

Rebalancing Premium in Cryptocurrencies

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Abstract

This paper analyzes the rebalancing premium in cryptocurrencies. Rebalancing premium is defined as the premium an investor gains from periodically rebalancing their portfolio. Many papers examine this effect; however, very few to none study crypto markets.

In the first section of this article, we generate 30 vectors, each with the mean daily return equal to 0 and daily volatility set to 7.5%, to simulate cryptocurrencies. Firstly, we created two portfolios, a buy and hold portfolio and a daily rebalanced portfolio. Multiple improvements can be observed when the portfolio is rebalanced periodically, including improved cumulative return and lowered volatility, resulting in a better Sharpe ratio. Moreover, the drawdowns are not as significant when applying daily rebalancing.

The second section focuses on real data. We analyzed a portfolio consisting of 27 cryptocurrencies and compared daily- and monthly-rebalanced portfolios with benchmark buy-and-hold portfolio. We also compare the daily-rebalanced long-only portfolio to long-short portfolio with various weights on the short side.

Moreover, in this section, we also consider the combination of cryptos with bonds. We assume that the volatility of cryptocurrencies combined with low volatile assets such as bonds could raise the overall performance while keeping the volatility at a reasonable level.

Overall, we can say that there is a significant rebalancing premium in cryptocurrencies. Moreover, the crypto portfolio can also improve the performance of less volatile assets, such as bonds, when combined in a periodically rebalanced portfolio. Lastly, the functionality is based on a proposition that no single asset consistently outperforms the others. The rebalancing might not be as profitable in such a case.

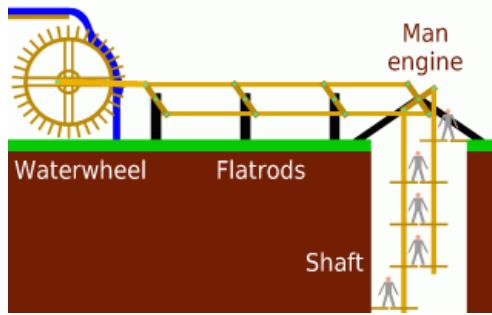
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Introduction

A long time ago, before elevators were a thing, a simple mechanism was used to get the miners in and out of the mines. This mechanism is called a Man Engine and works on a simple principle of two reciprocating ladders and stationary platforms. The two ladders move up and down, so if a miner stands on one platform, he is not going anywhere. However, if the miner jumps back and forth between the two ladders at the right time, he can easily get out of the mine.



(Source: [Wikipedia – Man Engine](#))

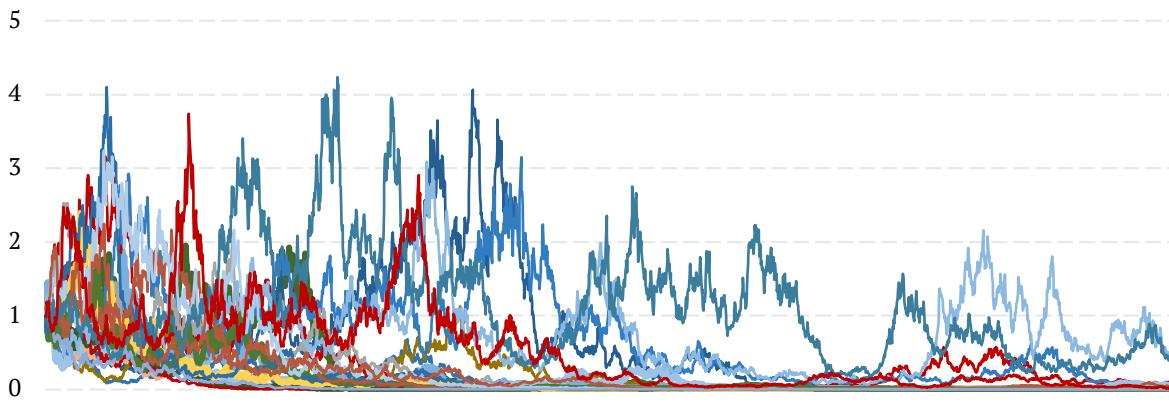
There is an investment strategy, which works on a similar principle. Imagine having two assets that have zero return and high volatility. Similarly to the ladders, if we just buy one, we are not going to earn anything. However, if we buy both and rebalance them periodically, we can earn a so-called “rebalancing premium” or “diversification return”. In simple words rebalancing premium is the premium an investor gains from periodically rebalancing their portfolio.

To explain how this anomaly could work in practice, imagine having a portfolio with two uncorrelated assets, one which is volatile but has high returns, and the second one which is not as risky but also has lower returns. If you decide to rebalance it periodically, you are essentially forced to buy the asset that has decreased in relative value and sell the asset which has appreciated in relative value, as measured by their weights in the portfolio.

If you set 50-50 weights at the beginning and let them drift without rebalancing, you will shortly have a pretty risky portfolio because the risky asset will take over. However, if you periodically rebalance to the 50-50 weights, you won't have as much risk and will gain higher returns.

Another example we can demonstrate is a portfolio consisting of 30 assets, each with a mean daily return close to 0 and daily volatility of around 7.5%. We generated this data, and the following figure shows the cumulative returns of the individual assets.

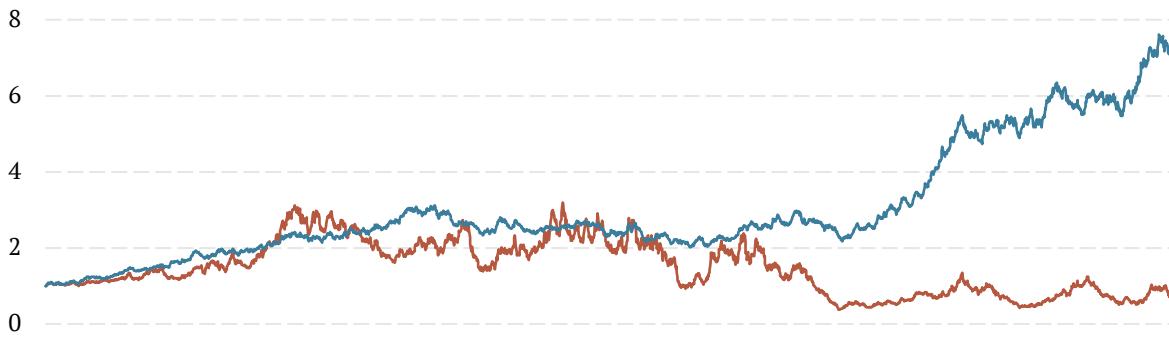
Cumulative Returns of Individual Assets



As we can see, neither of the assets consistently outperforms the other ones. And thus, this kind of data is a good candidate for rebalancing premium. In the next step, we compared how a buy-and-hold portfolio looks compared to a daily rebalanced portfolio. Additionally, we analyzed the annualized risk and return characteristics of such portfolios.

Cumulative Return of a Porttolio with

— Buy-and-Hold Portfolio — Daily Rebalanced Portfolio



	Cumulative Return	Volatility	Sharpe Ratio	Max Drawdown	95% Drawdown	CR/ Max DD	CR/ 95% DD
Drifting Weights	-2.69%	57.69%	-0.047	-35.19%	-83.78%	0.076	0.032
Daily Rebalanced Weights	21.84%	21.03%	1.038	-88.20%	-28.54%	-0.248	-0.765

As we can see, the daily rebalancing not only improved the cumulative return of the portfolio it also lowered the volatility, thus increasing the Sharpe ratio. Moreover, the drawdowns are not as significant when applying daily rebalancing.

This anomaly is further analyzed in [Diversification Return, Portfolio Rebalancing, and the Commodity Return Puzzle by Scott Willenbrock](#). The paper argues that a simple buy-and-hold portfolio does not earn a diversification return, though it generally has a lower variance than the weighted-average variance of its constituents. The cumulative return of a buy-and-hold portfolio is driven by the assets that perform the best and thus become a greater fraction of the portfolio.

On the other hand, there is a debate about the diversification return of the periodically rebalanced portfolios. Although multiple studies ascribe the diversification return to a reduction in variance, this paper explains that the underlying source of the diversification return is periodic rebalancing. Additionally, the paper emphasizes that the reduction in variance in a diversified portfolio is a necessary but not sufficient condition to earn a diversification return.

Rebalancing Cryptocurrency Portfolio

We cannot say whether cryptocurrencies will have positive or negative performance in the near future. There can be found research papers that argue both sides, and we stand somewhere in between. However, what we can say for certain is that cryptos are highly correlated with each other. That leaves us with two options: we can either construct a buy-and-hold portfolio of cryptocurrencies or a periodically rebalanced portfolio.

This paper analyzes whether the daily/ monthly rebalanced portfolio outperforms a simple buy-and-hold portfolio of cryptocurrencies and whether there is a rebalancing premium. Similarly to the example, we introduced at the beginning of this article. Moreover, in the second section, we also look at the combination of cryptos with bonds. We assume that the volatility of cryptocurrencies, in combination with low volatile assets such as bonds, could raise the overall performance while keeping the volatility at a reasonable level.

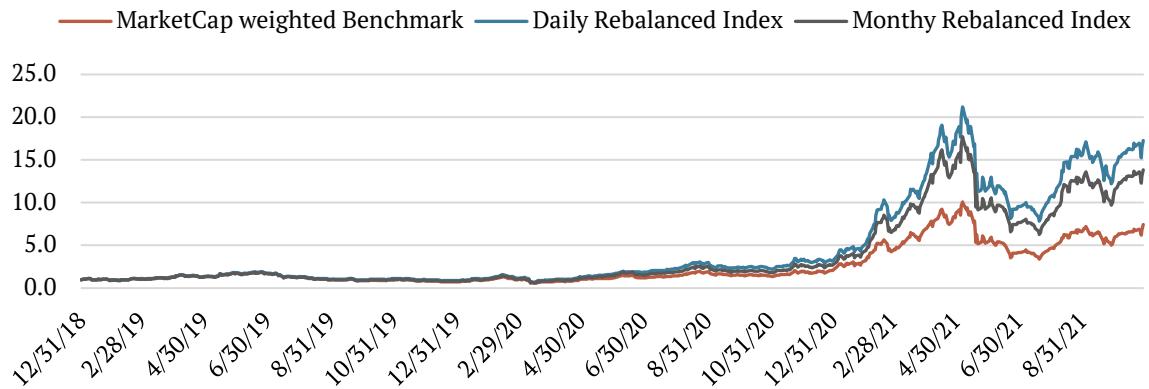
Analysis

In our analysis, we focused on rebalancing premium in cryptocurrencies. Our portfolio consisted of 27 cryptocurrencies with a time period from 31.12.2018 till 29.10.2021. The portfolio includes BAT (*Basic Attention Token*), BTC (*Bitcoin*), BTG (*Bitcoin Gold*), DAI (*Dai*), DATA (*Data Coin*), DGB (*DigiByte*), EOS (*EIS.io*), ETH (*Ethereum*), FUN (*FUN Token*), IOTA (*Iota*), LRC (*Loopring token*), LTC (*Litecoin*), MANA (*Mana coin*), NEO (*Neo*), OMG (*OMG, Formally known as OmiseGo*), REQ (*Request*), SAN (*Santiment Network Token*), SNT (*Status*), TRX (*Tron*), WAX (*Wax*), XLM (*Stellar*), XMR (*Monero*), XRP (*Ripple*), XVG (*Verge*), ZEC (*Zcash*), ZIL (*Zilliqa*) and ZRX (*Ox*).

We analyzed three strategies. The first one, the Market Cap Benchmark strategy, is not rebalanced at all. We simply set equal weights at the beginning and let them drift.

The second strategy is rebalanced daily. And the third strategy is rebalanced on a monthly basis.

CRYPTO



As we can see from the figure above, both the daily and monthly rebalanced portfolios outperformed the Market Cap weighted benchmark. Moreover, the daily rebalanced portfolio's performance is even higher than the performance of the monthly rebalanced portfolio. Therefore, let's now look at the following table of annualized risk and return characteristics of the abovementioned strategies.

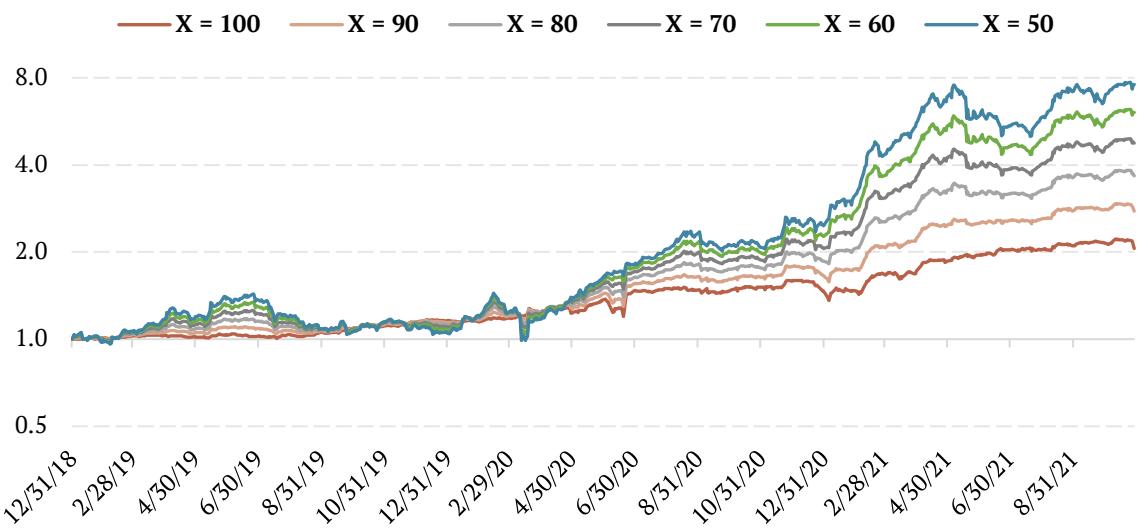
	Cumulative Return	Volatility	Sharpe Ratio	Max Drawdown	95% Drawdown	CR/maxDD	CR/95%DD
MarketCap weighted Benchmark	102.72%	80.06%	1.283	-69.96%	-59.68%	1.468	0.700
Daily Rebalanced Index	172.91%	76.85%	2.250	-63.97%	-54.30%	2.703	0.640
Monthly Rebalanced Index	152.59%	78.00%	1.956	-66.39%	-56.74%	2.298	0.550

As we can see, the daily and monthly rebalancing not only increased the cumulative return but also reduced volatility resulting in overall higher Sharpe ratios. Additionally, the drawdowns are not as significant in the daily/ monthly rebalanced portfolios.

Long – Short Strategies

In this section we analyze the performance of a long-short cryptocurrency strategy. The strategy goes long 100% Daily Rebalanced Crypto Index and shorts X% of the Market Cap weighted Benchmark, where X% is 100%, 90%, 80%, 70%, 60%, and 50%. The figure shows the cumulative performance of the abovementioned long-short strategies.

Portfolio that goes Long 100% Daily Rebalanced Crypto and Short X% Market Cap Benchmark



As we can see, the lower the percentage on the short side, the higher the cumulative performance. However, the strategies with a bigger short side seem to be less volatile. Let's analyze the following table.

**Portfolio that goes
Long 100% Daily Rebalanced Crypto and Short X% Market Cap Benchmark**

	Cumulative Return	Volatility	Sharpe Ratio	Max Drawdown	95% Drawdown	CR/maxDD	CR/95%DD
X = 100	30.15%	18.68%	1.614	-14.971%	-6.573%	-2.014	-4.587
X = 90	45.04%	18.11%	2.486	-11.963%	-4.966%	-3.765	-9.069
X = 80	60.56%	20.97%	2.888	-12.840%	-8.596%	-4.716	-7.045
X = 70	76.55%	26.14%	2.928	-19.383%	-14.135%	-3.949	-5.415
X = 60	92.81%	32.55%	2.851	-26.409%	-20.177%	-3.514	-4.600
X = 50	109.14%	39.60%	2.756	-33.741%	-26.599%	-3.235	-4.103

The annualized risk and return characteristics are represented in the table above. The Sharpe ratio of the strategy, which goes 70% short, is the highest. On the other hand, the strategy which goes 90% short has the smallest drawdowns. Finally, we can say that the long-short strategy improves compared to the long-only Daily Rebalanced Crypto Index.

Cryptos and Bonds

We can say that there is a significant rebalancing premium in cryptocurrencies. However, having a pure cryptocurrency portfolio is not the safest bet. On the other hand, cryptos could significantly improve the performance of a much safer portfolio. So, in the next section, we demonstrate another strategy that takes advantage of the

rebalancing premium in cryptocurrencies. The following portfolio consists of IEI (*iShares 3-7 Year Treasury Bond ETF*) and all the cryptos from the previous section.

Overall, we analyze seven scenarios:

- 1) Portfolio, consisting of 95% IEI + 5% Market Cap weighted Benchmark of Cryptocurrencies, in which we let the weights drift
- 2) Portfolio, consisting of 95% IEI + 5% Market Cap weighted Benchmark of Cryptocurrencies, in which we rebalance the weights daily
- 3) Portfolio, consisting of 95% IEI + 5% Market Cap weighted Benchmark of Cryptocurrencies, in which we rebalance the weights monthly
- 4) Portfolio, consisting of 95% IEI + 5% Daily rebalanced Index of Cryptocurrencies, in which we let the weights drift
- 5) Portfolio, consisting of 95% IEI + 5% Daily rebalanced Index of Cryptocurrencies, in which we rebalance the weights daily
- 6) Portfolio, consisting of 95% IEI + 5% Monthly rebalanced Index of Cryptocurrencies, in which we let the weights drift
- 7) Portfolio, consisting of 95% IEI + 5% Monthly rebalanced Index of Cryptocurrencies, in which we rebalance the weights monthly

The following table shows annualized risk and return characteristics of all the abovementioned strategies.

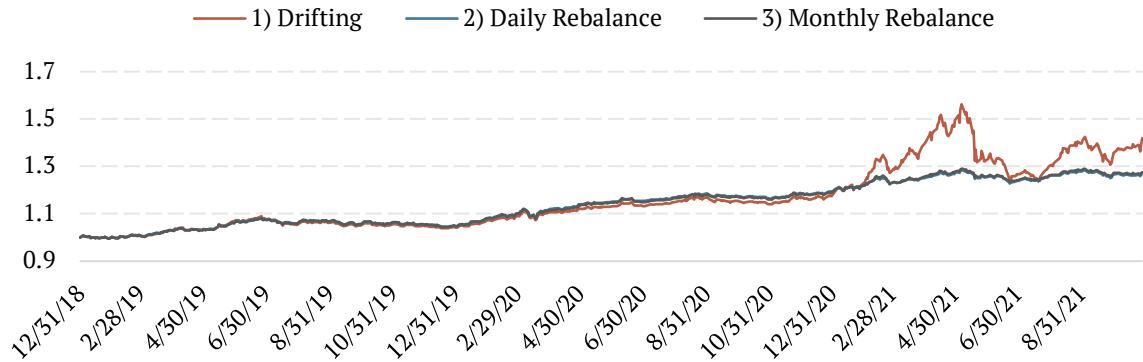
		Cumulative Return	Volatility	Sharpe Ratio	Max Drawdown	95% Drawdown	CR/maxDD	CR/95%DD
MarketCap Crypto	1) Drifting	13.13%	12.64%	1.039	-20.86%	-16.03%	0.629	0.209
	2) Daily Rebalance	8.77%	4.89%	1.795	-4.35%	-3.02%	2.018	0.043
	3) Monthly Rebalance	8.98%	5.11%	1.758	-4.30%	-3.06%	2.087	0.043
Daily Rebalanced Crypto	4) Drifting	25.64%	19.88%	1.290	-31.09%	-23.49%	0.825	0.311
	5) Daily Rebalance	10.26%	4.74%	2.167	-4.07%	-2.67%	2.525	0.041
Monthly Rebalanced Crypto	6) Drifting	21.58%	17.86%	1.208	-28.90%	-22.12%	0.747	0.289
	7) Monthly Rebalance	10.40%	5.08%	2.046	-4.21%	-2.92%	2.471	0.042

As we can see, all of the strategies 2-7 improve the Sharpe ratio of 100% IEI portfolio. However, if we let the weights drift (strategies 1, 4, 6) even though the performance is higher, so is the volatility, resulting in a lower Sharpe ratio compared to strategies that are periodically rebalanced (strategies 2, 3, 5, 7). Overall, it seems daily rebalanced portfolio consisting of 95% IEI and 5% daily rebalanced crypto portfolio (strategy 5) performed the best. And a monthly rebalanced portfolio consisting of 95% IEI and 5% monthly rebalanced crypto portfolio (strategy 7) being a close second. Both

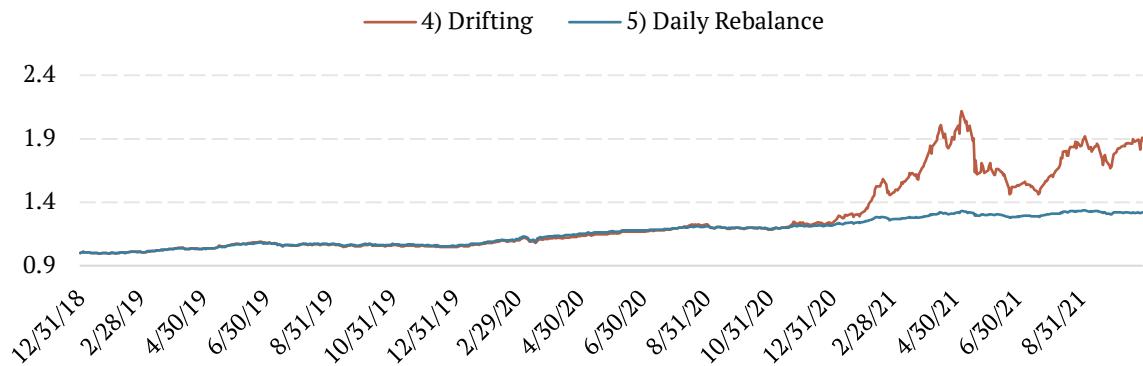
strategy 5 and strategy 7 have a Sharpe ratio above 2, and they are also the two with the smallest drawdowns.

Now let's look at the following figures, showing the cumulative returns of the strategies 1-7.

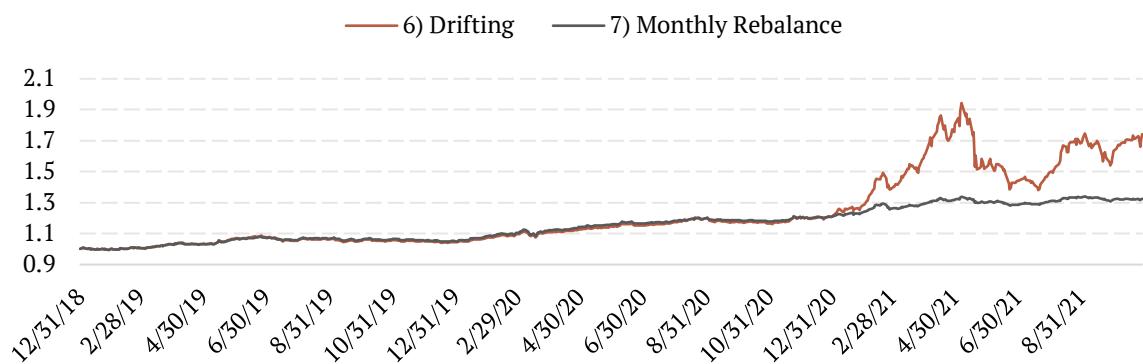
Cumulative Return: IEI + MarketCap Cryptos



Cumulative Return: IEI + Daily Rebalanced Crypto



Cumulative Return: IEI + Monthly Rebalanced Crypto



As we can see, in all the cases, the “drifting” strategy is significantly more volatile and thus resulting in a much lower Sharpe ratio.

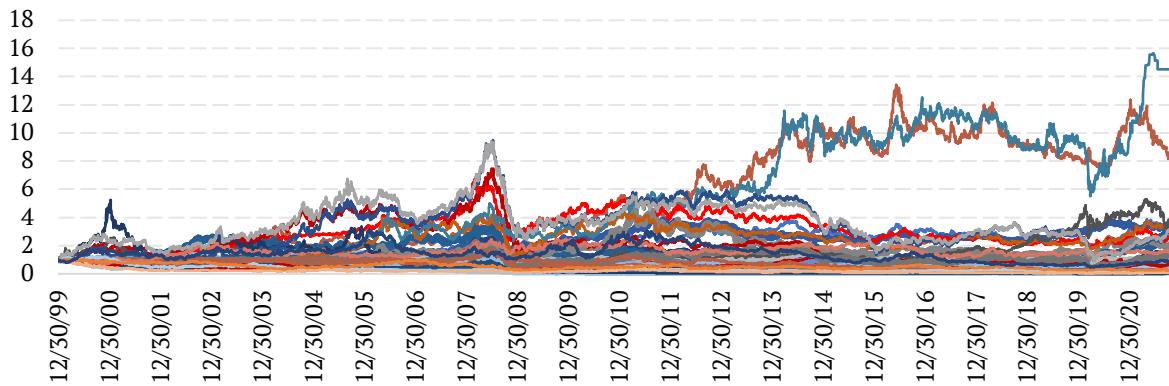
Conclusion

Overall, we can say that there is a significant rebalancing premium in cryptocurrencies. Both the Daily rebalanced index and the Monthly rebalanced index improved the performance of a Market-Cap weighted benchmark. Additionally, to improve the Daily Rebalanced portfolio further, an investor can create a long-short strategy by shorting the Market-Cap weighted benchmark. The weight on the short side may vary, depending on the market conditions. However, it seems that any weight between 50% and 90% would improve the long-only strategy.

Moreover, the crypto portfolio can also improve the performance of less volatile assets, such as bonds, when combined in a periodically rebalanced portfolio. However, all of this works because there is no outlier within the cryptocurrencies. By an outlier, we mean an asset that consistently outperforms the others. If there was an outlier, the rebalancing might not be profitable, and it might be wiser to let the weights drift. In such a case, the asset that outperforms the rest will take the majority weight and drive the entire portfolio's performance.

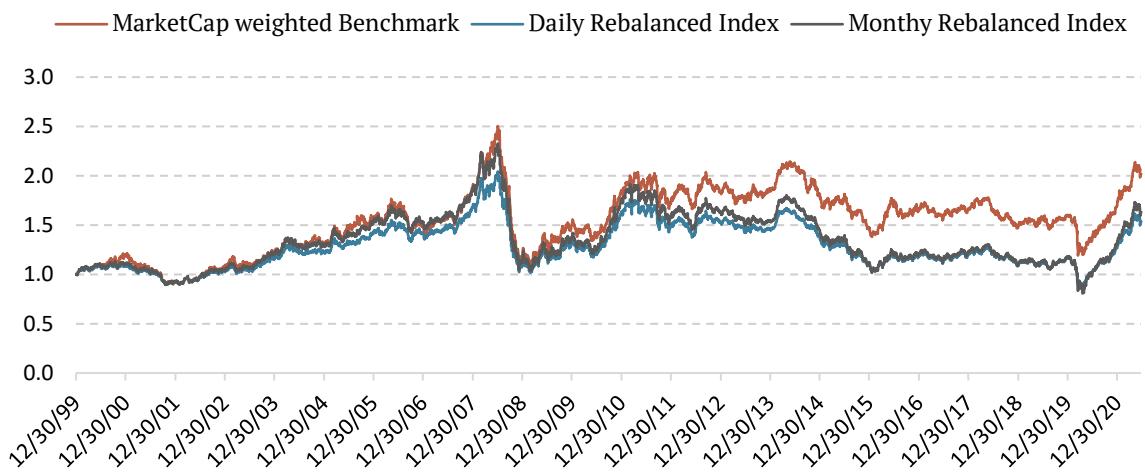
This happened in 2010 with commodities. The following figure shows the individual daily returns of 31 commodities.

Cumulative Return of Individual Commodities



As we can see, until 2010, the performance of all commodities was very similar, so it would be wise to rebalance this portfolio periodically. Then, however, the performance of the two commodities skyrocketed, and thus the periodical rebalancing stopped being profitable, as shown in the following figure.

Cumulative Return



This figure illustrates how the cumulative performance of the two strategies significantly changed after 2010 when the returns of the two commodities rapidly grew.

Related literature

- [1] Willenbrock, Scott, Diversification Return, Portfolio Rebalancing, and the Commodity Return Puzzle (Nov 5, 2021). Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1898864
- [2] ReSolve, Maximizing the Rebalancing Premium: Why Risk Parity portfolios are much greater than the sum of their parts (Nov 7, 2021). Available at: <https://investresolve.com/maximizing-the-rebalancing-premium-why-risk-parity-portfolios-are-much-greater-than-the-sum-of-their-parts-lp/>