

Donchian Breakout Strategy with EMA Filter

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Abstract

The goal of this analysis is to compare the famed “Turtle System” strategy against a common 60/40 buy-and-hold, or rebalance, strategy on a basket of two ETFs by measuring basic statistics such as Maximum Drawdown, Annualized Returns and Cumulative Returns. This analysis does not take into consideration transaction fees, slippage or taxation.

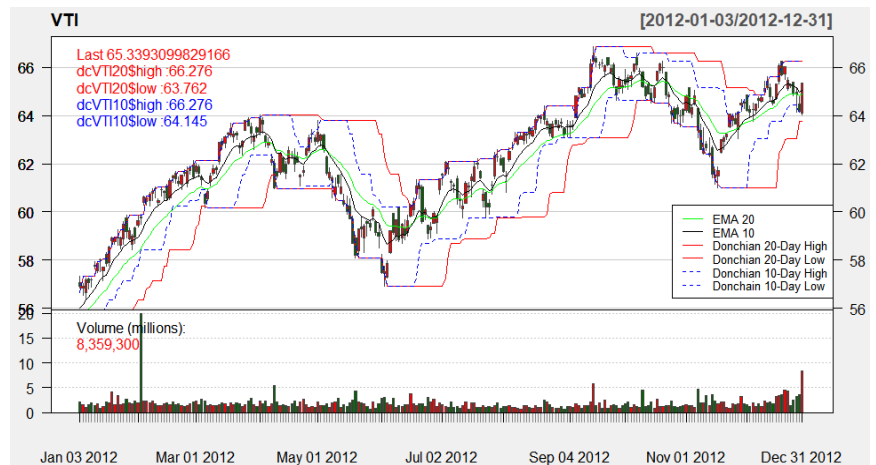
Strategy

Donchian Turtle System

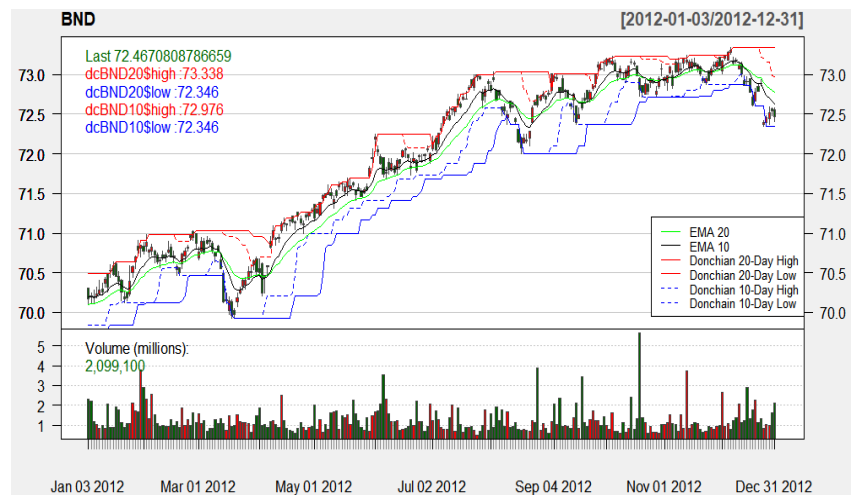
Pioneered by Richard Donchian, “The Father of Trend Following”, this system uses upper bands marking the highest price of a security over the previous N periods while also using a lower band to mark the lowest price of the security over the previous N periods (median band excluded from this strategy).

The Donchian 20/10 Breakout Strategy combines the sensitivity of this strategy’s ability to identify bullish and bearish energy, as well as reversals, which may lead to breakouts. To hedge the risk of entering the market due to false signals, one aspect of the Turtle Trading System is to apply an Exponential Moving Average (EMA) Momentum/Trend Filter. In our analysis, we apply two Donchian Channels, each reflecting highest and lowest security prices over 20 days and 10 days with two EMA filters over 20 days and 360 days to VTI and BND (Plots 1.1 and 1.2).

Plot 1.1



Plot 1.2



Plot 1.3

```
204 add.signal(strat.donchian, name="sigFormula",
205             arguments = list(columns=c("close", "EMA.EMA20", "EMA.EMA360", "high.DCH20"),
206                                 formula = "(EMA.EMA20 > EMA.EMA360) & (close > high.DCH20)",
207                                 label="trigger",
208                                 cross=FALSE),
209             label="EMAfilterLong" #Close.gt.high.DCH20"
210 )
211
212 add.signal(strat.donchian, name="sigFormula",
213             arguments = list(columns=c("close", "EMA.EMA20", "EMA.EMA360", "high.DCH20"),
214                                 formula = "(EMA.EMA360 > EMA.EMA20) & (low.DCH20 > close)",
215                                 label="trigger",
216                                 cross=FALSE),
217             label="EMAfilterShort" #Close.lt.low.DCH20
218 )
219
220 #will work but will throw an error when it goes to BND Data or, vice-versa, with VTI data in mktdata.
221 #add.signal(strat.donchian, name="sigFormula",
222             arguments = list(columns=c("VTI.Close", "EMA.EMA20", "EMA.EMA360", "high.DCH20"),
223                                 formula = "(EMA.EMA20 > EMA.EMA360) & (VTI.Close > high.DCH20)",
224                                 label="trigger",
225                                 cross=FALSE),
226             label="EMAfilterLong" #Close.gt.high.DCH20"
227 )
228
229 #add.signal(strat.donchian, name="sigFormula",
230             arguments = list(columns=c("VTI.Close", "EMA.EMA20", "EMA.EMA360", "high.DCH20"),
231                                 formula = "(EMA.EMA360 > EMA.EMA20) & (low.DCH20 > VTI.Close)",
232                                 label="trigger",
233                                 cross=FALSE),
234             label="EMAfilterShort" #Close.lt.low.DCH20
235 )
> applyStrategy(strategy = strat.Donchian, portfolios = strat.Donchian)
Error in eval(parse(text = formula), as.list(data)) :
  object 'close' not found
Error in `colnames<-`(`*tmp*`, value = seq(ncol(tmp_val))) :
  attempt to set 'colnames' on an object with less than two dimensions
Error during wrapup:
> |
```

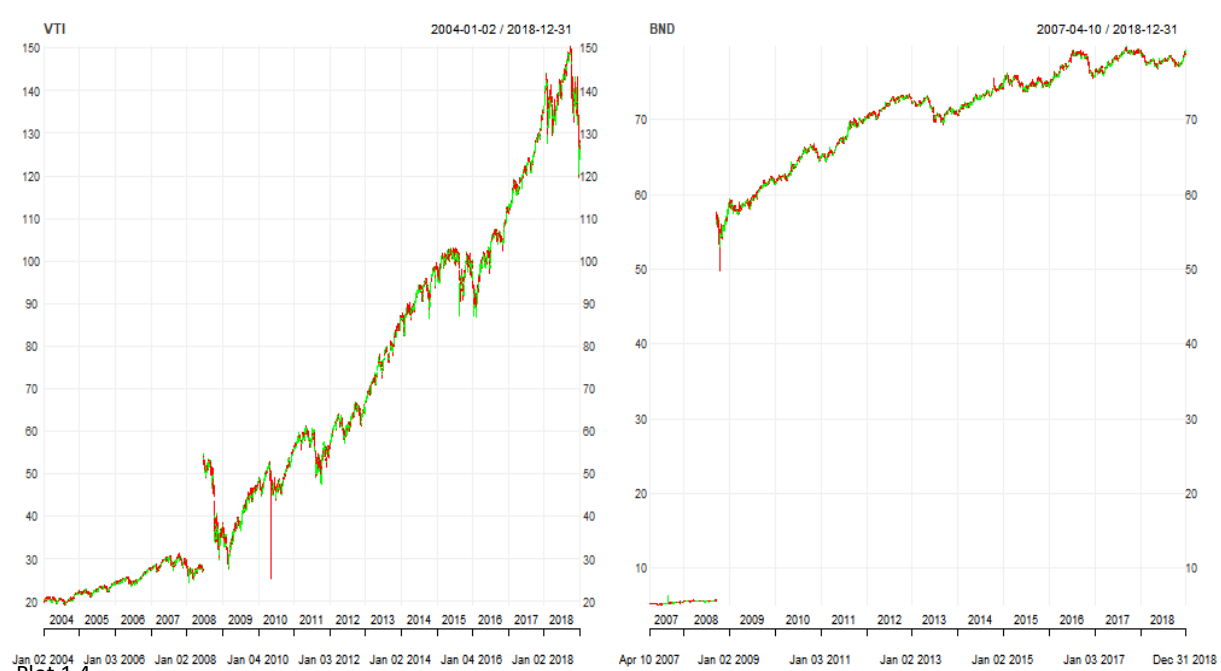
Quantstrat Drawbacks Using Multiple Indicators

The primary programming language was R with heavy use of the Quantstrat library. Overall, this library proved fantastic for analyzing the securities under all of these systems.

However, when both underlying assets were combined into one portfolio Quantstrat was unable to identify the necessary arguments to add.signal to transition from one asset to another when apply.strategy was used for the Donchian Strategy (Plot 1.3).

More specifically, because this system used 2 indicators for both a long entry and short entry, instead of the usual single indicators, the necessary code for execution was difficult to manage.

In the end, because of this drawback, two separate sessions of the same code were used to run this strategy on each asset separately. The results were adequate, but the method is quite inefficient for any substantial portfolios especially the ones in store for the future of large companies such as ShreddedRockLLC. Quanstrat documentation and demos don't seem to address this. My recommendation is to find other avenues capable of supporting multiple indicators, when needed.



Plot 1.4

Portfolios

Data for VTI and BND

The securities chosen for this analysis were VTI (Vanguard Total Stock Market ETF) and BND (Vanguard Total Bond Market ETF) with data ranging back to, in frequency of days, Jan 01, 2003 (Plot 1.4).

Portfolio Construction

The following were the portfolios, with equities of \$1,000,000* each, constructed for this analysis:

1. 60/40 Split between VTI and BND with a Buy and Hold Strategy
2. 60/40 Split between VTI and BND with a Rebalanced Yearly Strategy
3. VTI using \$500,000* in equity with a Donchian 20/10 Breakout Strategy plus Trend Filter
4. BND using \$500,000* in equity with a Donchian 20/10 Breakout Strategy plus Trend Filter

Results

Buy-and-Hold and Rebalance

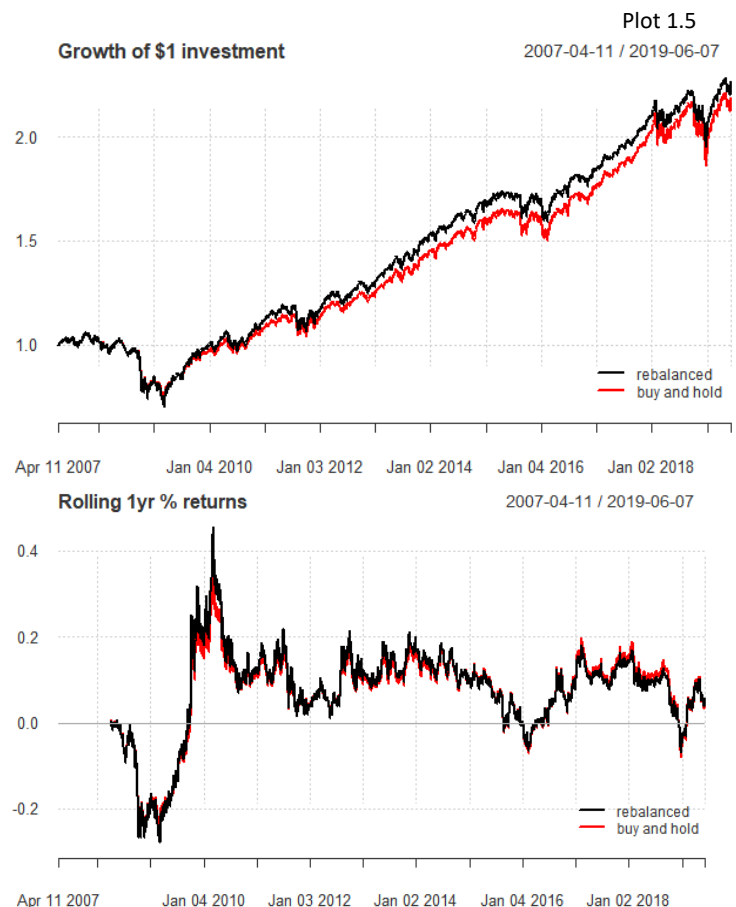
The common 60/40 ETF portfolio performed well in either case, rebalance or not. In this span of time, both more than doubled your investment while sustaining adequate returns (Plot 1.5).

VTI Donchian

To limit market exposure shares were limited (in both VTI and BND) to about 30% of the initial equity. VTI showed negative results for about 4 years where it began a slow steady climb. At one point, the strategy showed massive promise (Plot 1.5), sporting a CumPL of almost \$40,000.00.

This was short lived as the pitfall of this strategy began to show itself. This strategy enjoyed a sharp trend upward, causing a lowest-low to stay too low relative to a sharp drop experienced at the end of Jan 2018.

The strategy took a fatal hit that a stop-loss could have countered. It is also important to note that because this strategy was applied to a stock with a relatively constant positive slope, the triggers for Short Selling were never hit as EMA 360 had to be less than EMA 20. This can be noted about BND as well.





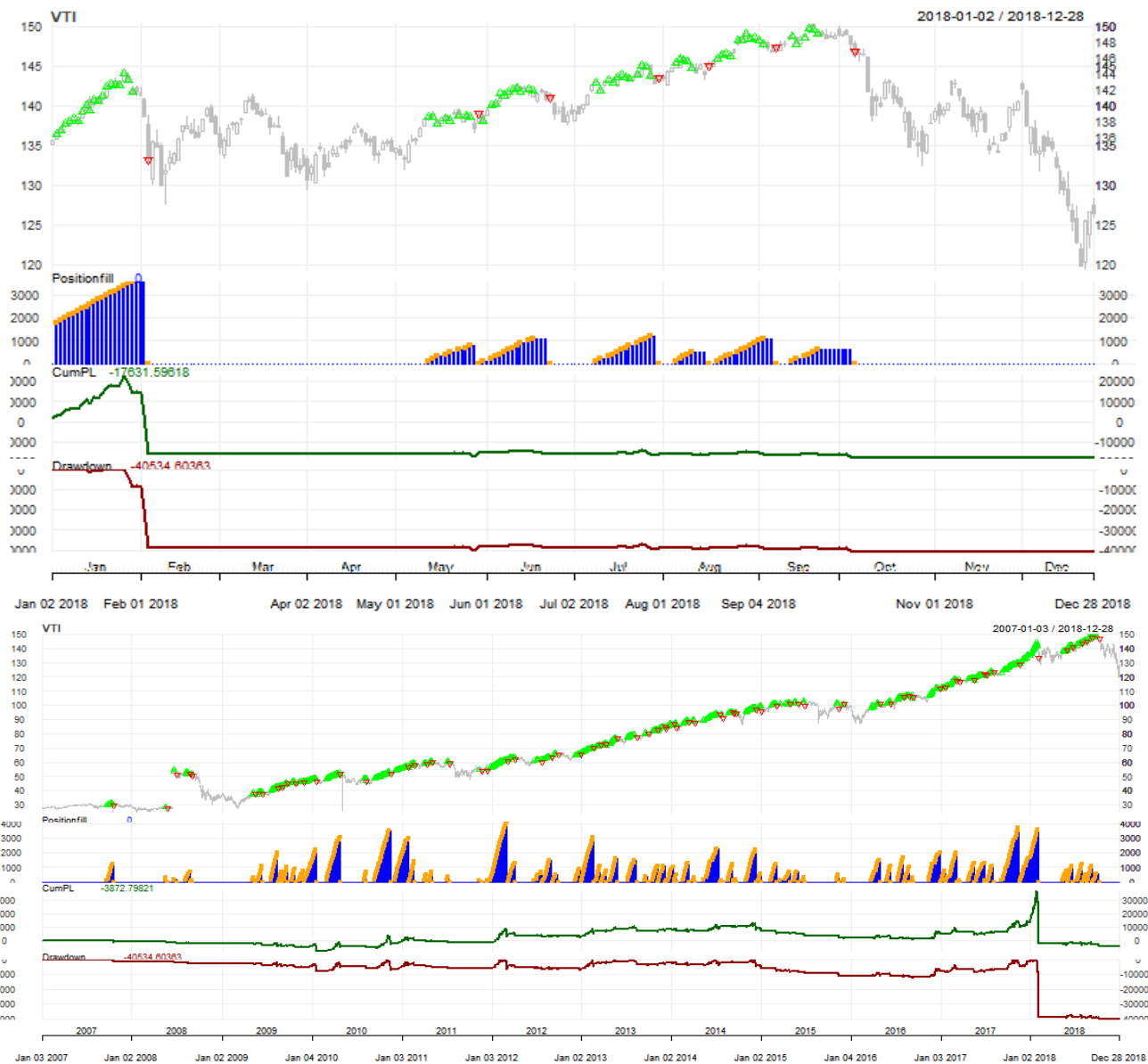
SHREDDED ROCK LLC



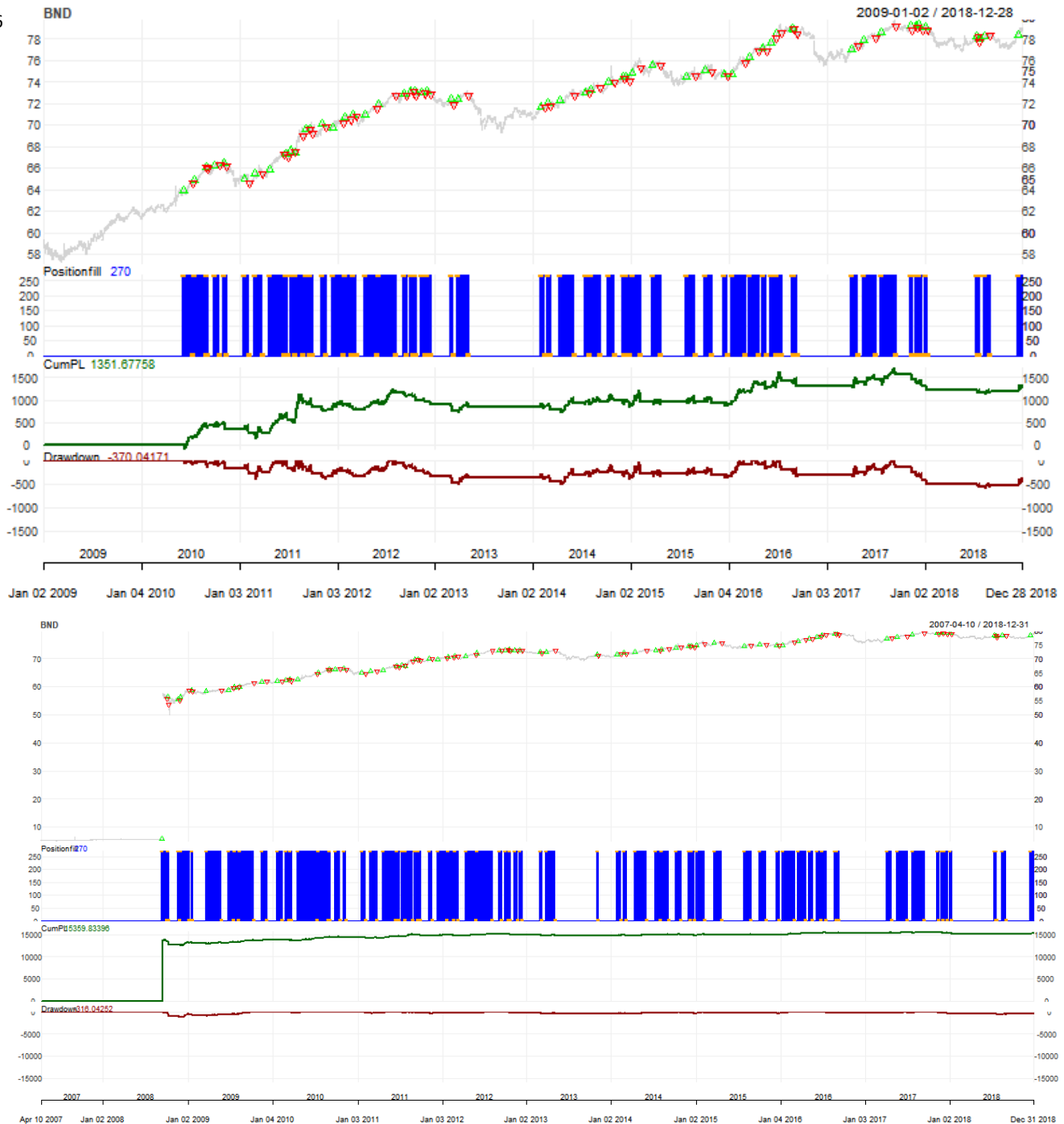
Daniel Hanson, CEO

Weston Barger, CEO

Plot 1.5



Plot 1.6



BND Donchian

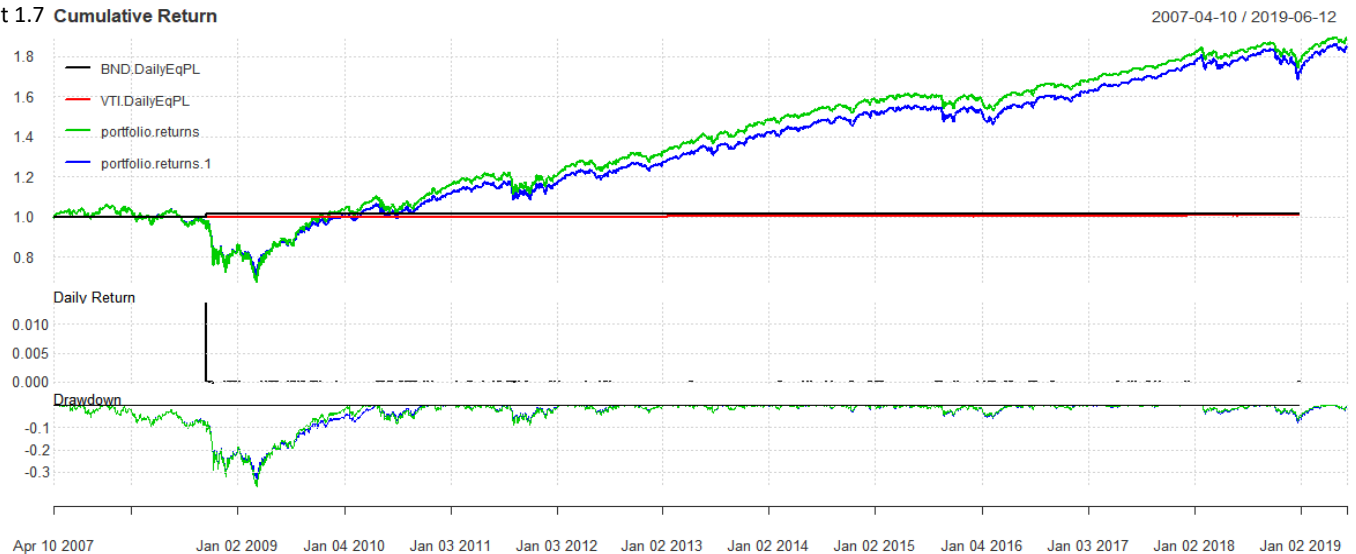
BND showed the most stability with a low and stable maxDD and a consistent increase in CumPL. Due to the large increase in price at the beginning of this ETF's lifespan, data could be skewed. The strategy was ran once again to ignore this data (plot 1.6). In this new period, the strategy continued to show good results with steady CumPL and low maxDD. Due to the low market exposure it would seem as though profits were limited as well due to limited investment capital.

Comparison

The 60/40 Portfolio, rebalanced yearly, made short work of this strategy given it's current state. 60/40, whether rebalanced or not, also enjoys a higher Sharpe Ratio (almost double), with its associated better performing risk-adjusted returns (plot 1.7). The data supports that the Turtle Strategy is risky when applied to assets that could throw false market signals or on securities that tend to ride trends.

BND vs VTI vs 60/40 BH vs 60/40 Rebal

Plot 1.7 Cumulative Return



	VTI.DailyEqPL	BND.DailyEqPL	Rebalanced	Buy and Hold
Annualized Return	0.0004	0.0013	0.0696	0.0667
Annualized Sharpe Ratio	0.2853	0.3225	0.6297	0.6321
Annualized StdDev	0.0014	0.0040	0.1106	0.1055

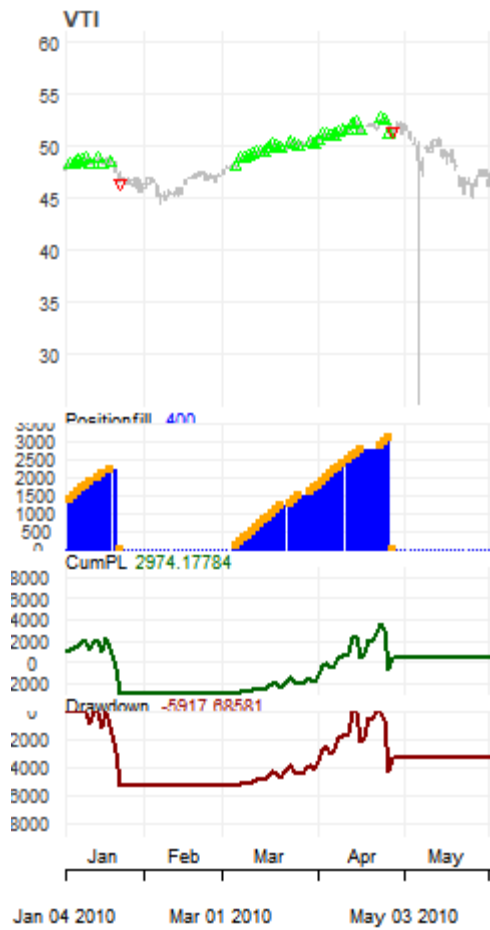
Conclusions

An obvious adjustment to this Turtle Strategy is the implementation of a Stop-Loss to lock in profits. Had this been implemented during VTI's Jan 2018 highly-bullish period, the strategy would have flourished (probably sooner as well).

A final critique of this strategy would be to apply/backtest this to a more volatile stock or ETF to possibly profit from short sales. This may also counter the trend problem, such that VTI encountered, in bullish or bearish flashes. The EMA filter may have been triggered, as well, to allow not only the stop-loss mentioned earlier to "kick-in" but to maybe even make up ground as the stock experienced a reversal.

Most importantly, the final check on the integrity of this strategy is not when getting into the market but when to get out. Analysis on the dates of the flash crash in May 06, 2010 does indicate the glory of these systems. VTI exited the market before the crash and BND was not in to begin with.

Plot 1.8



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