Overview of crypto factors: cap, price, liquidity, momentum, volatility, drawdown and beta

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Abstract: Factor analysis has been dominating the stock market in explanation of risk premium induced excess returns. We analyzed basic price-volume based factors including capitalization, price, liquidity, momentum, volatility and beta on cryptos among top 50 caps historically, constructed multiple factor portfolios and confirmed their explanatory power for excess returns in the crypto domain. The long components of these portfolios outperform Bitcoin consistently with reasonable information ratios.

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1 Introduction

Multi-factor analysis has been popular in the stock market and expected to stay as such in the forseeable future. The multi-factor model uses a number of key factors that represent features of investments. Some of these factors in the stock market include and are not limited to yield, earnings growth, volatility, liquidity, momentum, price-earnings ratio, size, leverage, and growth. They are used to describe the risks or returns of a portfolio or asset, as there are usually maps between these quantitative factors and identifiable fundamental characteristics. Much like the stocks, the return-generating process for cryptos is also driven by the presence of various common factors and the asset's unique sensitivities to each of them. A few important factors can usually explain to a good degree the risk and return expected on a crypto investment.

The paper is structured as follows. Section 2 presents an overview of crypto factors, including universe selection, factor construction and performance analysis. Section 3 describes and discusses the tradability and performances of the long compenents of these factors, followed by conclusions in Section 4.

2 Crypto factors

The crypto market is arguably the most popular emerging market since 2017, with trade volume almost matching NYSE at its peak, followed by a strong 70% correction in the first quarter of 2018. Metcalfe's law offers fundamental support to crypto value, and the more useful and widely applicable the network, the more valuable the ecosystem and hence the token. Unlike the stock market however, many crypto factors are unavailable or not easily retrievable, especially those concerning the fundamentals of underlying companies, organizations or ecosystems. We focus in this paper the price-volume induced factors including capitalization, price, liquidity, volatility, momentum, drawdown and beta. A factor portfolio is constructed on each factor, followed by analysis on its performance and potential to explain market movements.

We observed and reported small cap premium at length in ref [1], which constructed cap weighted and equal weighted porfolios on top 20 and 50 cap cryptos with monthly turnover starting mid 2013. The portfolios show excess return over Bitcoin consistently. Following a similar path, we applied a series of factors on top 50 cap cryptos with monthly turnover. The universe was ranked and picked point-in-time. We removed anchor cryptocurrencies or commodities like USDT and XAURUM, since they are merely cryptolized fiat or commodity of quite different natures from conventional cryptos. All factor portfolios adopted the referred factor (or the inverse as specified) as raw score, and neutralized the book to bring the net exposure zero, i.e. the long and short positions are equal in dollar value (market neutral). We removed all prices with over 100 times appreciation in any single day (fewer than 30 in total), as they seem either highly manipulated or in error. No crypto news is worthy as such, and these can't happen too often in a sane and moderately regulated market. This treatment gave us a better picture for quantitative analysis purposes, but may affect live performance in extreme market conditions. All removed exotic price movements went upwards, so one can circumvent losses easily by taking long-only positions, to be discussed in Section 3.

2.1 Cap

The cap factor portfolio applies inverse cap as raw score. We are effectively buying cryptos with low caps and selling those with high caps. The performance is shown in Fig. 1, with annual information ratio (IR) 2.3, return 120%, volatility 52%, max drawdown 48%. The factor underwent three long drawdowns in second half of 2015, 4th quarter 2016 and 3rd quarter 2017 (16%, 25% and 31% peak to trough, respectively). Two other notable, steep drawdowns happened in 4th quarter 2013 and 1st quarter 2014: 48% and 28% peak to trough.

As was pointed out in ref [1] and anticipated, small cap premium played an important role in the early days of the crypto market, and will keep dominating the aggressively expanding realm in quite a few years to come. The Bitcoin dominance declined for a good reason.

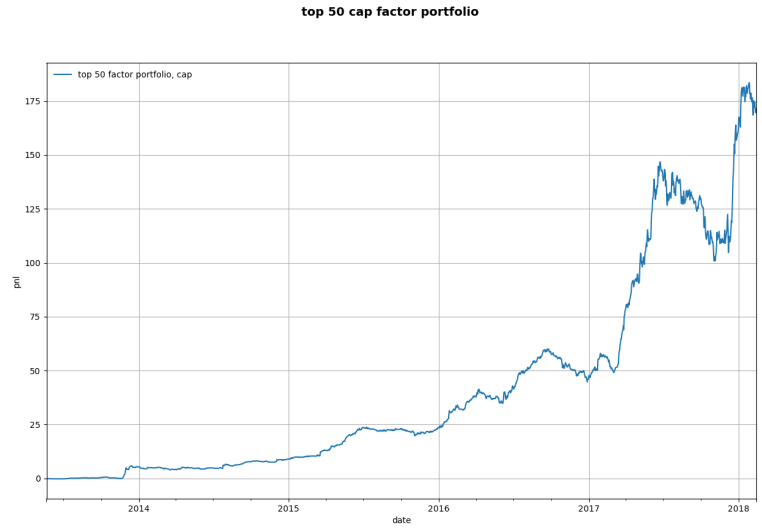

Figure 1. The cap factor porfolio performance on top 50 cap cryptos.

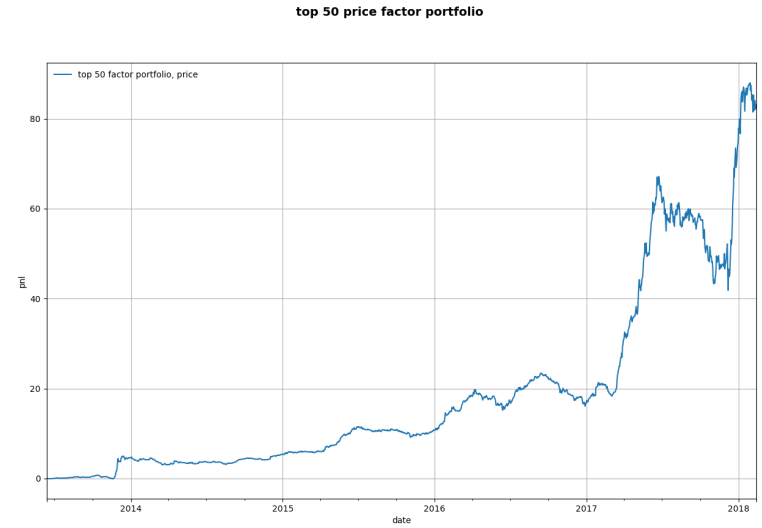

Figure 2. The price factor porfolio performance on top 50 cap cryptos.

2.2 Price

Similarly, we constructed a dollar neutral factor portfolio on inverse price, i.e. buying cheap cryptos and selling expensive ones. The performance is in Fig. 2. We got annual IR 2.2, return 110%, volatility 49%, max drawdown 49%. The P&L is very similar to the cap factor in Fig. 1, as the price and cap in the crypto world are highly correlated. Note new tokens are mined at a fixed or exponentially decayed rate, which compromises the predictive power of price to a small degree and leads to a return drift over all.

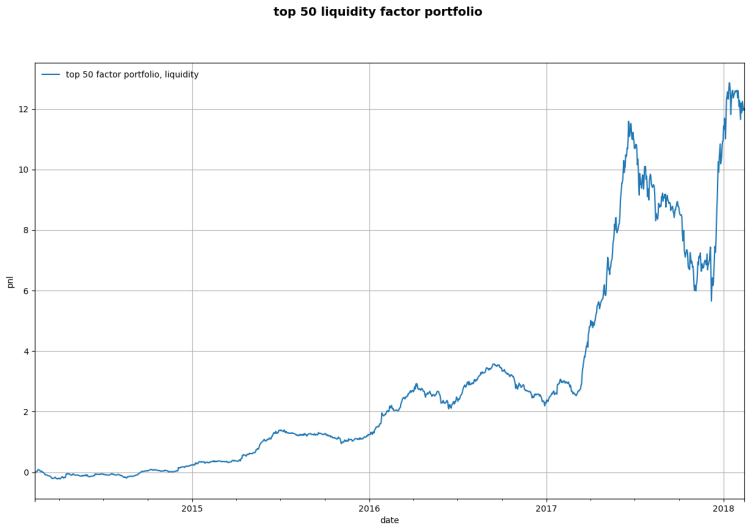

Figure 3. The liquidity factor porfolio performance on top 50 cap cryptos.

2.3 Liquidity

We took liquidity as the product of price and volume, calculated the rolling simple mean over the last month, inverse and constructed a factor portfolio following the same procedures. Much like the cap factor, this is another buy-low-sell-high type strategy except on liquidity. Due to limited historical volume data, we estimated the first half year of liquidity with cap. The performance is in Fig. 3. We got annual IR 2.0, return 70%, volatility 34%, max drawdown 47%. Not surprisingly, the liquidity factor performance highly resembles the cap factor.

2.4 Momentum

Now let's construct a dollar neutral factor portfolio on inverse momentum. The momentum is defined as the monthly rate of return. Note the momentum factor employed here is different from the momentum in the traditional sense, as we buy cryptos with low momentum and vice versa. Reversion tends to follow higher momentum as we observed in the crypto world, and the factor portfolio is effectively built on monthly price reversion. The crypto market features shorter cycles than traditional markets like stocks, and monthly returns could serve as a reasonable predictor in period length - fine tuning would be certainly helpful, but it is probably futile to go as far as annual momentum - after all, most cryptos stem back less than two years historically (as of March 2018 the time of writing).

The factor performance is in Fig. 4. We observed some premium in momentum, with annual IR 1.3, return 70%, volatility 55%, max drawdown 63%. There were strong surges before mid 2014 and after 2016, with a long decline in between. However, many cryptos dropped out of the universe due to lack of maintenance, even worse, some projects launched in malicious intent and aimed solely for fundraising. They couldn't hide their intent forever, and their price kept falling as investors gradually found out about their ill nature. One way

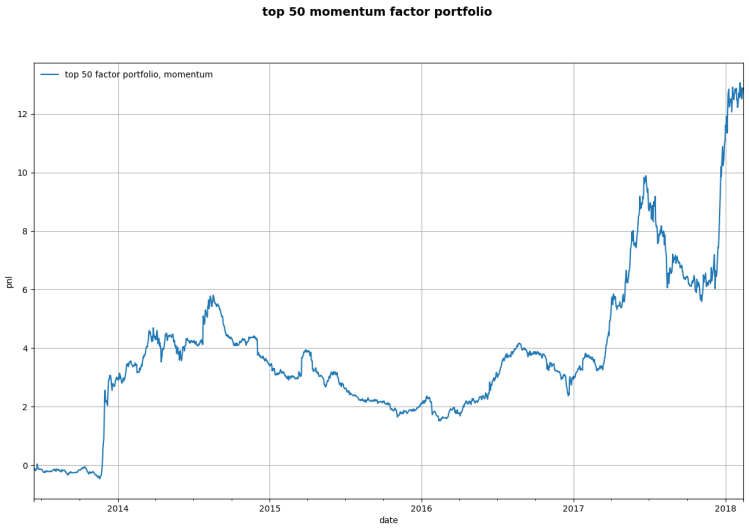

Figure 4. The momentum factor porfolio performance on top 50 cap cryptos.

to subdue underlyings of this kind could be to remove all cryptos on the fall last month (set momentum 0) and reconstruct the factor portfolio, but this can't constitute a factor portfolio for obvious reasons. We leave the discussion to Section 3. Note most of the premium arised in 2017 - the year of genesis for the forthcoming crypto era. It is surely bubbled after the surge, but as the market regresses to its fair value with moderate and healthy regulations in place, another tide can't be too far behind.

2.5 Volatility

We calculated monthly volatility on daily rate of return series, constructd a factor portfolio using the same standards as above, and applied the volatility itself as the factor. Remember the small cap premium indicates cryptos with lower cap tend to outperform. These cryptos tend to carry higher volatility too, and with greater risks comes with higher returns. The performance is as shown in Fig. 5, with the y-axis set to logarithmic scale for better readability. One may expect the performance similar to that of the cap factor, but it did not turn out to be the case - the volatility factor portfolio offers exponential return and is by far the best representation of the crypto growth in the dollar neutral domain over the last few years. We have annual IR 1.8, return 450%, volatility 240%, max drawdown 64%. It features significantly higher return than previous factor portfolios. Nevertheless, high risk is involved as always and compromised the IR. Notably, there were multiple periods when the P&L is flat, including most of 2014, second halves of 2016 and 2017, but whenever the portfolio was on the move, it accessed returns at an exponential rate. There has not been much progress since mid 2017, and the performance of the volatility factor onwards remains highly fascinating, one way or the other.

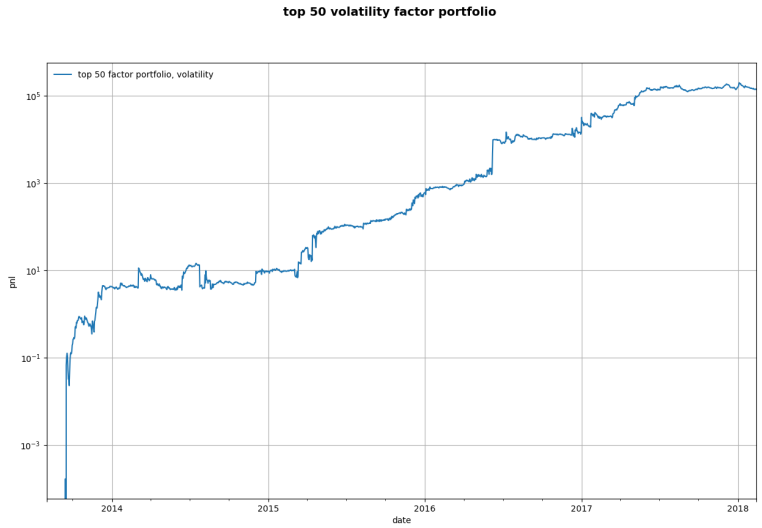

Figure 5. The volatility factor porfolio performance on top 50 cap cryptos, with the y-axis set to logarithmic scale.

2.6 Drawdown

The drawdown is not necessarily a widely applicable or acclaimed factor in the market neutral upfront of stock market, as it is limited to carefully selected universes or strongly growing markets only. Moreover, it inherits a disputable fame from its remote cousin - the Martingale betting system, which doubles up the positions every time the price falls down one more predefined interval, and liquidates all positions once it climbs one level back up. It is proven mathematically that a 50% edge and infinite capital net out all P&Ls to zero in the long run, but nobody has infinite capital, so all Martingale gamblers are doomed eventually if they don't have a solid edge over 50%. This process can however take very long if one is lucky, unremitting and very rich. It is conjectured by some brightest minds that all active fund managers in the world are effectively practitioners of Martingale betting equivalents, as there are no alphas as they claimed whatsoever, and they are all deemed to lose at some point - a simple matter of time.

Does the drawdown factor work for cryptos? We obtained the percent drawdown from the latest peak, took the inverse, and constructed a factor portfolio constantly buying low drawdowns and selling high ones on the top 50 cap. The performance is shown in Fig. 6, we have annual IR 0.32, return 30%, volatility 96%, max drawdown 90%. It seems to work in a interesting direction in contrast to the common value investing approach - buy more when good stocks dive deeper, whereas we sell more instead. That is likely because we are not always building the portfolio on good cryptos, and everything else equal, good cryptos actually dip less. As the quality of our universe improved, i.e. more good cryptos entered and stayed in the top 50 cap, the factor performance began to pick up, as was observed after 2016 in Fig. 6.

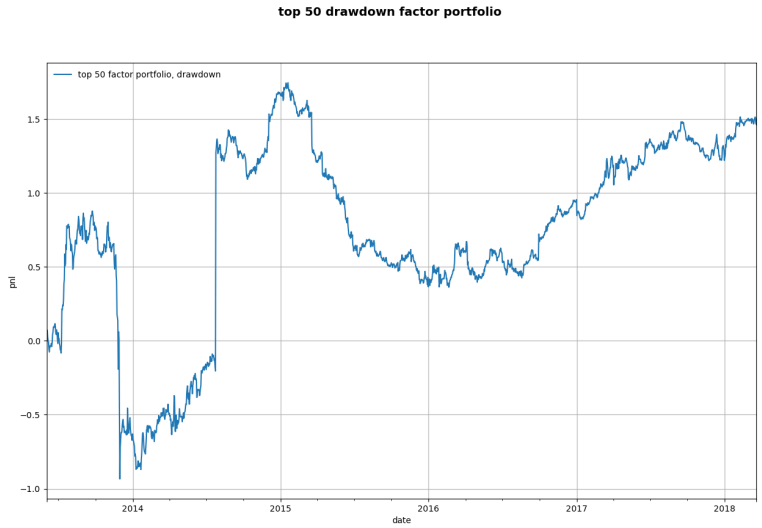

Figure 6. The drawdown factor porfolio performance on top 50 cap cryptos.

At this point one may wonder if it is worthy at all to look into the drawdown factor. 0.32 is the lowest IR we observed among all factors indeed, however, it was largely compromized by a few weird price data points in 2013 and 2014, which we think are faithful but not to reoccur easily for the top 50 cap moving forward as the crypto market keeps growing. There could still be a potential in this factor, although one may seriously consider to apply a more appropriate universe. We will revisit the drawdown factor in Section 3 and present another proof. The nature of this factor is however pending further observations out-of-sample.

2.7 Beta

Similarly, we computed the rolling annual beta of each crypto against the market (in this case Bitcoin for simplicity), and took the inverse to construct the beta factor portfolio with monthly rebalancing, i.e. buying crypos with low beta and selling those with high beta. The result is shown in Fig. 7, with annual IR 1.4, return 94%, volatility 70%, max drawdown 73%. The performance is strong between 2014 and 2016 but decayed since. One may like to consider a higher frequency or expanded universe for stronger signals.

We include performance numbers for all three scenarios in Table. 1.

3 Tradability and the long-only construction

3.1 Challenges in shorting and capacity

One may wonder if these factors, assuming they keep working, are tradable at all. Maybe their very existence results from the fact that they are not executable. The crypto market is at its infant phase after all. Unlike the stock market, there haven't been a single crypto prime broker to offer large-scale hedging or shorting service at a relatively low cost, mostly due to limited liquidity and publicity. The typical shorting interest with a crypto exchange

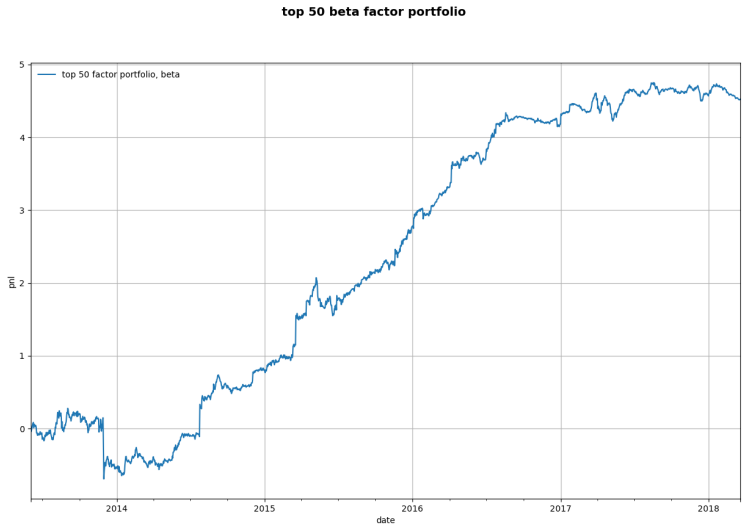

Figure 7. The beta factor porfolio performance on top 50 cap cryptos.

strategy	IR	return	volatility	max drawdown
cap	2.3	120%	52%	44%
price	2.0	99%	49%	43%
liquidity	1.7	57%	33%	49%
momentum, full	1.1	66%	59%	74%
volatility	1.5	360%	240%	61%
drawdown	0.32	30%	96%	90%
beta	1.4	94%	70%	73%

Table 1. Performance summary for all factor portfolios.

supporting margin accounts is 0.1% per day or higher whenever volatility picks up. This amounts to over 36% per annum and would take away a large cut (if not all) of profit. Even worse, most cryptos in the list are not shortable. Typical hedging service covers top 20 cap at most. Bitfinex for instance covers 15 cryptos in shorting as of March 2018.

Transaction costs, including bid-ask spread and impact cost is another concern in live trading. Though picking up quickly, the crypto liquidity is still too poor to accomodate large hedge funds or mutual funds. Whales can't swim in a small pool. Since the turnover assumed in our analysis is only monthly, as long as the size isn't overwhelming, liquidity would not pose a big problem for small to mid-size sharks to take a bite or two. One could however achieve better performance with higher frequency at a cost of lower capacity. More cryptos could be included in the universe construction for additional benefits in breadth too, but again not without the cost of further limited tradability.

3.2 A partial solution: the long-only construction

What if we give up market neutrality and focus on the long-only half of the factor portfolios? This treatment eliminates all challenges involving shorting, and offers a reasonable and straightforward solution mostly suited to long-term token holders with good faith on the crypto market. One must be willing to take a significant long exposure, and the only goal of these long-only portfolios would be to beat the benchmark, the bitcoin.

The performance of these long-only portfolios are shown in Fig. 8. For ease of comparison, we calculated the excess returns of these portfolios over Bitcoin and showed them in Fig. 9. Admittedly, profits in these long components are mostly induced from small cap premium and somewhat correlated, since a good number of low cap cryptos are involved in any case. However, orthogonal ingredients from individual factors persisted and led to some uncorrelated differences in P&L. Their performances are given Table. 2.

We mentioned in Section 2.4 that troubled projects could be identified by a consistently falling momentum. When we set the weight zero for cryptos with negative monthly momentum, a stronger momentum premium did emerge in the long component of the factor, as was shown in Fig. 8-9 and summarized in Table. 2.

Another curious observation is that the long component of the drawdown factor did well in the anticipated max down dates (Nov. 2013) from Fig. 6. This is because the max drawdown happened to stem from the short component in those days and got removed. However, even if it is committed, most profit still came from small cap premium materialized, which would have covered up the hole easily.

These crypto factors are as applicable on the long exposures as their market neutral counterparts. They are simple and straightforward, yet non-trivial and effective historically. We noticed recently a large wave of crypto data vendors, social media and news agencies on the rise, so are various kinds of ranking services, most of which endeavor to become the crypto counterparts of Bloomberg, Facebook, Google, S&P, Wikipedia, etc. Most of them will fail. Nevertheless, they offer more angles on the fundamentals of cryptos and shed light on advanced quantitative analysis, where more smart betas or alphas lurk within.

4 Conclusion

Factor models can be used to evaluate how much of a crypto portfolio's return is attributable to each common factor exposure, and more importantly offer guidelines along portfolio construction and optimization. We presented the performances of multiple crypto factor portfolios, and discussed their tradability and excess returns over Bitcoin in their long-only components. These are the earliest smart betas observed and reported in the crypto market, with their validity contingent on further out-of-sample confirmation. However, we are confident that many of them will persist, as they are popular factors widely applicable in traditional markets like stocks.

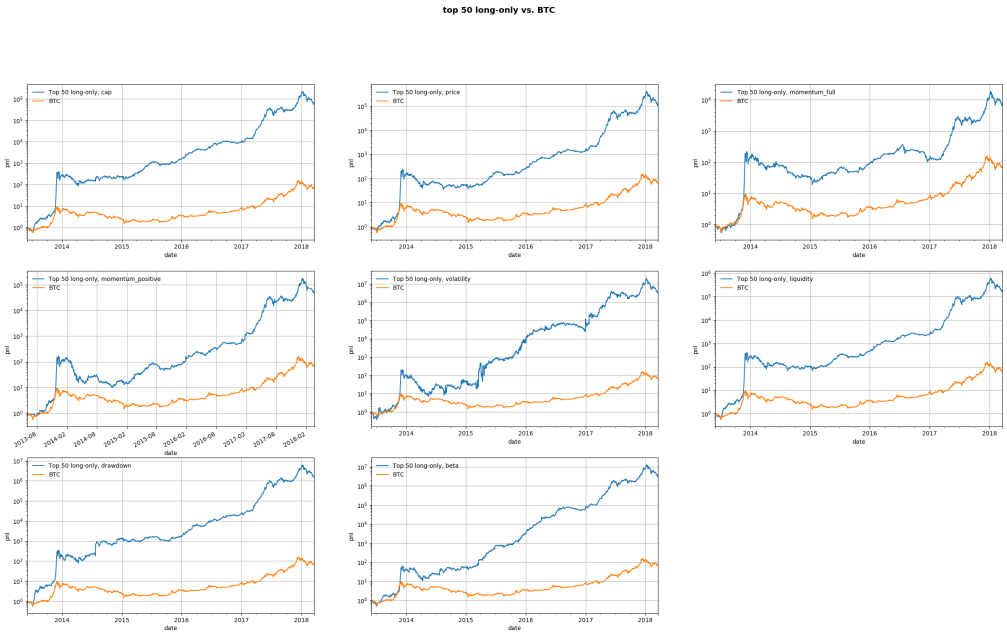

Figure 8. Performances of the long-only components for factor porfolios on top 50 cap cryptos: cap, price, liquidity, momentum (full), momentum (positive), volatility, drawdown and beta. Blue: factor performance, orange: BTC performance.

strategy	IR	return	volatility	max drawdown
btc	1.5	130%	86%	81%
cap	2.7	360%	130%	75%
price	2.5	320%	130%	84%
liquidity	2.2	200%	92%	73%
momentum, full	2.0	270%	130%	90%
momentum, positive	2.3	320%	140%	93%
volatility	1.8	900%	500%	96%
drawdown	2.2	420%	190%	75%
beta	2.9	400%	140%	84%

Table 2. Performance summary for the long components of factor portfolios on top 50 cap.

We will pay close attention to smart beta factors as such and more, as they may evolve further or undergo complete nature conversion while the crypto market keeps growing and developing. We encourage interested parties to join us and explore more quantitative crypto dimensions in depth, and are happy to offer assistance in our reach.

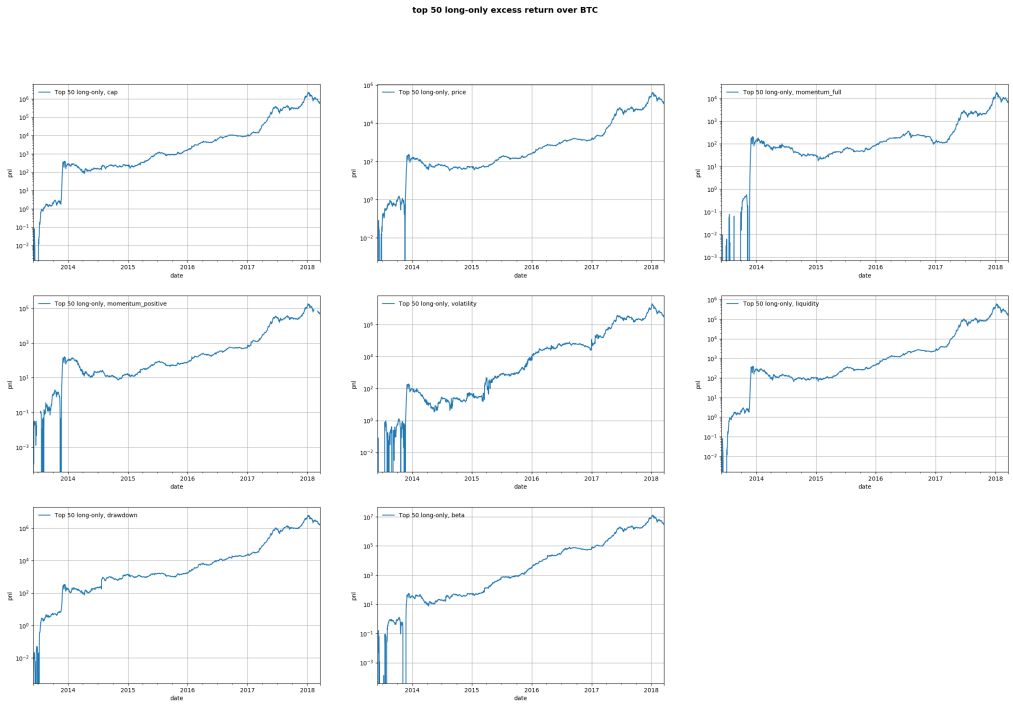

Figure 9. The excess P&L over Bitcoin in the long-only components of factor porfolios on top 50 cap cryptos: cap, price, liquidity, momentum (full), momentum (positive), volatility, drawdown and beta.

(This paper is NOT to offer investment advice. You are responsible for your investment decisions at your own risk.)

References

[1] K. Lamperouge, *founder of cryptosmartbeta.com*, link, 2018.