ALTERNATIVE INVESTMENT

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TPPIUS: Should we use it to construct our TIPP strategy?

Reminder: How TIPP works?

$$X : \ Floor\ Percentage$$

$$V_t : Portfolio\ Value\ at\ time\ t$$

$$T\ : \ time\ at\ maturity$$

$$Rf_t : \ Risk\ Free\ rate\ at\ time\ t$$

$$R_L : \ Lock\ in\ rate$$

$$M : \ multiplier$$

$$Ref_t : \ Reference\ Capital$$

$$Floor_t = max\left(\frac{X\ *\ V_{t-1}}{((1+Rf_{t-1})^{T-t+1})}, \frac{X\ *\ V_t}{((1+Rf_t)^{T-t})}\right)$$

$$Cushion_t = V_t - Floor_t$$

$$Exposure_t\ =\ Min(Cushion_t * M, V_t)$$

$$SafePart_t = V_t - Exposure_t$$

$$R_{injection} : \ Capital\ Threshold$$

In the TPPI the reference capital is updated each time $\left(\frac{V_t}{Ref_{t-1}} - 1\right) > R_L$,then:

$$Ref_t = V_t$$

In addition, the asset manager will wire an amount of money Val_t on its account if $V_t <\ Ref_t * R_{injection}$ with:

$$Val_t = Ref_t * R_{injection} - V_t$$

The Portfolio Value after the reinjection becomes equal to :

$$V_{t+1} = V_t + Val_t + PnL_t$$

$$Ref_{t+1}\ =\ Ref_t\ -\ Ref_t * R_{injection}$$

TIPPIUS allows us to backtest our TIPP strategy in an out of sample environment

An Example of a strategy using an S&P 500 etf (SPY) and a 1 Yr American Treasury Bond.The strategy starts from 1995 and is implemented on a weekly basis to reduce rebalancing fees.

We choose the following parameters in the menu:

Risky asset	SPY
Multiplier	6
Lock in	0.02
Floor	0.9
Minimum risk capital allocation	0.1
Capital Reinjection threshold	0.85
Amount(in M$)	100

The application computes for you the principal ratios and risk adjusted metrics such as the Sharpe ratio, the probabilistic Sharpe raftio(which evaluates the portfolio's Sharpe ratio with the benchmark's one),the Omega ratio ,the Modigliani ratio ,the Sortino ratio ,the compounded growth annualized return, the annualized standard deviation, the Information ratio ,the portfolio's Beta ,the annualized Jensen alpha ,the portfolio's maximum drawdown and the various VaRs and CVaRs:

Sharpe Ratio	0.540
Sortino Ratio	0.736
Information Ratio	-0.103
Modigliani Ratio	0.097
Probabilistic Sharpe Ratio(in %)	88.346
CAGR(in %)	9.345
Standard Deviation	0.146
t-student Garch VaR 95%(in %)	-3.416
t-student Garch CVaR 95%(in %)	-4.221
Unconditional VaR 95%(in %)	-1.616
Beta	0.722
Jensen alpha	0.023
Omega ratio	1.348
Maximum Drawdown(in %)	-31.542
Cumulative return(in %)	1020.341

Figure 1: The Strategy backtest is showed by the graphic below (for a 100 Million$ original account):

Figure 2: Strategy Drawdown

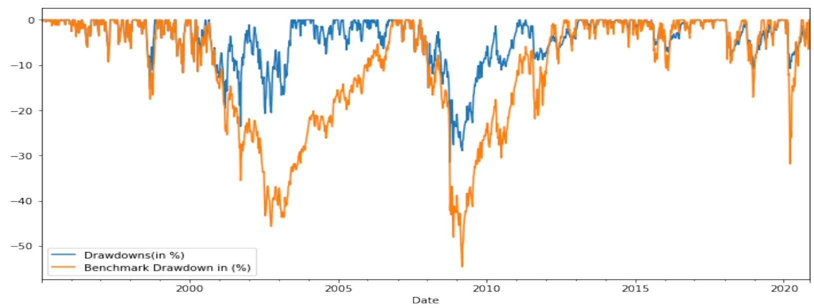


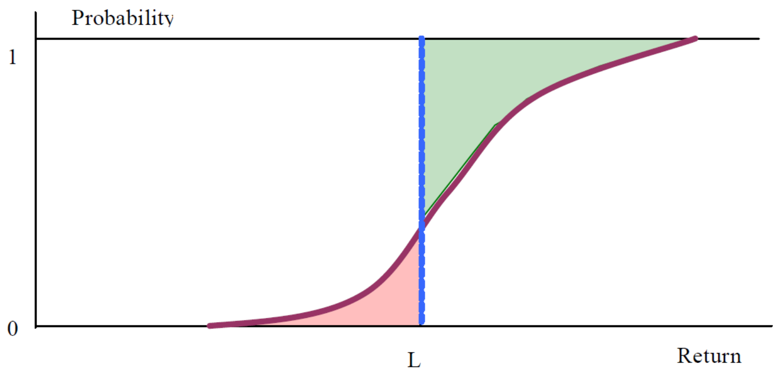
Figure 3 :CVaR and VaR analysis (Starting from 2004 as we needed at least 500 data):

The application is made to work with all kind of risky assets, that's why we can choose our asset from the menu by inserting the ticker into the input field, allowing us to be fully flexible on what parameters and asset include in our strategy.

The ratio choice I made was based on what is used in the industry. First of all, We included all the theoretical ratios such as the Sortino ratio, the Sharpe ratio, the information ratio to have an overview of the strategy. Then I included more complex risk adjusted measurements, which are characterized to be less biased.

We included the omega ratio, which formula is equal to the positive portion of the Cumulative Distribution Function divided by the negative portion, such as here where L = 0 for us :

Figure 4: Graphical explanation of the Omega Ratio



This ratio reflects the real distribution of the returns and is known to not be biased as we are dealing with the real distributions of returns.

Thirdly, we reevaluated the Sharpe ratio through the Probabilistic Sharpe ratio. Financial Institutions often don't care so much about the Sharpe ratio because the measure doesn't take into account the kurtosis and the skewness of the portfolio's returns across time and is therefore not comparable with other Sharpe ratios. In order to fix that, David H. Bailey and Marcos Lopez de Prado (2012) reevaluated the measure. The new measure consists at evaluating the probability of the Sharpe ratio to be higher than the benchmark's one.

In addition, a Jensen alpha and a Beta were computed through an OLS regression. We didn't include the Treynor ratio as it doesn't quantify the value added of an actively managed portfolio unlike the Jensen alpha.

Strategy evaluation

Our strategy is mitigating downside risk as we successfully reduced drawdowns during the 25 years of our backtest compared to the SPY index.

Our maximum drawdown reached 31 % in 2008, during the global financial crisis. It is huge but in comparison to the index,it did very well as the SPY plummeted at less than 50% of its value before entirely recovering in 2012.The backtest shows that our strategy recovered faster than that of the benchmark. I separately computed the actualized Student t-Garch VaR and CVaR at 5%. These measures could greatly help us mitigating the next downfalls.

*The Displayed VaRs and CVaRs were all computed in an out of sample environment

Moreover, the beta of our strategy is close to 0.70, which shows that we are exposed to the market downsides. However, our annualized excess return is positive (2.25%) and our Omega ratio is equal to 1.348.In addition, The Probabilistic Sharpe Ratio is satisfying as it is equal to 88.346%. A stricter risk management could increase this measure though. With this strategy,we would have reinjected 345.09 million $ in our portfolio from 1995 to 2020, most of the money was injected during the 2008 crisis. As of 2009, the backtest shows that we wouldn't have reinjected money to the portfolio from this date.Another great news is that the floor has never been touched since 1995.

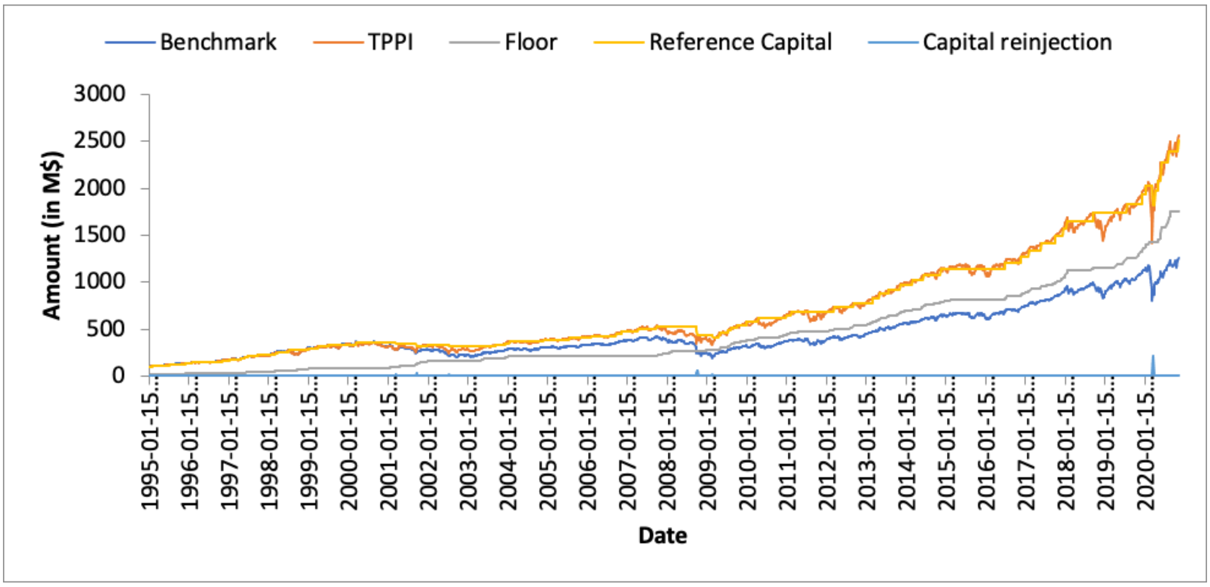
The compounded annual growth rate of the portfolio was equal to 9.345% during the whole period. However, the growth wasn't equally distributed during all the periods as we can see on the figure 1.The Modigliani ratio shows us that the CAGR should be located at 9.7%, we are unfortunately below that level. The annualized standard deviation of the portfolio is not very convincing as well, we are above the 10% threshold (the actual annualized standard deviation equals 14.6 %). However, as I said before a more strident risk management can help improve these metrics. The information ratio is negative, which shows that our strategy was outperformed by the benchmark (SPY). This is principally due to the skyrocketing of the technology stocks since 2019.

However, we notice a positive insight of the strategy when we look to the difference between the Sortino ratio (0.736) and the Sharpe ratio (0.540). This positive difference indicates that for 25 years, the strategy better succeeded to manage negative downsides. As we are dealing with a portfolio constructor, we can "play" with the parameters so as to find portfolios with a better backtest performances such as:

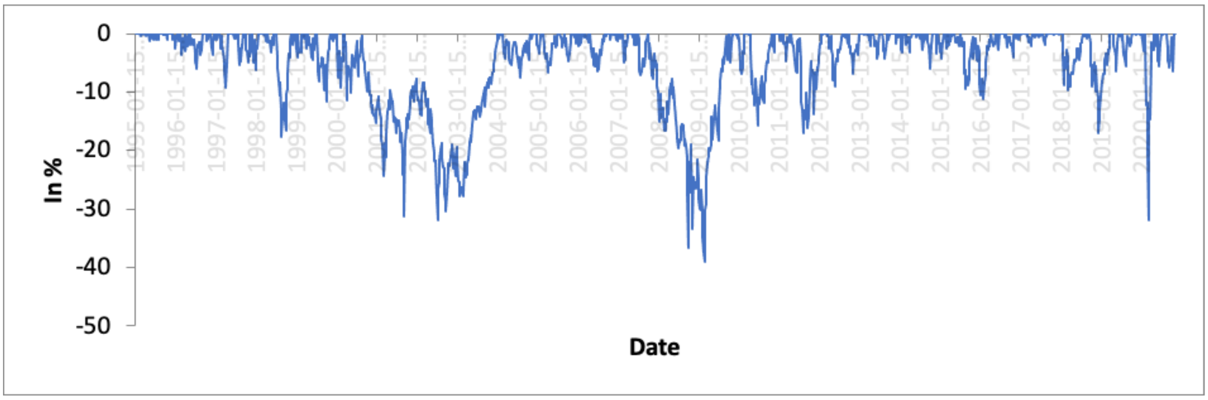
Risky asset	SPY
Multiplier	9
Lock in	0.05
Floor	0.7
Minimum risk capital allocation	0.1
Capital Reinjection threshold	0.8
Amount(in M$)	100

Sharpe Ratio	0.616
Sortino Ratio	0.890
Information Ratio	0.510
Modigliani Ratio	0.110
Probabilistic Sharpe Ratio(in %)	99.892
CAGR(in %)	13.051
Standard Deviation	0.191
t-student Garch VaR 95%(in %)	-8.184
t-student Garch CVaR 95%(in %)	-9.284
Unconditional VaR 95%(in %)	-1.638
Beta	1.025
Jensen alpha	0.027
Omega ratio	1.332
Maximum Drawdown	-39.053
Cumulative return(in %)	2427.171

The application has an implementation that allows you to download the data on an excel spreadsheet:



Drawdowns:



Using these parameters, the risk adjusted ratios improved but our strategy became riskier and in consequence capital reinjection are higher (405.5 Million dollars would have been injected in the portfolio).

TIPPIUS is a TIPP portfolio constructor where the only task you have is to choose an asset. All the backtests are proceeded automatically. The algorithm was coded in python and is available with the following paper.

Thank you for your reading