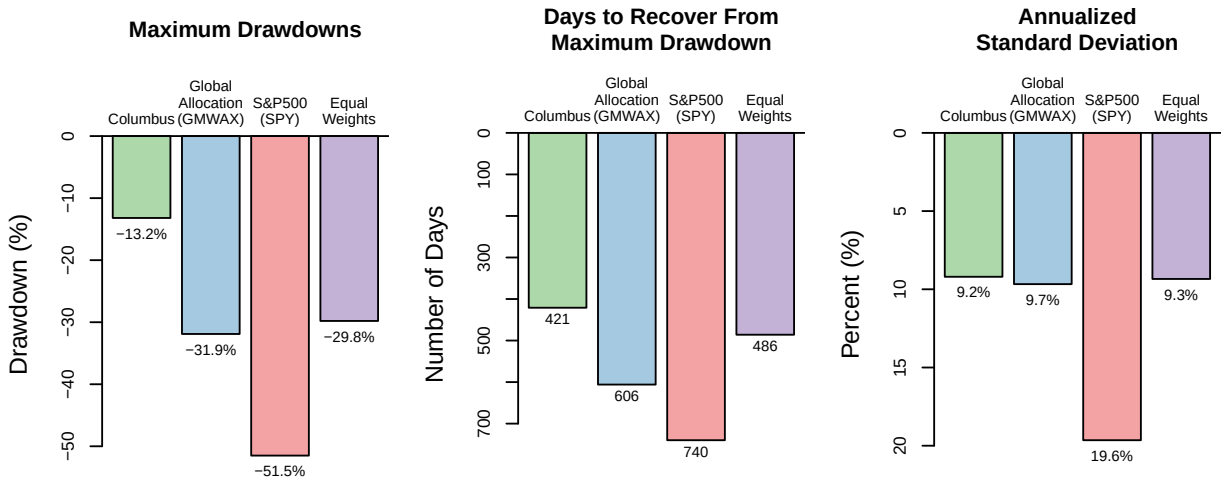
The top bar charts below show the returns over various timeframes. All returns are annualized (compounded annually) except for the returns shown since the live Columbus inception in our model account, which is a simple return since the beginning of April 2017.

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 almost 3 years to recover from its 51.5% drawdown.

Also note that this analysis starts on May 1, 2008, well 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 starting in 1998 using a mutual funds universe as a proxy for the Columbus ETF universe. This analysis is particularly informative because it includes both the dotcom crash and the entire financial crisis. Please contact us to obtain a copy of this analysis and to learn more about our robustness testing methodology.





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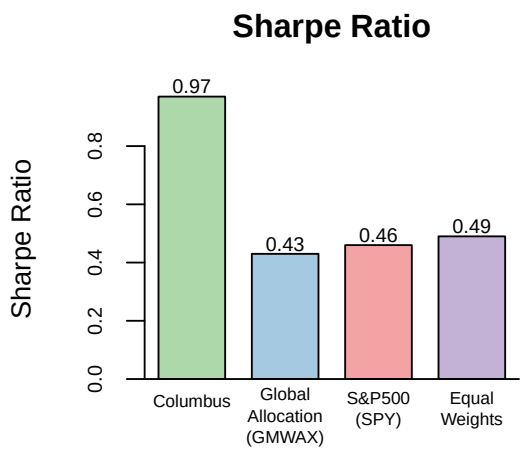
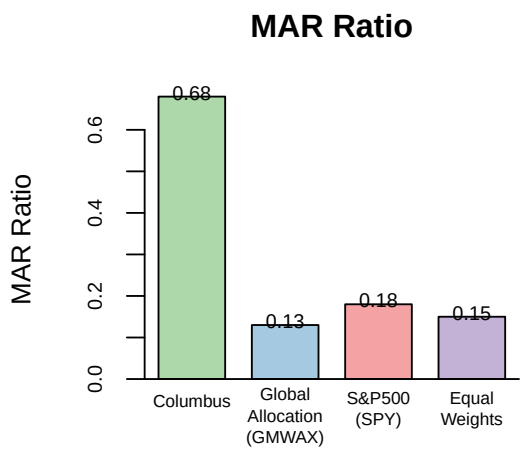
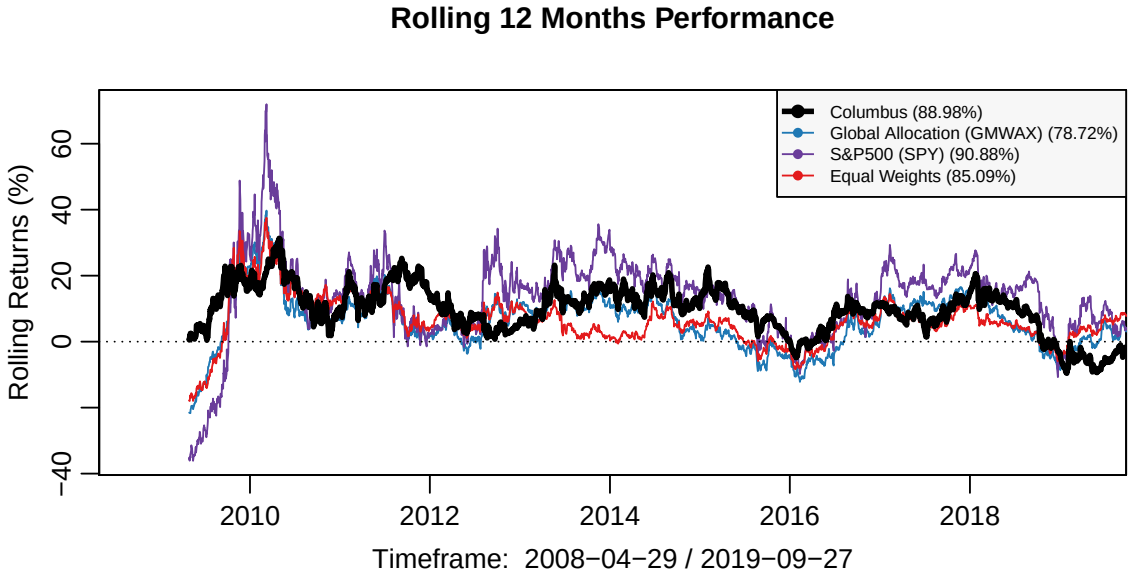
Sharpe, MAR and Rolling 12 Months Analysis

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 same investor had invested at any given time during the time frame. The percentages shown in the legend are the percentage of the time the 12 month return was positive during the time frame.



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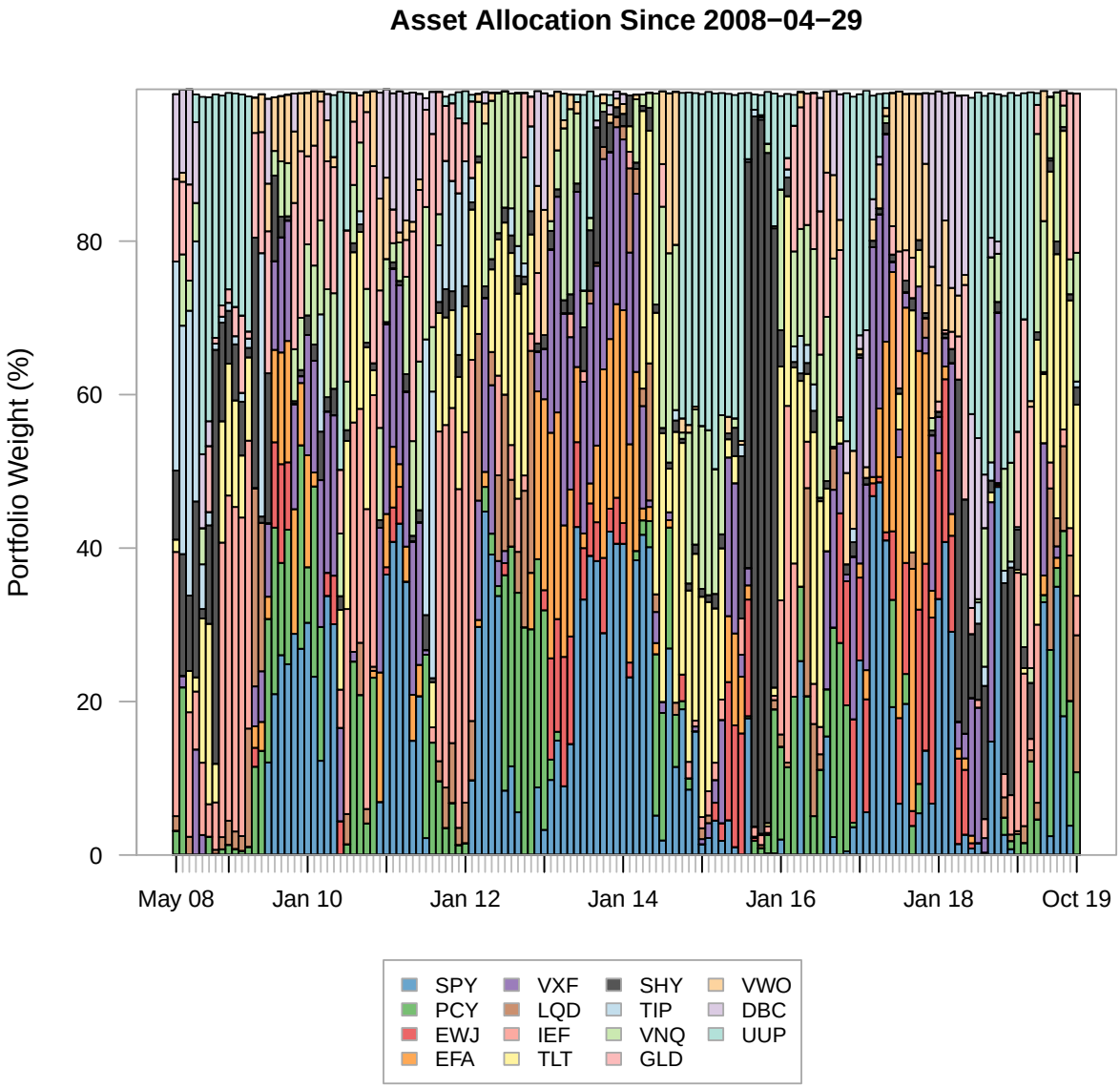
APPENDIX C - Historical Weight Allocations

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



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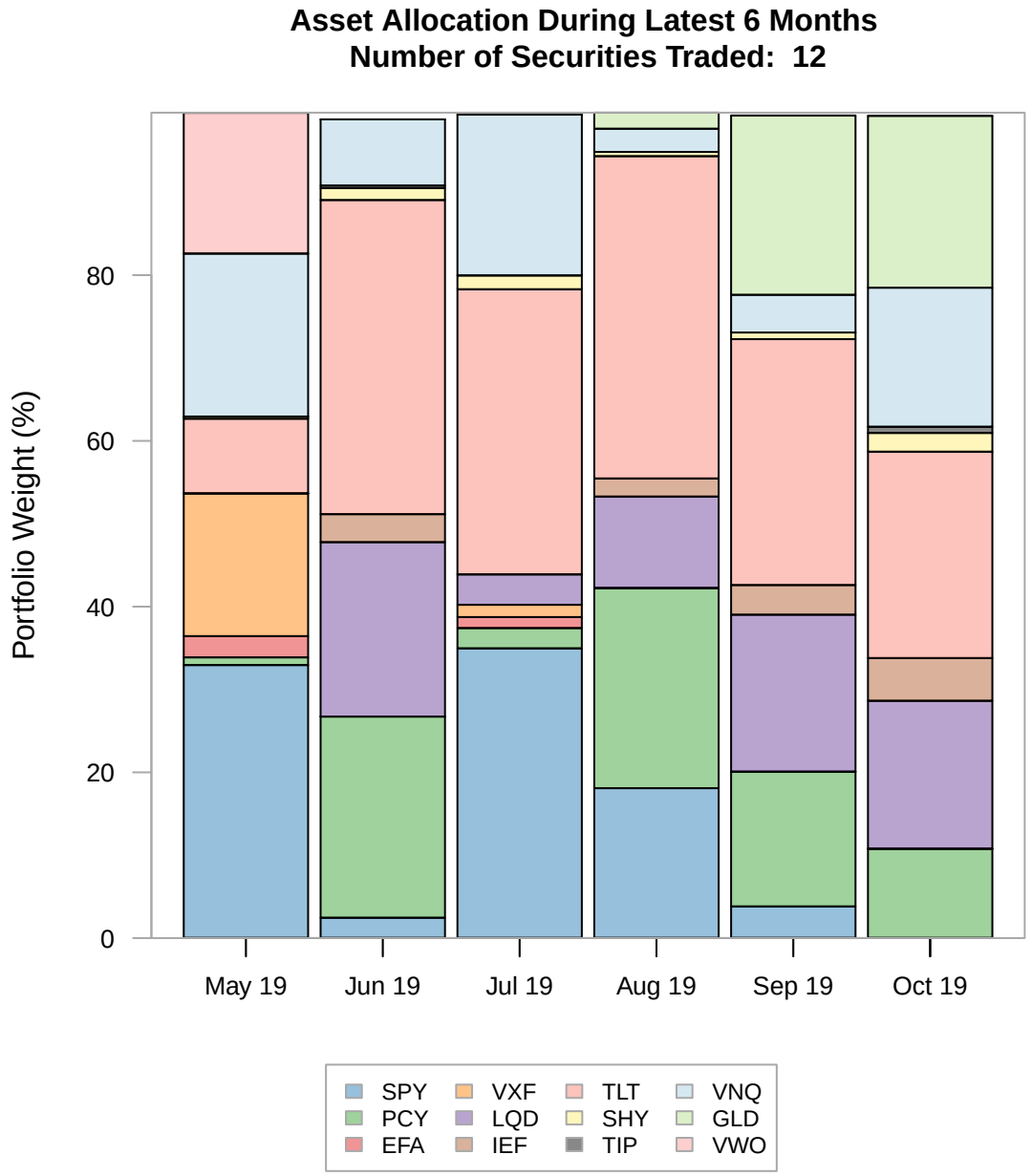
The following chart shows the relative asset allocation during the most recent 6 months.



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APPENDIX D - Columbus ETF Universe

The Columbus ETF universe is designed according to the following criteria:

- It is based on ETFs representing the major tradable asset classes available in global finance.
- Each ETF trades on the US markets and provides ample liquidity through its size.
- The level of correlation between each ETF is generally low enough to provide diversification.

The table below provides a short description of each ETF with their total assets and annual expense ratios.

Symbol	Assets	Exp. Ratio	ETF Name and Description
SPY	$ 242B	0.09%	SPDR S&P500 Index
EFA	$ 79B	0.33%	iShares MSCI EAFE Index
VWO	$ 82B	0.14%	Vanguard FTSE Emerging Market Equities
VXF	$ 58B	0.08%	Vanguard Extended Market (US small & mid caps, ex-S&P500)
EWJ	$ 17B	0.48%	iShares MSCI Japan Equities
VNQ	$ 65B	0.12%	Vanguard REIT Index
GLD	$ 32B	0.40%	SPDR Gold Trust (Gold Bullion)
DBC	$ 1.9B	0.89%	PowerShares DB Commodity Index Tracking Fund
IEF	$ 7.3B	0.15%	iShares 7-10 Year Treasury Bonds
TLT	$ 7.4B	0.15%	iShares 20+ Year Treasury Bonds
TIP	$ 23B	0.20%	iShares TIPS Bonds
LQD	$ 38B	0.15%	iShares iBoxx $ Investment Grade Corporate Bond Fund
PCY	$ 4.7B	0.50%	PowerShares Emerging Markets Sovereign Debt Portfolio
UUP	$ 515M	0.75%	PowerShares DB US Dollar Bullish Index Fund
SHY	$ 11B	0.15%	iShares 1-3 Year Treasury Bonds (Primary Cash Asset)
AVERAGE	**$44.6B**	**0.31%**	

Note that certain asset classes were considered 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 via large multinational Japanese companies. 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.

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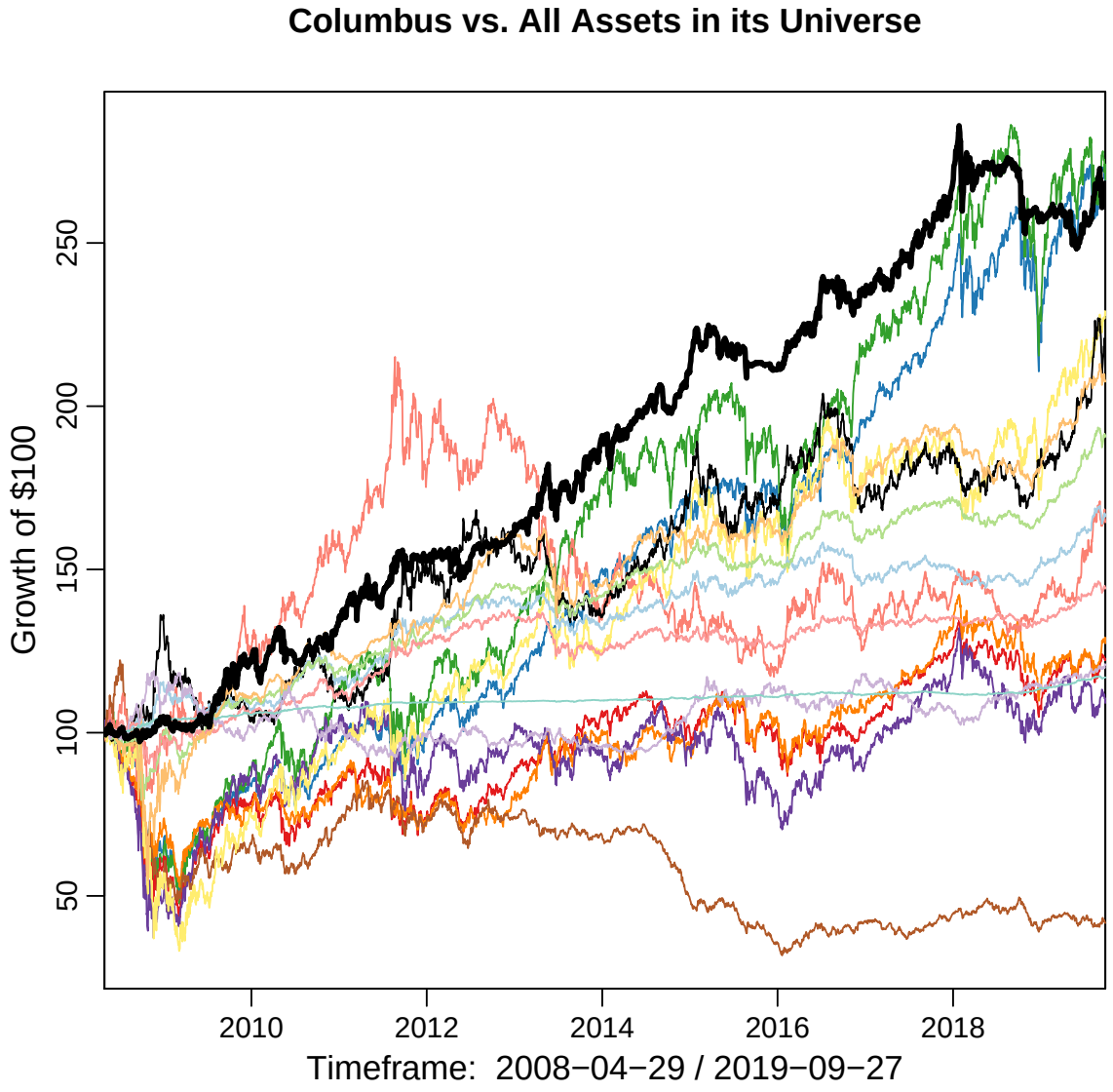
Columbus Performance vs. Assets in its Universe

Producing alpha from an investment universe requires an algorithm that can consistently allocate the right amount of funds to the most optimal assets, and to do so 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 chart illustrates how Columbus compares against all assets forming its investment universe. The Columbus equity curve is shown as the thick black line.



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APPENDIX E - Reducing Whipsaws and Improving De-Correlation

On June 27, 2019, we introduced some small modifications to the way Columbus optimizes its monthly portfolio. This was motivated by a number of whipsaws we experienced lately at month-end rebalancing. To understand the situation, we simulated many versions of Columbus each with a different rebalance date during the month. In every case, performance had improved and in some cases it did so quite substantially. So one question was whether rebalancing at month-end was still a good idea while another question was whether we were observing a crowding effect happening at month-end driven by so many popular quant strategies that all rebalance around the end of the month.

After much consideration, we chose to maintain the month-end rebalance date for the time being while addressing our issue at hand by applying additional filtering in the algorithm's momentum calculations and by increasing the level of decorrelation used when optimizing the portfolio. The impact of these is to produce a portfolio that is generally more balanced and less susceptible to Presidential tweets happening around month end.

Note that these are tweaks at the margin to bring more stability to the portfolio allocations, and in no way does it imply that the underlying algorithm has changed. The overall method, including the screening of assets, the analysis of volatility on a per asset and portfolio basis and the constrained genetic optimization process were all left unchanged.

To ensure these modifications did not introduce any unintended consequences, we have applied our extensive suite of statistical backtests, which consists of well over 300 backtests of carefully designed corner cases, including some with major investment universe modifications, and each running over a period of at least 20 years. Other than having obtained a large computing bill from Amazon Web Services (AWS is our cloud computing platform) we have not observed any unexpected behavior by the algorithm. In fact, the opposite is true as the stability introduced by these changes made the Columbus algorithm perform better even at the extreme corner cases.

In practice, these changes will only make the portfolio more balanced and reduce the level of extreme positioning we have observed at times. Since Columbus is meant to be a tactical sleeve within an otherwise balanced portfolio, making it a bit more balanced with less inclination to make extreme moves should not be an issue. In fact, given Columbus is transparent (since all assets can be viewed by clients), showing less extreme allocation changes should be helpful with client dialogues.

Please don't hesitate to contact me should you have questions or concerns.

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