CONSTANT PROPORTION PORTFOLIO INSURANCE (CPPI) STRATEGY IMPLEMENTATION ESSAY

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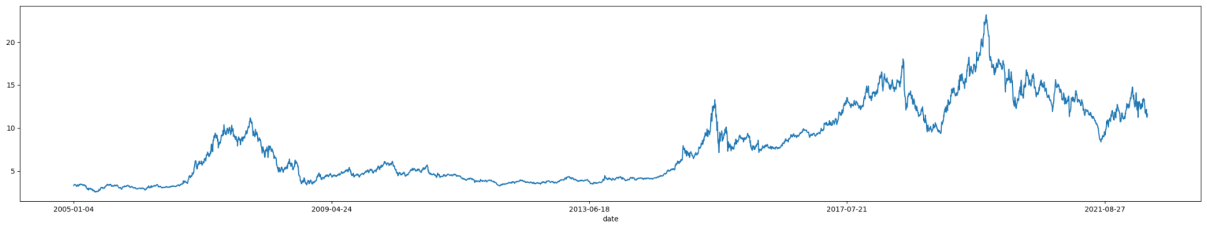
Articles:

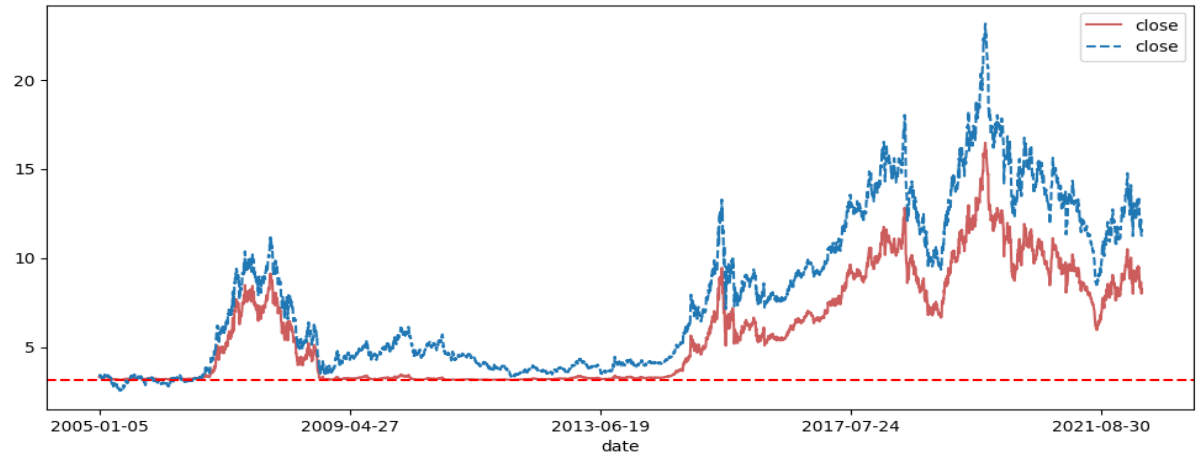
1. https://www.researchgate.net/publication/347239539_Portfolio_insurance_OBPI_vs_CPPI
2. https://alpaca.markets/learn/cppi-1/ (Just theory, code is not that important there)
3. *https://www.investopedia.com/terms/c/cppi.asp*

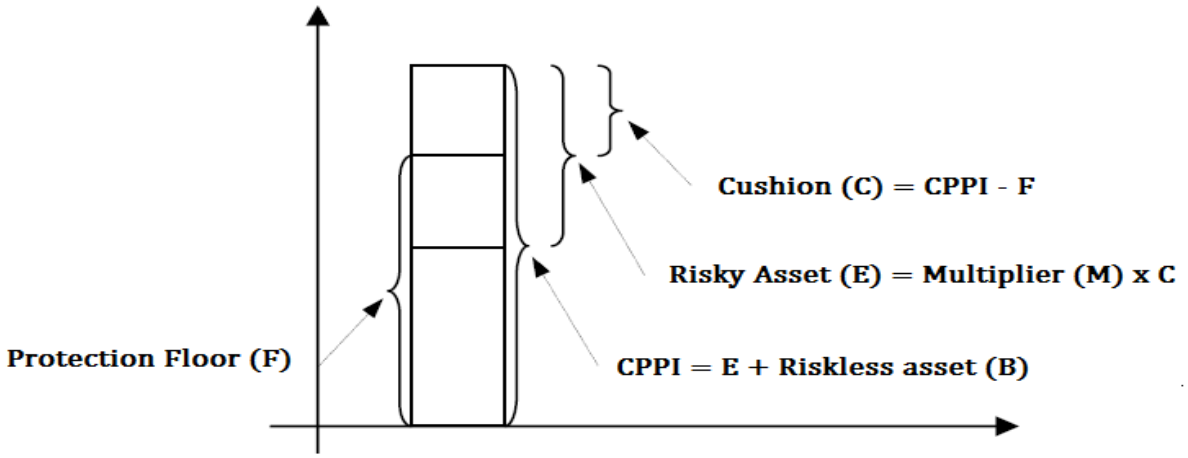
So what is the basic idea in CPPI? It's a dynamic algorithm. So we're going to dynamically allocate between a risky asset and a safe asset with the goal of making sure that that combined portfolio that consists of some allocation to the risky asset and some allocation to kthe safe asset does not violate a floor constraint, and does not go below a certain number. That's the basic algorithm. So what do we need for that? Obviously, we need a risky asset - our Chinese Stock, but we won't really be concerned about its price but returns instead, that's why we are going to pandas.DataFrame.pct_change it. We also will pay attention to “close” feature only, not only since it doubled in “open”, but because it's pretty capable of representing the whole picture of the equities movement we need.

To implement the whole algorithm let's choose an arbitrary stock and will go with it. It will be a "sh600004":

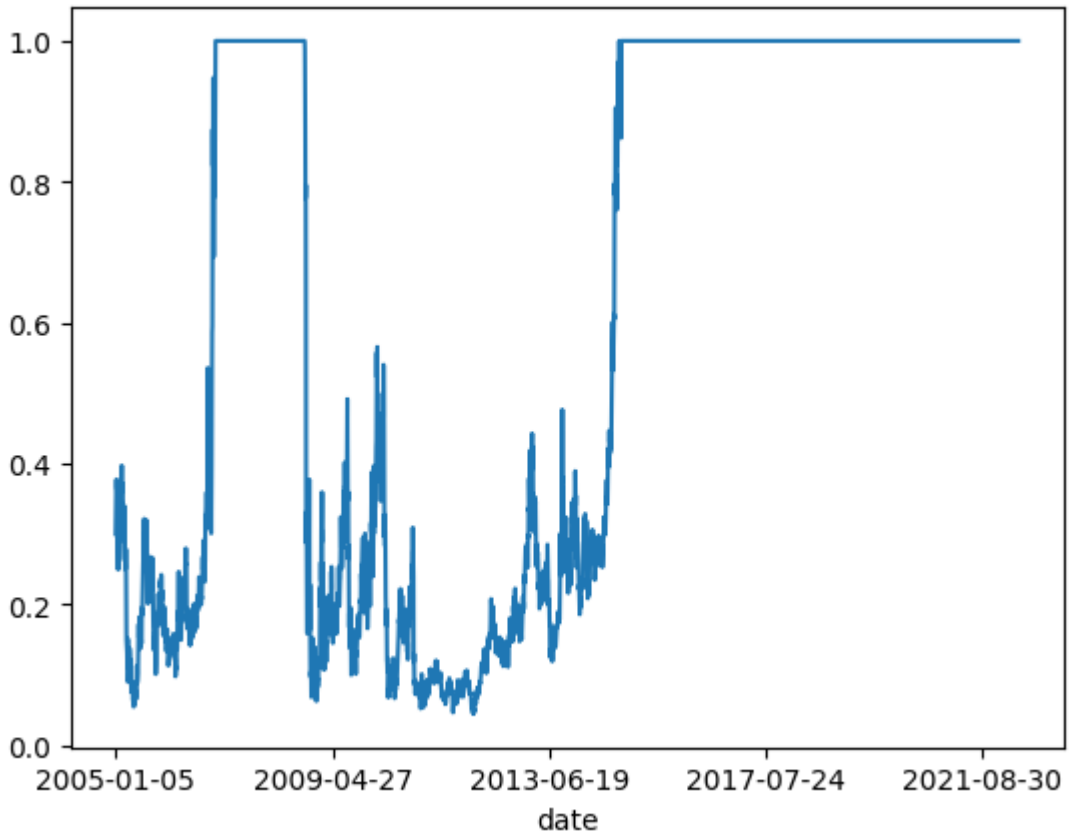


After realization of very basic algorithm, which can be illustrated for better understanding with a scheme bellow, we got the following results:



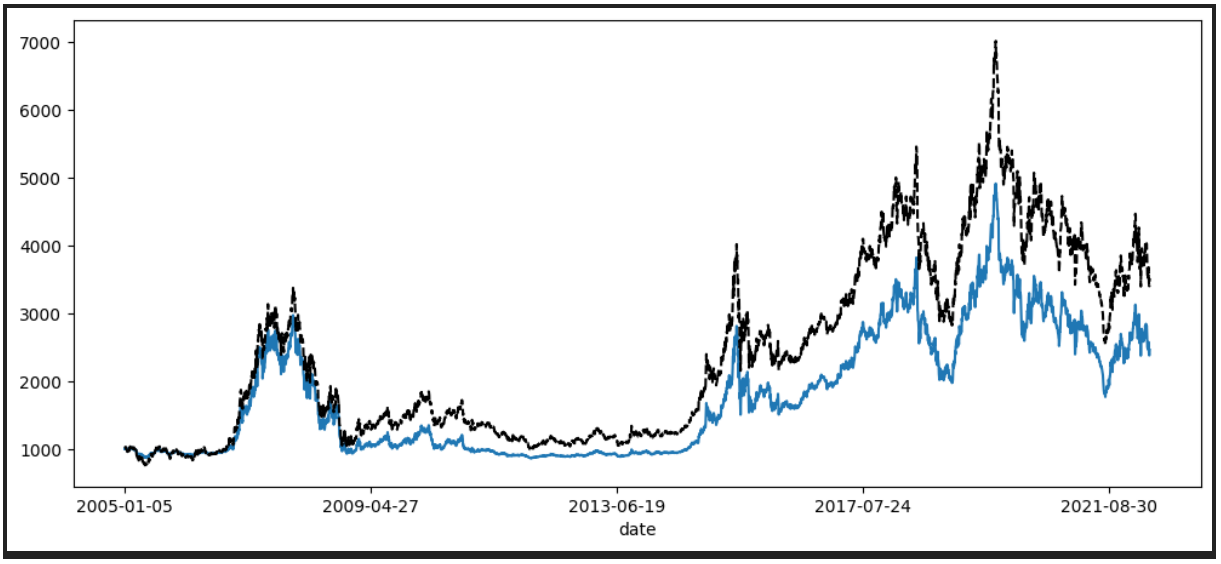


Where the dotted blue line is Buy and Hold, Red line is our strategy, and the dotted red line is the floor of CPPI.
Interesting is that we can also observe weights we put in our risky asset during our strategy.



This example provides very basic concept of CPPI strategy, the most noticeable part in red dotted line which is floor value of portfolio, as might be seen, unlike our CPPI portfolio, blue line (buy and hold) intersects floor-line, which means value of portfolio goes below maximum drawdown required. This result might be dramatic in terms of financial planning, for instance it might affect a person's retirement or college fund.

Let us add to our model a risk free asset, which in our case will be 10Y Chinese Government bonds with riskfree_rate=0.035. As we can see it will increase our profitability. (https://tradingeconomics.com/china/government-bond-yield)

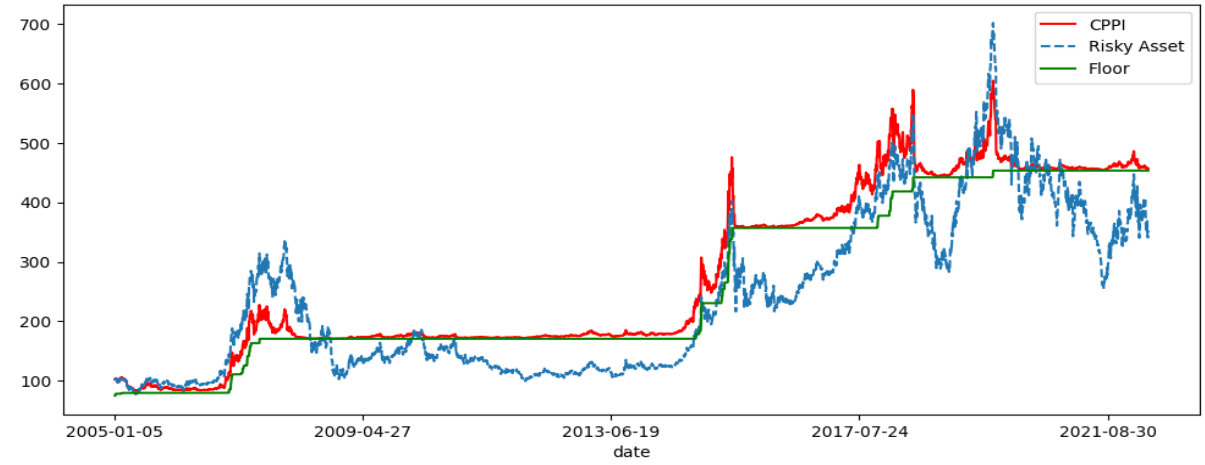


Blue line - our strategy. Dotted black one - Risky Asset.

So, now it's not for upside but for downside protection, we have a static floor to hedge against excessive downside. In this concrete example the difference might seem insignificant, but in reality it is indeed noticeable.

Adding drawdown.
Sometimes when the value of our assets goes up, it becomes less likely for it to drop to our floor value, which is the share of our invested capital. Lets modify this parameter and just keep in mind that fraction we can afford to lose, not the value we want to keep.

Now, let's add a drawdown constraint, our floor value is not the static value anymore, it's actually a dynamic value that changes over time as our peak changes over time. So let's say we had set drawdown at 25 percent, all we have to do is update our floor value, which is no longer a static number.



Now it becomes obvious how powerful the CPPI strategy can be just by looking at two previous graphs.

Stock Picking
Well, CPPI is great, right... And one of the pros is if you trade consistently nothing can go wrong with any asset (the only danger here is Gap Risk, so we will prefer something not that volatile), but anyway let's choose some stocks to invest in.

Eventually we computed volatility for every stock possible and here are some for the Finale model starting with the year of 2022.

'sh603122', 'sh603176', 'sh603191', 'sh603206', 'sh688170', 'sh688290', 'sh688320', 'z001228'.

With some decent Sharpe Ratio and Wealth Max Drawdown Ratio, we should point out that max downside here is just 25% since that's a part of our CPPI algorithm:

```
good_ShR = {
       'sh603122': 1.144377,       ### 2022-02-17
       'sh603176': 1.008576,       ### 2022-01-04
       'sh603191': 4.079811,       ### 2022-04-29
       'sh603206': 183654.749332, ### 2022-05-09
       'sh688170': 3.397773,       ### 2022-05-05
       'sh688290': 1.779515,       ### 2022-05-05
       'sh688320': 1.111694,       ### 2022-04-29
       'z001228': 8287.520334
       }
```

Wealth Max Drawdown Ratio:

```
{'sh603206': 132.31357552581255,
 'sz001228': 244.32284541723664,
 'sh601916': -87.87109257634688,
 'sh601229': -37.00222922540058,
 'sh601288': 200.39331865673455}
```

In conclusion I would like to say that I very much enjoyed the whole momentum of going right from the beginning and implementing the CPPI algorithm as well as going all the way to adding drawdown constraints. The technical beauty and results that a given algorithm can bring to one’s portfolio are incredible, although this also can be a basis for more complex strategies. Personally I would encourage everyone to try this out.