

Crypto Commonwealth: a Blockchain based scientific publisher and asset manager of the COMMunity, by the COMMunity and for the COMMunity

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ABSTRACT: The whitepaper introduces Crypto Commonwealth - a scientific publisher and asset managing platform that aim for the welfare of the most. We designed rich tokenomics for our publishing and asset management ecosystem, and offer one of the fairest production relations to fundamentally change the value seeking processes in both industries. We boast a professional publishing and investment team in traditional and crypto domains. The publisher and investing platform operations as well as alpha and content mining enable rich use cases for our token - COMM and benefit our COMMunity.

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Contents

1	Introduction	2
2	Introducing world’s first crowd-owned and operated, peer-reviewed non-profit scientific publisher	4
2.1	The goal	5
2.2	The e-print hosting website and the journal	7
2.3	Our columns	7
2.4	The acceptance criteria and compensations	7
2.5	Campaigns	11
2.5.1	Quality Content Award	11
2.5.2	Publication endorsement	12
2.5.3	Article Support Program	12
2.6	Active openings and quests	12
2.6.1	Article translation	12
2.6.2	Co-authorship	13
2.6.3	Article review	13
2.6.4	Editor openings	14
2.6.5	Partnership program	14
2.6.6	Crypto book co-management	15
2.6.7	Website development	15
3	An overview of the investing, funding and research platform	16
3.1	The Commonwealth asset managing partnership structure	16
3.2	Risk factors related	19
3.3	Opportunities to join us as researchers, portfolio managers or partner funds	20
4	The Commonwealth tokenomics	22
4.1	Initial Coin Offering	22
4.1.1	Overview	22
4.1.2	The lock structure in the public sale - the making of CBND	23
4.2	Technical details	25
4.3	COMM’s dedicated main net	26
4.4	An ecosystem with global payment network	26
4.4.1	COMM as the compensation for alpha and content mining	27
4.4.2	COMM as the right to invest	28
4.5	The charity program	31
5	The roadmap	32
5.1	The timeline	32
5.2	The past, present and future of the crypto as an asset under management	34

6	The team	43
7	Conclusion	48
8	Appendices	50
A	Passive crypto investing: introducing the crypto ETFs and small cap premium	50
A.1	Introduction	50
A.2	Crypto ETFs	51
A.2.1	The top 20 cap weighted ETF	51
A.2.2	Improvements	51
A.3	Small cap premium on cryptos	52
A.3.1	Top 20 caps equal weighted	53
A.3.2	Generalizing to top 50 caps	53
A.4	Conclusion	53
B	Overview of crypto factors: size, price, liquidity, momentum, volatility, drawdown and beta	55
B.1	Introduction	55
B.2	Crypto factors	55
B.2.1	Size	56
B.2.2	Price	56
B.2.3	Liquidity	57
B.2.4	Momentum	58
B.2.5	Volatility	59
B.2.6	Drawdown	59
B.2.7	Beta	60
B.3	Tradability and the long-only construction	60
B.3.1	Challenges in shorting and capacity	60
B.3.2	A partial solution: the long-only construction	62
B.4	Conclusion	63
C	The decline and fall of angels: where did the historical top cap cryptos go?	66
C.1	Introduction	66
C.2	Historical top 50 cap cryptos on the dollar basis	66
C.3	Top 50 cap threshold on the rise	68
C.4	Top 50 dropouts on the bitcoin basis	68
C.5	Top 50 dropouts on the ethereum basis	69
C.6	Conclusion	69

D	The art of blade grasp: historical drawdown statistics on common cryptos	71
D.1	Introduction	71
D.2	Historical drawdown statistics	72
D.3	Stability scoring	74
D.4	Conclusion	76
E	Buckle up and enjoy the ride - volatility analysis on common cryptos	77
E.1	Introduction	77
E.2	Defining daily and annual volatility	77
E.3	Volatilities on top 50 cap cryptos and implications	78
E.4	Conclusion	80
F	Blue pill or red pill? Common myths in quantitative strategy research	81
F.1	Introduction	81
F.2	Overfitting	82
F.3	Forward looking bias	82
F.4	Selection bias	83
F.5	Executability of consolidated prices	86
F.6	Reliability of interval prices	86
F.7	Transaction costs	87
F.8	Conclusion and brainstorm	88

1 Introduction

It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way - in short, the period was so far like the present period, that some of its noisiest authorities insisted on its being received, for good or for evil, in the superlative degree of comparison only.

- Charles Dickens, *A Tale of Two Cities*

Financial markets have their cycles, typically ranging from years to decades. Arguably the world's most popular emerging market, the crypto market features much shorter cycles, sometimes only in a matter of months. Starting 2009 and absolutely zero, bitcoin went through and survived a baptism of fire. It was attacked and declared dead hundreds of times, yet each time rose from the ashes and reached new highs, peaking at tens of thousands US dollars in 2017. The Blockchain as an epoch-making technological revolution brings about this exponential growth in crypto markets.

The unprecedented growth and born greed rooted deeply in humanity induced fickle speculation, short-termism and pump-and-dumps, which effectively imposes a leverage on the entire market and magnifies all price movements. This is largely the reason all cryptos suffer from supreme volatility. It is not uncommon that large price movements up to ten or hundred folds are observed in the crypto market, for it is still an infant and highly immature with ambiguous future in most people's eyes. The public has not reached consensus for the prospects of consensus based and cryptography backed universal equivalents.

Nevertheless, we as a professional publishing, quantitative research, modeling and asset pricing team saw abundant opportunities amid noisy data with conventional research tools, including but not limited to factor analysis and fundamental valuation. Our nonprofit publisher features innovative tokenomics design, and endeavors to fundamentally change the traditional, centralized scientific publishing monopoly with decentralized economics. Our goal is to build an academic publishing COMMunity of the people, by the people and for the people. Furthermore, we partner with professional funds and will seek to tokenize the best of them. The potential partners include smart beta funds that aim to accommodate smart betas and alphas, hedge funds that endeavor to seek pure alpha out of a 100% market neutral portfolio, long/short funds that exploit the timing opportunities out of large cap instruments, passive funds that target high capacity accommodation at ultra-low fees with passive investing principles, and venture funds that seek to invest in startup projects in their early phases during or post IPO/ICO. They feature distinct portfolio constructions and fee structures, and are expected to launch in a matter of months to years when we finish all preparations and confirm all partnerships.

The whitepaper (the 'Whitepaper' or 'WP' hereinafter) is structured as follows. Section 2 introduces our operations as world's first Blockchain based, peer-reviewed scientific publisher. Section 3 outlines our distinct partnering fund structures and preliminary fees. Section 4 introduces our tokenomics and ecosystem with technical details and use cases. Section 5 presents our roadmap, including goals we have achieved, short-term and long-term objectives, a brief history and the prospects of the cryptocurrency as an asset under management. Section 6 introduces our team, followed by conclusions in Section 7. We present our market insights at length in Appendices A-F. Some articles are available in the publication area of our website cryptosmartbeta.com ('the Website'), and we will host a separate website like ArXiv.org, inSpire or SSRN, advertise and solicit e-prints for some time to give our comprehensive, peer-reviewed journal ('The Commonwealth') a head-start.

2 Introducing world's first crowd-owned and operated, peer-reviewed nonprofit scientific publisher

There is nothing which can better deserve your patronage, than the promotion of science and literature. Knowledge is in every country the surest basis of public happiness.

- George Washington, *First Annual Address to Congress*

Knowledge is power. The discovery and distribution of new knowledge is an ultimate form of contribution to humanity, for its selfless nature and benevolent will to serve the people. Crypto Commonwealth is an innovative scientific publisher on tokenomics, and compensates all endeavors that assist us with the crypto we issue in day-to-day publishing operations, including but not limited to article submission, reviewing, editing and translation. Our publication area offers high-quality and original quantitative analysis purchased from the authors upon peer review. We do our best to publish novel articles and strategies of original ideas.

Currently, most essential and renowned technical protocols like the internet did not carry concrete financial value in their original form, thanks to the inventor's generosity and nobility in many cases. The value of the internet primarily manifests in the dotcom companies like Google, Facebook, Amazon, etc. On the other hand, according to the historical prices or the underlying value of various Blockchain projects, mankind has established consensus that fundamental Blockchain protocols, or the public chains in particular are usually as valuable, and in many cases more so than the decentralized applications or DApps. This is the Blockchain spirit, a powerful reform of production relations that endows the fundamental basis of productivity with both fame and financial value. See Fig. 1 for the cap distributions of traditional / internet companies and the cryptos.

Humanity is sometimes overly obsessed with power and lucrative businesses, at a cost of looking less upon the sky. Competition is deeply rooted in humanity and fine, this is how we evolved and became who we are, but more and more participants in the endless zero-sum games raised our concern. Fundamental, applied and social sciences are the roots beneath the evolution of civilizations, with most large-scale business practices the stems, leaves and flowers. However, our human nature admires and encourages the actual revenue-generating processes much more, and tends to overlook the value of the fundamental basis and protocols they rely upon. Exceptional academic research results lay the foundations and cornerstones of the modern civilization indeed, but the majority of publications take high risks and present relatively lower rewards or application value on an average, much like the IPOs and ICOs in certain ways - the head return of limited few projects outweighs the cost or loss of most ordinary ones. As a result, the hard work of scientists and scholars is hardly well and fairly compensated, especially those jewels and gems in fundamental sciences. But the power of scientific research truly lies in the law of large numbers and the neutral theory of evolution: if every scholar strives to push our boundaries of knowledge, more of them would definitively stand on the shoulders of the giants, as well as accomplish major academic achievements.

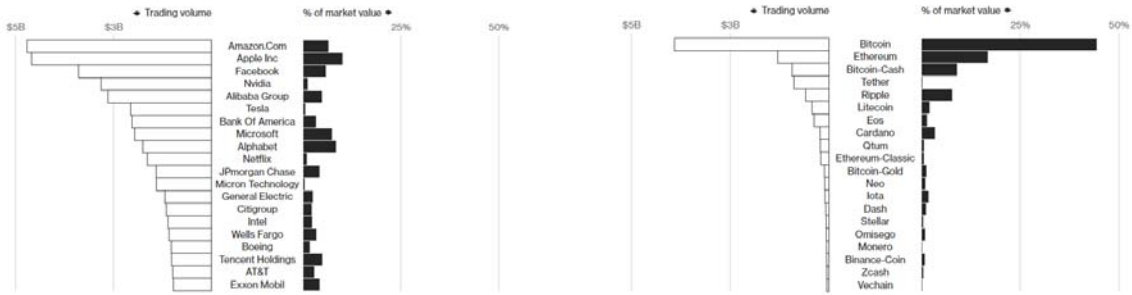


Figure 1. Left: The cap distribution of traditional and internet companies. Right: The cap distribution of major cryptos. Source: Bloomberg.

Our scientific publisher is world’s first crowd-owned and operated peer-reviewed publisher, as the right of token ownership belongs to the contributors and the nonprofit Commonwealth Foundation, see our distribution plan in Section 4 for details. The COMM token is much more flexible than conventional financial instruments, in that it is infinitesimally divisible, easily transferable and backed by encrypted algorithms to protect the financial value therein. It is the indisputable right to share the financial prospect and consensus of our ecosystem, and the only way to share the stakes with a large group of COMMunity contributors in proportion to their work to assist our operation. We would like to compensate all endeavors to advance human’s knowledge base this way, as we believe that every effort on the advancement of our knowledge boundary matters, and all excursions into the truth, either successful or not, are worth much more than what they appear to be as of the point in time.

2.1 The goal

The scientific publishing industry is highly centralized. Scholars submit and review articles for major publishers for free and voluntarily. It is a noble act, yet many for-profit publishers accessed large profits without returning appropriate favor to academia. The Commonwealth Publisher is COMMitted to innovatively improving this traditional field with a decentralized digital ecosystem. It intends to compensate all authors, reviewers, and editors with fair token payment. With a healthy token distribution plan, we will eventually generalize the tokenomics to a comprehensive journal covering major natural and social sciences. This is an area where the Blockchain can bring fundamental changes to. And we are the one and only peer reviewed journal on Blockchain aiming for that. And we shall start with publications in the crypto domain first.

Over 30 billion USD large, the scientific publishing industry is also unique in that it has a homogeneous community world wide. Top scholars, although from different countries and regions, publish articles and conduct peer reviews in pretty much the same manner. This is largely different from industries based on consumer products or services, which often show strong dependency on local or regional consumer behavior patterns. The homogeneity makes this global market easy to target, without the burden of breaking into regional markets one by one.

It is an innovative and promising endeavor to apply tokenomics to the peer-reviewed publishing domain, academia or pop science. The success of the COMM token relies heavily on the contributions from our COMMunity, particularly high-quality articles or quantitative analysis from distinguished authors and researchers. All contributors will benefit from the tokens they hold as our ecosystem grows. This is a charitable business we intend to support as a major subsidiary, and a COMMitment that all endeavors to discover new knowledge are valuable and financially worthy. All knowledge producers deserve humanity's highest respect, not only at the superstructural level but also on the economic basis.

The [Simons Foundation](#) offers a paradigm consolidating resources from the hedge fund industry to academia. Unlike most other zero-sum participants, they trade and profit for a solid purpose. Most other hedge funds focus solely to amass wealth and gain relative advantages over peers, whereas they have been supporting academic projects in a wide range of fields, which amounts to a third of research grants in selected programs. Our ultimate goal is similar. We seek to advance research in multiple frontiers, including but not limited to mathematics, fundamental and social sciences, and are dedicated to building a safer, more open-source digital world with the Blockchain. With this Blockchain revolution at dawn and forthcoming developments in global crypto markets, we see great opportunities to strive for our dreams and make it come true. The operations in the publishing industry is one of our major endeavors.

We will apply the tokenomics on our own website in the publication area first, and in the meantime develop a separate website like arXiv.org, advertise and solicit e-prints for some time, and invited active scholars to help operate the peer-reviewed journal, The Commonwealth ('the Journal'). Each submission is COMMitted to the Blockchain and serves as the indisputable and immutable evidence for the originality of the article. The text would be safely preserved on the Blockchain permanently as long as internet still exists on earth. We will experiment and deploy a point system at first, polish it and eventually build our tokenomics based on the system. The points one cumulates would be positively correlated to his/her contribution to the Website or the Journal, contingent on a number of factors such as article quality, reviewer feedback, citations, h-index and many more. On the other hand, when the Journal acquires high-quality, stable submissions and a good impact factor, we would start charging subscription and publishing fees like a COMMercial journal, but redistribute all profits after operational costs back to the authors, editors and reviewers.

The introduction of tokenomics into scientific publishing is subtle. We are well connected and discussed the subject with a large number of professors and scholars in renowned universities including but not limited to MIT, Harvard, Boston, Stony Brook University, University of Chicago and Michigan at Ann Arbor. An important feedback is that any monetary policy in academia may result in unfairness or even worse, speculation in publications, which may harm the purity of science in its non-profit, selfless nature and would be the last thing we want to see. For that reason we would do our best not to give authors any indications that each publication is directly linked to financial compensations, neither

would we openly publish the formula to decide the amount of such compensation. We may lag the remuneration for a significant amount of time - after all, the correctness and influence of any publications take time to settle; one other useful thought is to organize a review COMMittee and offer grants or assistantships to applicants instead of compensating every single article. We will collect feedback from all users, host discussions and achieve consensus among the majority of scholars before we proceed. It is our solemn duty to make every effort and ensure all the authors and contributors get fair compensation from their work statistically. We will design a self-correction mechanism or appoint a COMMittee to monitor the whole process. Eventually, we hope to compensate all scholars by the quality of their work, so that more smart people stay in academia, especially those interested and good at research but left academia under finance-related, force-majeure circumstances.

We outline a quick overview for the e-print hosting website and the Journal in Section 2.2. They are subject to changes as the web development goes on. Section 2.3-2.6) apply solely to the publications hosted on our main site unless otherwise specified.

2.2 The e-print hosting website and the journal

The website intends to host e-prints, facilitate Latex editing, compilation and promote scientific social networking. A point system would be carefully designed to attribute user activities and fame. This system may serve as a partial basis for COMM distribution in the future. We have a initial deployment plan of great details, and have been actively designing, expnding and developing the website. Please consult us for details if you are a private sale investor.

2.3 Our columns

The 'Beta for Pros' column publishes heavyweight research papers intended for professionals with advanced quantitative backgrounds. This is the column where all publications require review and recommendation from a dedicated COMMittee of professionals.

The 'Beta for Fun' column publishes quantitative and fun crypto analysis, tokenomics and philosophies. Most topics in 'Beta for Pros' are covered too except intended for generic readers.

The 'Crypto Insights' column publishes non-quantitative articles in the Blockchain domain including crypto overviews, insights, token mechanism / algorithm, macro visions, Blockchain techniques, etc. They serve as educational resources and a crypto knowledge base.

2.4 The acceptance criteria and compensations

The 'Beta for Pros' column aims for the readers with advanced quantitative backgrounds. The scope of the paper covers smart beta / alpha investigation, factor /risk premium analysis, ETF construction, pair arbitrage, statistical arbitrage, exchange arbitrage, high frequency trading, risk management, automatic investment, market making, and the applications of portfolio management techniques that improve simple trading methods. We

will invite experts in coding, data analysis and quantitative disciplines including finance, economics, math and statistics to serve on the review COMMITtee.

The 'Beta for Fun' column is intended for college level readers and largely serves as educational resources. They are preferred to be concise and clear. Simple formulas are encouraged only if/when they are necessary to explain the qualitative nature of the problem. We favor fun and clear articles with nice plots. Please try NOT to go over 3000 words or 10 plots unless utterly necessary, but we expect them beyond 1000 words and 2-3 plots or tables in general. Please merge similar plots if you can. We encourage every effort to bring complex quantitative crypto analysis into pop science. Articles or strategies in this column have equal likelihood to get referenced, possibly more. All submissions to 'Beta for Pros' and 'Beta for Fun' must be quantitative in a way, with limited exceptions such as high-quality, self-contained and excellent token economics or consensus philosophy.

The 'Crypto Insights' column publishes non-quantitative, novel articles in the Blockchain domain. We welcome well-written, original articles, including but not limited to crypto overviews, in-depth and distinguished research on the Blockchain, IoT, big data, token mechanism / algorithm, macro visions, Blockchain techniques, follow-up analysis on hot topics, interview / presentations of industry leaders, etc. Over 2000 words preferred. Note: since most articles on the internet are non-quantitative, the caliber we required of the authors will be high. A history of publications in your blogs or social media accounts with good insights will enhance your acceptance rate significantly.

We give original articles highest priority. Please do include the sources if you reference other people's work. Articles of the following subjects will have priority: smart beta / alpha investigation, factor / risk premium analysis, ETF construction, pair arbitrage, statistical arbitrage, exchange arbitrage, high frequency trading, risk management, automatic investment, market making, and the applications of portfolio management techniques that improve simple trading methods. But all quantitative crypto analysis are surely welcome, including but not limited to rate of return statistics, market cyclically, timing, market sentiment, sector analysis, liquidity study, exchange data analysis, token/consensus economics, etc. Note many articles in finance journals are readily applicable to cryptos with minimal or minor adaptations. We encourage and publish works, insights, principles or theories on generic financial instruments too, with the only requirement that they are applicable to cryptos.

We will do our best not to publish any similar articles. If you have good and new ideas, please publish early. Trivial generalizations such as trading universe expansion are categorized as the same subject in general. Read our columns carefully and come up with new topics. Articles of a similar nature and quality will compete on a first-come-first-serve basis. You are responsible to ensure originality of your work. Though we do our best to resolve claims and decide benefit attributions, we are NOT legally responsible for copyright disputes.

We favor analysis applicable to multiple or all cryptos in all columns. Normally we do not accept single project analysis on any crypto except those among the top 20 cap or the subject of the article is widely applicable and of novel economical, financial value / phenomenal technical nature. Simple technical analysis will not be accepted in quantitative columns, as they are mostly intended for professional investors. College math is to be exercised in all quantitative publications at least. It might publish in our 'Crypto Insights' column, though.

We welcome rewritten and improved crypto analysis at the pop science level. If so, please include the original link to the source (OK if it's not yours). Such articles can be published twice in both 'beta for pros' and 'beta for fun' columns after reasonable adaptation if you wish or vice versa, provided they come from the same author(s) and offer references properly. This is the only exception to our article correlation check, otherwise we do not publish similar works. The compensations of adapted articles are decided separately and independently, but they share the same referencing benefits in terms of management fee. We offer review and publication priority if your other article is published with us previously.

We accept PDF submissions only. No format requirements as long as it is an amusement to read, but we strongly recommend to use our [template](#). Please allow 2-3 weeks for us to finish the peer review process, and collect / forward feedback if modifications are recommended. During the submission, you are welcome to suggest that certain parts of your article, which either contains original ideas or detailed trading strategies, are not to be revealed to generic readers but only to subscribers. Otherwise, we might publish a random, limited part of your article after a certain point, and hide the rest unless readers pay the subscription fee. The fee is to be paid in COMMs, an important use case of the token. If you prefer to publish your article with us in full without any contents hidden, please indicate as such explicitly upon submission as well.

To protect your right and to avoid others faking your identity for benefit claims, we must verify your ID (KYC) before publishing your article. It is however waived if you are an invited author (feel free to send us a request to invite you from the [submission form](#)); the article is submitted from a publicly verifiable (e.g. the one listed on your institution webpage) affiliation email address such as xxx@harvard.edu, xxx@bnl.gov, etc.; or the article is submitted from an email address that is verifiable through publications or CV online. We will email every author upon article acceptance. If you fail to respond or pass the KYC in two weeks, you are deemed not interested to publish with us. Those fail to verify his/her true identity consistently in claims will lose the case and all future benefits by default.

After being referenced in any allocated strategy, you automatically qualify as a partner and enjoy all partner benefits as outlined for all future publications. If your article is about a strategy, we very likely will invite you to co-manage the book with us and share a portion of management or incentive fees with you. The terms for loss of partnership apply if you stop contributing - at least one submission every two months, or actively co-manage the book if invited.

We will contact you if your article is accepted, and issue the COMMs two weeks after publication on our website and social media accounts. However, if plagiarism is reported and confirmed by our COMMunity over this period, we will cancel the compensation, announce it and permanently blacklist your submission.

Compensation starts at 1600, 1000, 600 COMMs a piece for 'Beta for Pros', 'Beta for Fun' and 'Crypto Insights' columns, respectively. The final amount is contingent on the quality scores from editors/reviewers, number of downloads, reader feedback, etc. We issue 50% more for every multilingual submission up to 200%. If your article is referenced by our strategy pool, we triple your reward and offer you a cut up to 50% of management or incentive fee (if applicable) earned by your strategy, contingent on the transparency, the importance and the quality of your publication and your participation in co-management. The multi-lingual bonus does not count as base in tripling. Please fill out the [submission form](#) and submit your work as source files (pdf, tex) in a zipped attachment. A step-by-step instruction for submission will be offered along your submission. We reserve the right to edit your work lightly, mostly for typesetting purposes. Moreover, we share half of subscription proceeds with all published authors annually. Please submit your work, share your insights and grow with us. Your cut will be proportional to your cumulative score of all publications on our site this year.

For strategy related publications, we offer 25% more COMMs for every out-of-sample performance update. We expect the frequency of updates between every two weeks to every two months, until six months after first submission or the strategy enters production pool, whichever is earlier. Update often and you will have a higher chance to get your strategy allocated or a higher percentage cut. If your strategy turns over faster than every two weeks, let us know upon submission and we will decide the best update frequency and compensation case by case. However, apply honor code and update the raw data only, no other changes allowed. If you revise or improve your published strategy, that's perfectly fine, we will accept and update the article on our website with same 25% remuneration in addition, but it is critical to tell us the nature of the update - is the strategy revised or not? Send us your updated submissions as titled 'submission update to Beta for Pros/Fun from [your name]: [article title] [publication link]. Strategy revised / NOT revised'.

The token reward is NOT intended to purchase the copyright, but only the right to publish and advertise your article on our website and on our social media accounts, and the right to support your research, which we cherish dearly and consider an honor. Distribution of knowledge is the highest form of neg-entropy production, as it aims to benefit the most. Your name or the original link on our site will be always provided along dissemination. The plots might be lightly watermarked with article link in protection of your copyright. If you publish the same work elsewhere later, all we require is to add this sentence to the beginning - 'This article is published on cryptosmartbeta.com'. We value your works and would like to endorse your effort if you authorize us the right to publish. And please do indicate upon submission explicitly if you elect to publish with us exclusively. We will compensate you 50% more COMMs (out of base, i.e. excluding multilingual versions or any other bonus)

as exclusiveness bonus. If you indicate as such but still publish the same article elsewhere, we reserve the right to cancel your future benefits.

Upon submission, please indicate if you are willing to supply data resulting from your strategy or analysis to our marketplace for subscription and the frequency to do so. We recommend weekly, monthly or quarterly. The subscription fee is low at the beginning and may increase as the number of subscribers grows. The data will be charged in USD or COMMs. All subscription fees pass through to the authors after 10% of operating costs. In the early phase and if applicable, we may use maillist to distribute periodic data subscriptions. If needed, we will seek to automate the process in user accounts. This way our investors can verify the out-of-sample performances themselves by point-in-time signal updates if they wish. It will be a strong track record for strategy quality.

All compensations proposed in the Whitepaper are by no means finalized. The actual numbers may be adjusted from the market price if applicable.

In summary, please submit [this form](#) (where all instructions are provided along the submission), or send your real name, position, title, account ID and web link (if adapted from your early posts/publications), along with the column to submit (Beta for Pros or Fun), if the article is exclusive for our website to publish, sections available for subscribers only (if any), keywords, a short abstract and personal ERC20 wallet address with the article. No exchange wallet address please. If you submit by email, please send to admin@cryptosmartbeta.com, with email titled 'submission to Beta for Fun from [your name]: [article title]'.

Please refer to Section [4.4.1](#) for a quick overview.

2.5 Campaigns

We have COMMenced several campaigns to initiate the project in the early phase, including the guest writer registration, COMMunity sticker contest, fantastic COMMs and where to find them, COMMunity survey, press release submission, mini games, quiz contests and random rain drops. Some of them are still ongoing, and many more will come. Stay tuned.

Some of these events might extend into long-term efforts. Please refer to Section [4.4.1](#) for a high-level summary.

2.5.1 Quality Content Award

We compensate 640, 400, 240 COMMs for selected, unpublished submissions to 'Beta for Pros', 'Beta for Fun', 'Crypto Insights', respectively. You are welcome to publish your work in any social media or publication channels, as long as it states 'This article received the Quality Content Award from cryptosmartbeta.com.' at the beginning of your work. This program covers more than crypto analysis. All informative articles in finance and economics are welcome to apply.

2.5.2 Publication endorsement

For a limited time only, if your crypto analysis is accepted by other journals, or is being posted on an open academic knowledge base, such as SSRN, ArXiv, etc. within the past half year, please send us the link and we will consider them for publication equally provided there is no copyright issue. Peer reviewed articles usually have a higher chance to be published. Older ones could be published too if the content is really impressive. We will verify your identity in the same way as for other publications. Same waivers apply here too.

2.5.3 Article Support Program

We support selected authors to publish articles in any publication channels as s/he wishes. Please fill [the form](#) if you would like to apply. Contingent on the article nature, we compensate 520, 320, 200 COMMs, for contents suiting three columns, respectively, and the author is required to make the following statement 'This article is supported by cryptosmartbeta.com.' at the beginning of the article if it's being posted on a publication channel or on social media. The support statement should stay with the article permanently except in the case of force majeure. We reserve the right to cancel the author's future benefits if it is removed purposefully.

Your work needn't be quantitative as long as it is informative. The support program covers articles on other financial instruments too, as long as they are posted with the correct statement and meet the qualifications - well written and informative (1000 words at least). Limited 3 articles per week per person. Links or snapshots must show timestamps. Please send us your article links (or snapshots with timestamp), your real name and ERC20 address once you accumulate over 5 articles. You can email us at admin@cryptosmartbeta.com with the following title 'article support program claim from [your name]'. Or simply fill out [this form](#) to claim COMMs. We will verify your links and issue the rewards to the first email claiming these articles, which should be undoubtedly the real author if you exercise caution. Please allow a week for us to process the claim.

2.6 Active openings and quests

The following outlines openings we are looking to fill. We welcome all applications and look forward to hearing back from our COMMunity. We do our best to reply, but if you don't hear back from us in a month, please presume your application is declined.

2.6.1 Article translation

The compensation starts at 300 COMMs a piece, stackable on any different language. However, please contact us first with an estimated time of arrival (ETA), and make sure nobody else is working on it. If you can't meet the deadline, please notify us 3 days in advance at least, or we may reallocate the job to someone else. If you feel an existing article need be polished in wording, please do let us know and we will compensate your work accordingly.

2.6.2 Co-authorship

We have good insights on the crypto market and will publish as the articles finish. However, our time is quite limited. We invite you to coauthor with us. In general, we expect your contribution beyond 75%. Also, as our resources are limited, we can only collaborate with a limited number of authors at a time. The openings are competitive, limited and per-article based.

There are benefits to co-author with us. We own a professional, industrial grade crypto simulator and are capable to do most heavy-liftings in smart beta and alpha construction. The only constraint - our library is proprietary, and we can't share the code with you. But the performance numbers are easy to reproduce and we are happy to offer consultancy and assistance if needed. We are happy to offer help in data acquisition and universal access/instructions to crypto knowledge. Please do feel free to ask us anything. If needed, we will open up a new FAQ session on our website for pedagogical purposes. We will offer time series data (OHLCV, cap) over thousands of cryptos in one zipped file upon request. As for data analysis, the recommended programming languages is Python, R or C++ if you wish. We will do our best to help if technical assistance is requested.

If you are a junior in this area, we could help you decide a subject that aligns with your background and interests, and guide you throughout the composition process, including but not limited to title, word flow, plotting, programming, data analysis and quantitative research. This may only happen in the early phase of the project. The coauthored articles have higher chances to publishing or referencing. The attribution in co-authorship benefits (remuneration, management fee cuts, etc.) will be discussed case by case based on contributions. To improve the publication rate and maximize efficiency, please feel free to tell us the subject you are going to study if you wish. We will let you know if there is a potential conflict, or suggest collaborators to co-author as appropriate.

We do not publish articles that are highly correlated or similar on site. Please fill out the [contact form](#), attach your CV and propose a few concrete subjects you are good at if you are interested to co-author. If you reach us by email directly, please title it as 'applying for co-authorship from [your name]'

2.6.3 Article review

We are looking for experts in coding, data analysis and quantitative disciplines including math, physics, statistics, finance, etc. to serve on the COMMITTEE. A COMMITTEE member is responsible to confirm the originality, review and suggest 0-10 quantitative articles to be published weekly per column, with a quality score (0-100), confidence score (0-100) and COMMENTS. Please normalize your quality score, as they are expected to be relative and roughly satisfy the Gaussian distribution. The revision suggestions are not required. If you do not recommend an article and feel the quality score and confidence score fully state your opinions, feel free to do so. Compensation starts at 400, 240 and 160 COMMs for each successful publication in 'Beta for Pros', 'Beta for Fun' and 'Crypto Insights' columns, respectively. Should any copyright claims arise, the COMMITTEE is responsible to decide an

appropriate resolution. Please fill out the [contact form](#) with your CV attached, or send an email to admin@cryptosmartbeta.com to apply. If you apply by email, please use the title 'applying for reviewer from [your name]'.

2.6.4 Editor openings

We are actively looking to form an editorial board, whose key responsibility is to promote scholarship in crypto analysis associated with Crypto Commonwealth, whilst also promoting our website as the best site to publish in. The openings are limited and highly competitive. You may increase your chance by reviewing a few articles with us before you apply.

An editor is responsible to select 3 reviewers for each article worthy of review, collect feedback, COMMunicate with the authors and make the final decision. The compensation is 400 / 240 / 160 COMMs for three columns, respectively, the same as article review. We publish 0-2 articles per column per business day. Please fill out the [contact form](#) or send your CV to admin@cryptosmartbeta.com to apply, with email titling 'applying for editor from [your name]'.

2.6.5 Partnership program

The partnership program is our peculiar way to look for partners. We can never overemphasize the importance of independent thinking, knowledge distribution and publication. We want to hear your insights on the market. We are looking for quantitative people alike. The best way to COMMunicate with the brightest minds in this world is to publish and let your voice be heard. All our partners will receive an additional percentage of tokens from the foundation, to be decided on a discretionary basis depending on the nature of your contribution. The natures of partnership include but are not limited to: administrator, publisher, reviewer, researcher, trader and portfolio manager. Bonus rewards in each category only applies within that scope. However, one can obtain partnerships of multiple natures. Long-term, high-quality contributors will enjoy higher cuts. All tokens acquired from the partnership program will lock within the foundation pool and release 20% per year. To qualify for the partnership program, please keep contributing to our project and document all accomplishments and timestamps. Your efforts will be recognized and compensated.

We will open up the partnership application in two months after COMMencing the publisher project. We cordially invite you to participate in quests actively and apply. We do review all applications, but the availability will be highly limited, please lower your expectations. Your existing contributions are retroactive and qualify for the partnership bonus too.

Please note there are circumstances when one loses the partner status: if a partner stops contributing to the project for over 2 months of certain nature, s/he will lose the partner status therein automatically. Any further contributions will not receive the partnership bonus, unless you reapply and are deemed qualified again. However, the locked tokens remain unaffected and will still be released as planned.

2.6.6 Crypto book co-management

If a good number of your strategies are referenced, selected into production and allocated, we will invite you to co-manage the book with us. If you accept, your main responsibilities are to generate quantitative signals, update the positions and P&Ls in a timely, predefined manner, and possibly to execute orders. You can elect not to expose your positions to the public, but the investors may likely favor more transparency when they allocate assets. However, we as co-manager need your positions to confirm your P&L. Your P&Ls shall be public and updated on a weekly basis. We will observe your paper trade results out-of-sample routinely. If they pass our criteria, we will start asset allocation on your book. The only way to earn 50% cut in management fee is to participate fully along our investment processes.

2.6.7 Website development

We are looking for developers to construct a subscription / voting system for articles, strategy allocation system (using COMM and BTC), and possibly a lightweight marketplace for COMM and BTC conversion, either OTC or exchange API, with account management and order book support. The compensation is in COMMs and negotiable. Please fill out the [contact form](#) and attach your CV or email admin@cryptosmartbeta.com to apply, titling 'applying for developer from [your name]'.

3 An overview of the investing, funding and research platform

Crypto Commonwealth is both a scientific publisher and investing, funding and research platform on Blockchain that seeks to fundamentally improve the traditional economic model. The Commonwealth Foundation ('the Foundation', 'Commonwealth Publisher' or 'the Publisher') relies on its strategic partners - a number of partnering professional funds (collectively 'the Funds') in asset management. And as the ecosystem develops, the Funds grow and may become exclusively available for COMM holders one day as they reach capacity. We would like to collaborate with all interested contributors in strategy research / alpha mining, content mining and knowledge distribution, and share our proceeds from asset allocation, article subscription and publishing with all authors, researchers, portfolio managers, token holders and investors.

The Funds take over the positions for trade execution, P&L generation / consolidation, auditing and net asset value (NAV) reporting (if applicable). They endeavor to seek value out of tens to hundreds of financial instruments by systematic asset allocation, and trade at relatively low turnover for a potential excess return above the market. They COMMit trades in multiple trustworthy prime brokers or crypto exchanges with good volumes and segregated vaults if applicable. The Funds manage distinct strategies, each of which employs independent auditing and NAV reports (if applicable). Different fee structures apply. We may adjust these fees in future as their assets under management (AUM), capacities and P&Ls evolve.

The Foundation is responsible for the daily operation of the publisher and the peer-reviewed journal. The ultimate goal is to make the journal as profitable as renowned scientific publishing companies like Springer and Elsevier, but distribute 100% net profit back to the authors, editors and reviewers, and support the long-term operation of the nonprofit Commonwealth Foundation. We issue a cryptocurrency, design rich tokenomics to promote its use and circulation, and distribute the token to all contributors for our journal in a good way to encourage excellent publications. Eventually, we hope to compensate all scholars by the quality of their work with research grants and/or remunerations so that more smart people stay in academia.

3.1 The Commonwealth asset managing partnership structure

Table 1 gives a high-level performance and structure summary of these funds. With greater risk comes greater return. When we bring the fund capacity in play, they form an trilemma - it is only possible to achieve at most two of the following three goals: high return, low risk and high capacity, see Fig. 2. Given the fact that the information ratio (IR) is defined as the return over unit risk, the rule also indicates that a high IR strategy only accommodates a limited capacity and vice versa. The return, risk and capacity levels in Table 1 follow the triangle.

The primary ways to invest in any of these funds are to invest directly if your investment is over the equivalent of \$100,000 in USD or 1% of our market capitalization ('Direct Investment'), whichever is greater, or to purchase the ERC20 token we issue, 'Commonwealth'

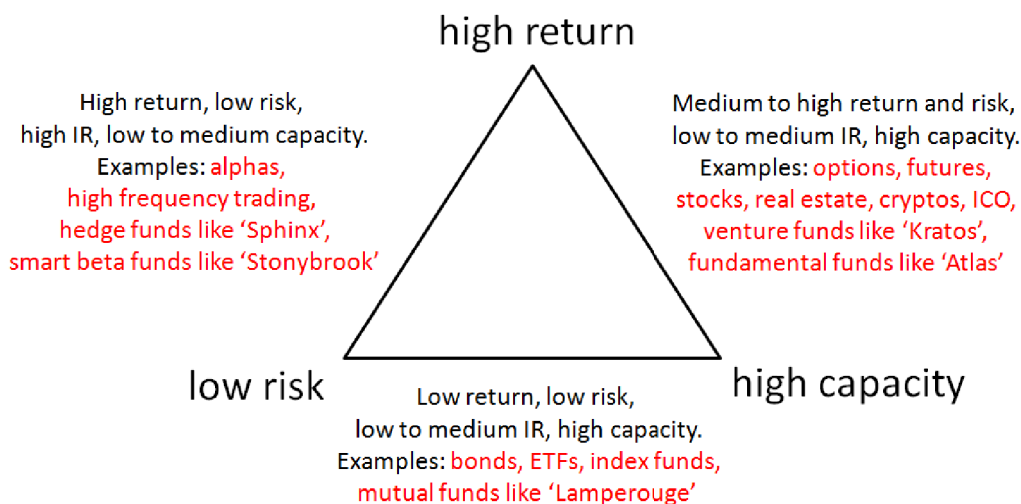


Figure 2. The trilemma in portfolio management.

style	return	risk	capacity	mgmt. fee	incentive fee	lock-up	notice
Smart Beta	medium	medium	medium	1%	10%	2 months	1 month
Hedge Fund	high	low	low	2%	20%	2 months	1 month
Long/short	medium	medium	medium	1%	10%	2 months	1 month
Passive	low	low	high	2%	0	2 months	1 month
Venture	high	high	high	5% one-time	0	2 years	N/A

Table 1. Suggested partnering fund structure summary. The fees and lock lengths may be decided case-by-case, and subject to change as the fund AUM, performance and capacity evolve.

(or 'COMM', 'the Token') at the latest price ('Token Investment'), either predefined over-the-counter (OTC) via our Initial Coin Offering (see Section 4.1 for details) or from other token holders. We will continue to conduct private or public sales for fundraising as the ecosystem grows. Section 4 introduces the Commonwealth tokenomics in great details. A token holder can lock the COMMs to the funds one would like to invest in and allocate assets up to the corresponding investing rights therein. Each COMM represents the right to invest the equivalent of \$1 (1 USD) in fiat or BTC with us.

The Funds allocate the assets from Direct Investments accordingly and accept redemption after fees. The fees would be accessed either quarterly or annually ('the Billing Period') at the investor's discretion upon signing the investment agreement. All investors can withdraw up to the latest account balance after the initial lock-up period and up to once per month, see Table 1. A withdrawal can be made with a 30-day notice in advance. The clients understand that the liquidation of investments may result in certain market impacts and requires a notice in advance. A shorter notice incurs an additional 15% charge on the amount requested at the minimum. The fees would be accessed upon redemption and at the end of every Billing Period. The cumulative balance will be reinvested by default until fully withdrawn. If an investor would like to invest more than the initial account balance, more COMMs may be required to lock into the fund to escalate the investing rights. In case of

redemption, The COMMs will be returned upon withdrawal in proportion to the redemption out of the initial investment until depleted. Some funds may charge a percentage of COMMs upon redemption. You are welcome to deposit COMMs or withdraw unlocked COMMs to/from your investment account any time. If the outstanding locked COMM balance is unable to cover the right to reinvest the latest digital asset balance under management, the Funds will automatically purchase missing COMMs with the investment by default at the best price, and lock into the corresponding funds before the next investment period begins, unless the investor specifically opts out of this option, in which case we leave the profit uninvested by default.

On the other hand, the Token Investments are not directly redeemable (except by selling COMMs) and would be allocated to the portfolios at the manager's best discretion, access profit ('the Profit') and maximize the long-term growth of the Ecosystem. Note bitcoin alone carries 86% annual volatility and 80% maximal drawdown (see Appendix A), whereas the rest of crypto market is usually much more volatile except the stable coins. We will do our best to stabilize the continuous growth of the Ecosystem via prudent investment and active or semi-active asset management to our best discretion. The Profit is expected to persist in both the bull and bear markets, and our growth is expected to be smoother than the bitcoin project. The Token Investment would be ideal for small investors, whose value relies predominantly on the quality of our publications, website traffic and popularity, costs and fees. As our ecosystem and performance grow and establish consensus and confidence in public, we expect the token to be more and more widely used.

We publish selected smart beta strategies at good transparency, and may offer signal subscription for out-of-sample verification before live trading. Aside from that, we do have more and better ideas, and are happy to share our market insights with our internal quantitative researchers, and in many cases the readers and investors along our research process. High-quality publications on smart betas or alphas do raise the bar in competition, but we embrace challenges and have been comfortable in a highly competitive market environment for many years.

There are two kinds of fund managers: those that trade to win the zero-sum game, and those that bet on the future of humanity. We have a strong background in the traditional markets, and it is attractive to establish a different business pattern in an emerging and vibrant market like cryptos. We are happy to start by publishing our insights on the market including smart beta based strategies, and welcome interested readers, scholars, researchers, portfolio managers and funds to join or partner with us.

As more independent strategies or partner funds become available in the Ecosystem, we intend to tokenize the best of them with well-designed token economics. The Commonwealth Foundation will support these tokenization endeavors and make sure all tokens and projects are compliant and properly regulated. We will convert the COMM token into a public or consortium chain and assist our subsidiaries and partners - the publisher, the funds, and all COMMunity participants, especially the scholars to issue their own tokens at

ease on chain. We are COMMITTED to consulting for these projects, and will fund or incubate the best of them in tokenomics design and COMMercialization (if applicable). This is one of our most important missions - to advance fundamental research in multiple frontiers and build a safe, just, open-source digital world with the Blockchain technology. We are glad, proud and capable to be of service as we are well connected with varied resources in the crypto industry.

3.2 Risk factors related

The investments especially on crypto markets will suffer from high volatility and great risks. Published and proven past record is NOT indicative of future performance.

The success of the funds depends upon the investment managers and trading / research team's efforts, experience and skills to allocate assets appropriately. The loss of any such individual could have a material, adverse effect on the fund, and such loss could occur any time due to death, disability, divorce, resignation or other reasons.

For cost saving and practical purposes the Funds store most or all of their crypto positions in the exchange accounts. However, if they happen to hold a large amount of BTC, ETH or any major cryptos for an extended period, they will transfer most of them to our cold wallets for storage. The Funds select exchanges to trade with at our best discretion and due diligence. They usually offer cold, segregated vaults for a majority of crypto holdings. However, there is a chance that these exchange accounts suffer monetary loss from thefts, cyber attacks, C2C transactions or similar incidents. We are not responsible for such losses.

The Funds are partially centralized as any other funds. Our token (COMM) serves as a means to allocate investing rights, to store and transfer value, and to facilitate our daily operations especially in the early phase. However, it is critical for you to understand that these tokens are technically decentralized, but operationally centralized in mining mechanisms, distribution rules, fund management, etc. Certain risks are involved.

The information on the Website and the Whitepaper is intended to enable investors to understand the nature of our investments or to serve educational purposes. It is not intended as and does not constitute investment advice or legal or tax advice or an offer to sell any cryptos to any person or a solicitation of any person or any offer to purchase any cryptos.

The COMM compensations referred to on the Website or in the Whitepaper serve as suggestions and are by no means the final payment amounts. The COMMunity rewards may be contingent on multiple factors including complexity, quality of the work and the bounty pool if/when applicable. Whenever there is a conflict between the Website, WP and an announcement, the latest one shall prevail. Please seek the most up-to-date information from the COMM team or any COMMunity managers.

Certain statements in the Whitepaper constitute forward-looking statements. When used in the Whitepaper, the words 'may', 'will', 'should', 'project', 'anticipate', 'believe', 'estimate', 'intend', 'expect', 'continue', and similar expressions or the negatives thereof are generally intended to identify forward-looking statements. Such forward-looking statements, including the intended actions and performance objectives of the Company, involve known and unknown risks, uncertainties, and other important factors that could cause the actual results, performance, or achievements of the Company in its operation and development of the COMM Network to differ materially from any future results, performance, or achievements expressed or implied by such forward-looking statements. No representation or warranty is made as to future performance or such forward-looking statements. All forward-looking statements in the Whitepaper speak only as of the date hereof. We will do our best to operate transparently, but the Commonwealth Foundation and the Ecosystem expressly disclaim any obligation or undertaking to disseminate any updates or revisions to any forward-looking statements contained herein to reflect any change in its expectations with regard thereto or any change in events, conditions, or circumstances on which any such statement is based.

Please consult us via [email](#) or [Telegram](#), and seek a full disclosure of risks in our Private Placement Offering Memorandum ('PPM') if you would like to become a large investor to the Funds or private sale investor to the Token.

3.3 Opportunities to join us as researchers, portfolio managers or partner funds

Just like one arrow, the power of just one person can easily be overcome. However, three arrows together cannot be destroyed. Human strength is the same as these arrows; we cannot be defeated if we work together.

- Mōri Motonari, Japanese folk tale 'The Lesson of Three Arrows'

We are actively developing a Python based backtesting platform for internal researchers to test and submit strategies with consolidated or exchange specific data. In the long run, we will open access to the platform, initiate coding and modeling competitions in major universities and invite the top performers to work with us as contractual quantitative researchers. The top researchers will receive invitations from us to work as portfolio managers (PM) and participate further in portfolio constructions and optimizations. We will promote the top portfolio managers to standalone fund managers if they wish, and assist them to open their own funds or tokenize their strategies. Each promotion requires outstanding performance out-of-sample for a considerable amount of time, usually in a matter of several years but contingent on one's performance as an employee as well. The better the performance, the sooner one draws our attention. Moreover, we give higher priorities to scholars that publish high-quality articles with us or other journals and trade well. Everything else equal, the published researchers or PMs access higher cuts too.

We share a generous percentage of profit ('the cut') with all trading model contributors. There are two ways to contribute strategies to the Crypto Commonwealth investment system: internally or independently. An internal researcher ('book researcher') is expected to run backtests on the platform and submit alphas for centralized post-processing, including but not limited to portfolio combination and optimization. Upon proper evaluation, a certain amount of COMMs will be paid out as a reward, with a significant amount to be followed pending the alpha performance out-of-sample and in live trading. See Section 4.4.1 for more alpha mining details. If the alphas a researcher submits are deemed tradable and enter production, we share up to a quarter of total incentive fees accrued out of the allocated capital to that strategy, which is tracked and attributed actively and internally. All alphas are required to access stable returns above bitcoin. An internal portfolio manager ('book PM') accesses the cut from his/her alphas in production, plus up to a quarter of incentive fees accrued from the combined portfolio ('combo'). However, the cut from all existing alphas or combos decays by a percentage per year until 0. All strategies decay and eventually vanish, it is therefore of utmost importance for a fund to keep developing new alphas on novel ideas.

We are a fund incubator as well. An independent portfolio manager ('IPM', i.e. one that does not submit strategies but manages and generates daily portfolios on his/her own) gets a discretionary cut, but loses all former benefits (if any) as an internal researcher or portfolio manager (if applicable). They are welcome to use our backtesting platform for backtesting purposes. As long as there is no submission, your code is protected, unexposed and fully confidential at your own discretion. Moreover, we welcome external crypto funds to join us directly, new or established. The new funds can only manage capital from us during the incubation period. The benefit sharing percentage is contingent on the fund performance, capacity and credibility, up to 100% for independent and strong funds, to be discussed on a discretionary basis. We are glad to offer consultation and assistance if an IPM intends to tokenize his/her portfolio.

Furthermore, we have a strong background in global stock markets, have amassed a good number of lowly correlated equity strategies at our disposal and will seek to tokenize them when the time is right. The ecosystem will eventually embrace strategies of all financial markets - commodities, futures, stocks, currencies, bonds and cryptos. We are a pioneer in strategy tokenization and will invite portfolio managers across multiple markets to participate in our ecosystem. The COMM token will serve as the public or consortium chain for all token issuance and transactions, similar to ethereum as of all ether-based crypto issuances.

4 The Commonwealth tokenomics

The token we issue, 'Commonwealth' (or 'COMM' for short) is the absolute, irreplaceable and undisputed right to participate in our subscription, circulation and investment ecosystem, and we expect this right to be widely held and executed as we progress into higher stages of our roadmap, which we present in Section 5 at length.

The total supply of Commonwealth is 1 billion, which was deployed as an ERC20 token with an audited [smart contract](#). The token distribution is shown in Fig. 3. 20% is reserved for the team, locked into an audited [vesting smart contract](#) in its entirety irrevocably, and to be released linearly over the course of 5 years. 30% is owned by the foundation pool and reserved for ecosystem operations, alpha and content mining in particular. 50% is available for sales in tiers. The tokenomics development, web traffic, user activity and participation, the quality of our publications, main net design, subproject expansion, investment performance and COMMunity contribution are the key drivers to the growth of the Ecosystem. We will offer contributors and prospective investors opportunities to acquire COMMs in full compliance with local laws, policies and regulations.

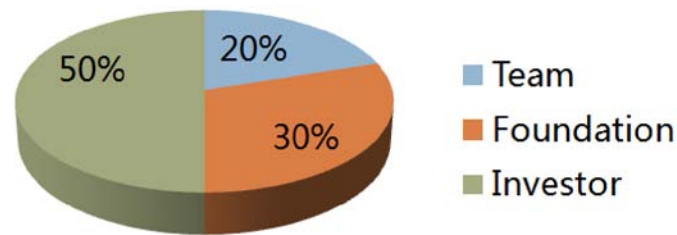


Figure 3. The token distribution.

4.1 Initial Coin Offering

4.1.1 Overview

Initial Coin Offering, or ICO, has emerged as a popular option for fundraising, especially among Blockchain-based projects. During an ICO event, the project distributes tokens to the public worldwide, and raises initial funds to grow its digital ecosystem, promote the token use and consolidate its circulation.

The first round of the Commonwealth ICO started at cryptocommonwealth.co on March 1st, 2020. More tokens will be available for sale later as the project progresses. COMM has been listed on [IMOEX](#) and [ChainX](#). The presale round was over, and the first round of public sale in this series of ICO is conducted with varied discounts off the market price. The sales will end when the investment hits the hard cap or whenever we deem appropriate. Bitcoin, Ether and USDT (ERC20) purchases are welcome and accepted.

Our ICO process desires KYC and is fully compliant with SEC Regulations D and S. The purchaser represents and warrants that he/she is not a citizen or resident, or otherwise subject to the Laws, of any jurisdiction in which the offer, sale, purchase, or transfer of

SAFTs or Tokens is not permitted by applicable Laws, in any and all respects. Furthermore, no U.S. investors will be allowed to participate in this sale, nor will investors from any country on the OFAC sanctions list, including Balkans, Belarus, Burma, Cote D'Ivoire (Ivory Coast), Cuba, Democratic Republic of Congo, Iran, Iraq, Liberia, North Korea, Sudan, Syria, and Zimbabwe. This sale is being offered in an offshore transaction as defined in Regulation S and to foreign investors in the Regulation S safe harbor. U.S. investors could invest only in the Regulation D 506(c) private sale for accredited investors via a SAFT with a 1-year holding period for the COMM tokens. Any and all investments from U.S. persons are disabled during this round of ICO. Any interested U.S. investors should seek a case-by-case discussion in another time with us.

Moreover, all our core employees and decision makers are requested to disclose all their COMM addresses for close monitoring. Insider trading as is defined by SEC regulations is strictly prohibited, including but not limited to Securities Exchange Act of 1933 and 1934, Form 3-5, Rule 10b-5. Violation of the prohibition on insider trading can result in termination of employment, a prison sentence and civil and criminal fines for the individuals who commit the violation.

The cryptocurrency issuer, Commonwealth Foundation Ltd. is fully regulated as a Public Company Limited Guaranteed (CLG) , by definition a nonprofit registered under the Accounting and Corporate Regulatory Authority of Company (ACRA) and governed by the Singapore Companies Act. The Foundation carries out non-profit-making activities that have basis of national or public interest.

4.1.2 The lock structure in the public sale - the making of CBND

We designed a decentralized novel financial product to facilitate the sales of its natural token, COMM with varied lock periods. It is expected to improve COMM's liquidity and locking transparency. The original version of this derivative was named as if it was an option or futures product, but soon it became clear after we consulted a senior derivative quant and advisor from investment banking - the name is Bond, COMM's Bond!

Typical IPOs and ICOs often come with lock periods, during which the shares or tokens distributed are not tradable. This secures the funds for project development, yet reduces the investment liquidity and strongly restricts the ways investors manage their risks.

A bridge between initial funding and listing, CBND or 'C Bond' is COMM's Bond, and world's first convertible crypto bond aiming for a solution to this dilemma. It shares certain features in COMMON with convertible bond in the traditional financial market, but with significant simplifications. It is expected to improve COMM's liquidity and locking transparency for its ICO. The token sale is essentially on the crypto underlying, COMM. Unlike typical ICOs, investors would receive tradable CBNDs while having the same amount of COMMs locked. When the lock period is over, 1:1 and one-way redemption would be offered to convert each CBND to COMM, the main token. All redeemed CBNDs would be burnt immediately, leaving the token in scarcity. The remaining and circulating CBNDs in the market, if any, would share the same tokenomics with COMM and continue to persist.

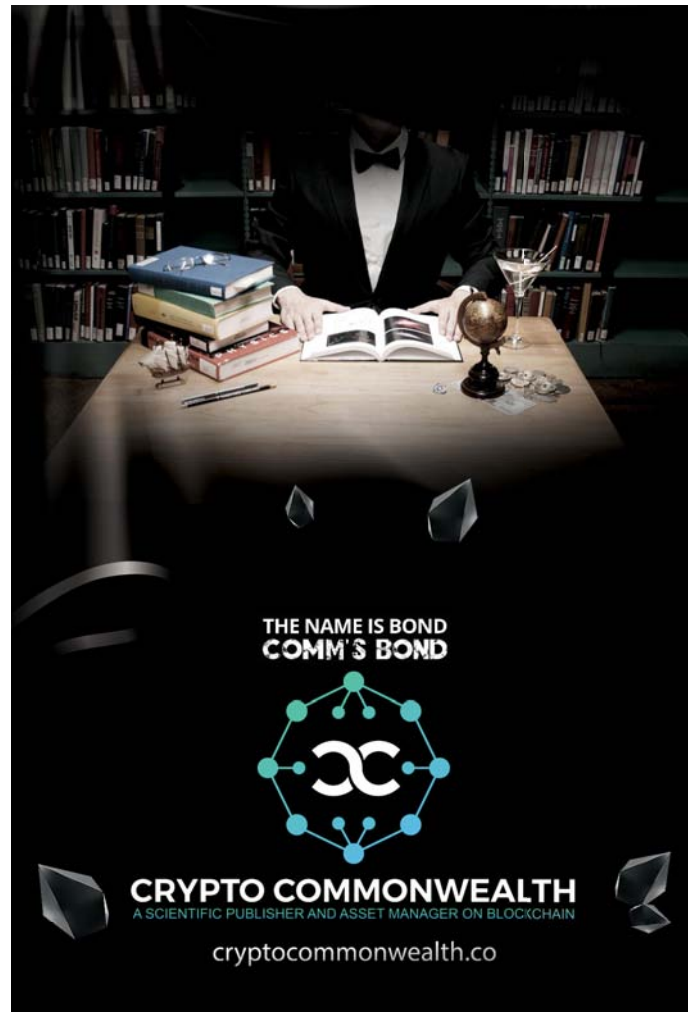


Figure 4. CBND - world's first convertible crypto bond.

There are 6 major stages, each to last 5 days, with tokens sold at varied discounts of the market price. Stages 1 and 2 offer [CBND6](#) (lock period six months) on sale, Stages 3 and 4 offer [CBND3](#) (lock period three months), and Stages 5, 6 offer [CBND](#) (lock period one month). The first five stages offer token bonuses at 10%, 8%, 6%, 4%, and 2% on top of purchase amounts, respectively. Meanwhile, Initial Exchange Offering (IEO) will run in sync on crypto exchanges, including [ChainX](#) (ETH accepted), and potentially 1-2 more exchanges of note. The token bonuses will be however exclusively available on [cryptocommonwealth.co](#) only. The CBNDs will be listed after all stages of ICO/IEO.

Private and institutional investors are welcome to contact us via [email](#) or [Telegram](#) directly for private placement at more customized lock periods with varied discounted prices, to be discussed on a case-by-case basis.

4.2 Technical details

*Remember the young days in the past
Everyone was sincere and honest
People meant what they said*

*Early morning at the train station
Long, dark and empty was the street
The soy milk diner unfurled steam and heat*

*Days were slower in the past
Carts, horses, and mails did not reach fast
A lifetime was barely enough to love the person that is right*

*The locks were fine too in the past
With keys exquisite and fit
You locked it, and people honored it*

- Muxin, *Slower Days In The Past*

COMM is an ethereum based token supported by all ERC20 compatible wallets, including but not limited to MyEtherWallet, MetaMask, imToken, TREZOR, Ledger, Mist, etc. It is a digital asset fit for store and transfer of value, and inherits multiple advantages from an ethereum based infrastructure. As one of the ERC20 family members, COMM carries good liquidity and can be easily interchanged with any other ERC20 tokens, as they use a COMMON set of protocols and technical guidelines. It is secure and compliant to all local laws and regulations wherever used.

The ethereum block creation time is between 10-20 seconds and adjusted dynamically on a PoW (Proof of Work) based mining difficulty, which is expected to migrate to a PoS (Proof of Stake) algorithm in future. The transaction is fast and will evolve as the ethereum network acquires a higher TPS. Moreover, ethereum smart contracts enable transparent and secure ways to achieve various goals among the token holders. The programming language 'Solidity' is Turing-complete, allowing calculations of all computable problems given enough time and memory. All token transfers require an amount of 'gas' payment evaluated in ETH. A program aborts if it runs out of gas, which prevents infinite loops and avoids potential Denial of Service (DoS) attacks.

CertiK, a renowned auditor thoroughly reviewed our code base, and concluded in their [report](#) that 'we believe these smart contracts pass security qualification to be listed on digital asset exchanges'. They conducted over 200 audits, reviewed the code for major crypto entities like Binance Labs, NEO and ONTology, and have secured over 5 billion USD assets on Blockchain.

4.3 COMM's dedicated main net

COMM is an ERC20 token, and as ETH stays up-to-date on the roadmap to solve the DCS Trilemma, we enjoy the benefits too. Meanwhile, as our Blockchain development team evolves, we will eventually convert our token into a standalone public or consortium chain, and enable text or file storage on a decentralized and distributed network with significant advantages over typical cloud-storage solutions. Since we are not a high frequency shop and do not plan to support high frequency trading on COMMs, transaction speed does not concern us, but miner charges (transfer fees) might. In the case of a full migration, we will announce well in advance and offer detailed mapping guidance or tools for our token holders. If public chain turns out to be a better option, we may allocate some tokens from the investor's pool or foundation pool as mining rewards.

We are actively designing and developing our own main net, which absorbs major advantages of best crypto projects and will support text or file storage too. In the future, all issuance of new strategies, standalone and copyrighted materials such as books and publications will be based on the COMM main net.

COMM's main net will support issuance of new tokens at ease, and incubate the best of them for fundraising and COMMercialization. We invite distinguished portfolio managers to host their strategies with us. And we already own many good strategies across global instruments to tokenize. Moreover, we have several books scheduled for publication with the COMM ecosystem, and will invite excellent authors to publish their books or preprints, raise initial funds and prepare for massive dissemination. All these subprojects will be based on the COMM main net, or migrated to it eventually.

The fundraising of subprojects in COMM may start via smart contract before the main net goes online. This could be released sooner as the first step of the main net development. COMM would be strongly desired as its subprojects grow and thrive.

4.4 An ecosystem with global payment network

COMM will be highly sought in our subscription, circulation and investment ecosystem. The COMM tokenomics is mainly three-fold: the compensation to assist our publishing operations and research, the right to invest in any subsidiary funds and receive excess returns, and the vehicle to load application scenarios from our investment and publishing endeavors. The COMM holders have the priority to invest up to the corresponding investing threshold in our strategies. If additional capacity is available, large investors may invest without token purchase too, and may receive a discretionary fee discount if they still lock a percentage of COMMs with us. A strategy contributor may also receive additional COMMs if his/her strategy approaches maximal capacity and requires a book building process to decide who is to invest. Metcalfe's law states that the value of a teleCOMMunications network is proportional to the square of the number of connected users of the system (n^2). Our international payment grid would keep acquiring users and traffic as there are solid use cases and genuine needs to obtain the Token.

4.4.1 COMM as the compensation for alpha and content mining

Our backtesting platform is under active construction and expected to finish in Q1-Q2 2020. It offers an industrial grade crypto simulator for researchers and PMs to implement and test Python based strategies at daily and intraday levels for several years, and on data from several major crypto exchanges. We will handle most technical infrastructures including but not limited to major data science driven module support, data cleanse and update, P&L calculation / plotting and performance evaluation, typical alpha operations and auxiliary functions. The platform enables quantitative researchers to focus most of his/her time on alpha modeling. We review all alpha submissions and decide if they are potentially profitable out-of-sample for asset allocation. The COMM compensations on alpha submissions are similar to those of the publications in our 'Beta for Pros' column, but highly contingent on multiple performance metrics, including IR, returns, risks, turnover, relative rank and many more, both in-sample and out-of-sample. Researchers are welcome to refer to any publications as the idea source upon submissions. We will compensate the article authors additional COMMs too for their hard work if the publications are on our website. One can also specify multiple authors and their percentage contributions upon alpha submission accordingly - they will split the compensation accordingly.

Furthermore, we welcome original article submissions on quantitative crypto analysis, token economics, consensus philosophy, and are actively expanding our crypto knowledge base. The compensation is also paid in COMMs, contingent on article quality and reader response. 50% bonus applies to every multilingual version, cumulative up to 200%. If your published article is referenced by our strategy pool in production, we triple your reward. We issue 25% more for every multilingual submission up to 200%, see Section 2.4 for details. Moreover, high quality research opinions matter and readers could still benefit from your methodology even unpublished on our website. Aside from all published submissions, we compensate selected, unpublished works as well. The amount is contingent on article quality and review response, and the terms are explained in Section 2.5 at length.

We also welcome article translation if the original author did not submit multilingual versions. The reward starts 300 COMMs each, contingent on the length and quality of the translation. See Table 2 and 3 for a summary of the compensations with our long-term and short-term programs. Furthermore, we may need help in administrative mandates from time to time. We will post the tasks on our quests page / forum as they arise, or invite past collaborators to participate. In case of multiple qualified applicants, contributors with strong records will have priority, otherwise be decided on a first-come-first-serve basis.

We offer an additional percentage bonus for authors with multiple publications. Every publication increases the author-specific bonus by a percentage, as is shown in the 'bonus' column of Table 2. New bonus tier becomes effective every time 5% threshold is reached, such as 5%, 10%, etc. The bonus compensations are stackable and permanent for 'Beta for Pros' and 'Beta for Fun' authors. For the 'Crypto Insights' column, 1 submission is required every two months to maintain the bonus tier, otherwise the accumulated percentage will

reboot. These rules are effective for a year upon launch of our publishing branch and subject to change later.

4.4.2 COMM as the right to invest

When we bring the strategies online and COMMence capital allocation, each COMM represents the right to invest the equivalent of \$1 (one US dollar) in our partner funds for small investors (investment less than 1% market cap). It is required to lock corresponding number of COMMs into the book to invest BTC, which are to be returned in proportion upon withdrawals and after fees. However, if you are a large investor (defined as investment size greater than 1% market cap), feel free to contact us directly via our investor portal. You can invest BTC or fiat currencies directly if you wish and if there is capacity, but we may offer a discount in fees if you elect to lock a percentage of COMMs with us. Note we always offer investment priority to token lockers if the capacity is limited. The discount on fees, if applicable, is to be discussed on a discretionary basis. We accommodate accredited investors the same way as a traditional fund to stay competitive in this industry, or we risk losing some largest clients.

Large investors will NOT lose their status as our market cap grows, until they withdraw over 50% initial balance from us, upon which their investor status will be reevaluated with the Ecosystem's latest market cap. We reserve the right to enforce a maximal percentage allowance per withdrawal in future.

Our smart beta research may offer transparent strategy allocation, and as long as the crypto market keeps growing, we expect our smart beta and alpha strategies to outperform BTC. It is a proud tradition in the smart beta industry - maximal transparency and honesty lead to decent trust and a good book size under management. They go a long way. If you read our publications and would like to invest in any strategies as proposed, you are welcome to lock COMMs and invest in the corresponding books. If the strategy isn't available for trading yet, write to us or vote for it! We listen to our COMMunity and will take action to expedite the process, provided we as professionals think it has a potential to be profitable.

We will open a voting system for articles and strategies. When a strategy meets certain qualifications and enters the strategy pool, the COMMs voted to the referenced articles and strategies earlier will automatically transfer over and become your investment allowance. When the strategy amasses a certain number of votes or investing interests, we COMMence capital allocation, and voted COMMs would represent the max amount one could invest. If you see an opportunity in certain publications being referenced or traded, please lock your investment quota early, as the capacity of best strategies is usually highly limited. We will stop accepting investments as capacity approaches threshold, and your locked tokens prioritize your right to invest a certain amount of capital in that strategy.

Investor's interest is our utmost priority. All of our strategies are required to incubate for a while before live trading, this is a standard procedure for funds to decide the worthiness of any new ideas. The voting system on articles will serve merely as a reference, and by

column	publish	bonus	review	edit	translation*
Beta for Pros	1600	2.5%	400	400	500
Beta for Fun	1000	1.5%	240	240	400
Crypto Insights	600	1%	160	160	300

Table 2. The COMM compensations for long-term quests(temporary). * Translation compensation may vary depending on difficulty.

column	quality content award	article support program
Beta for Pros	640	520
Beta for Fun	400	320
Crypto Insights	240	200

Table 3. The COMM compensations for short-term quests(temporary).

no means a norm to its value or tradability. Any quick and bold approach, such as blind, unmanaged decentralization will compromise investor’s trust on us, hurt the business and ultimately the industry in the long run. Decentralization is NOT the elixir for everything and this is an example. We as experienced professionals use our best judgments to select and combine tradable strategies for investors. Even so, there is a chance any single strategy or fund stops working, in which case we may deCOMMISSION it and return all COMMs locked and investments left therein. An appropriate combination diversifies and mitigates the risk - never put all eggs in the same basket.

Our data marketplace offers subscription for data and limited publication contents if applicable. Some articles may contain limited contents available for purchase in COMMs. Since our criteria for strategies in production are high, most of them will stay in the out-of-sample testing zone for quite a while. We will design a way for our quantitative researchers, and possibly readers and investors to buy signals from popular authors before they enter production. A researcher can generate intermediate data with our backtesting platform and post it in the marketplace for sales too. All data purchases will be made in COMMs. The proceed passes through to the authors after a 10% service charge. For regulatory reasons, the public data sale (if applicable) stops once we pick the strategy into production for asset allocation. They will be retained solely for internal use.

If your strategy is transparent, sensible and potentially tradable, they might enter the production phase and become available for asset allocation. The platform will indicate as such, and the authors will get more COMMs in compensation and a cut contingent on the size of capital allocated and the live performance. Furthermore, collaboration is highly encouraged. Many of our strategies will have some article references from our publications; if several articles or authors contribute to the same strategy for some reason, we will split the cut among them by their importance, quality and contribution percentage. We encourage you to publish or submit your strategy with us early, as your percentage cut will be contingent on your performance, out-of-sample history and correlation against existing strategies.

There is a benefit to be transparent. Investors like transparency way more than secrecy. They are willing to invest much more if they know very well what is going on. The capacity is big enough anyway in many cases. This is why smart beta funds are the most popular in the stock market nowadays. You will probably benefit more in management fee with a bigger book size. Moreover, no strategy is profitable forever as the market becomes more efficient. Typical passive funds do not charge an incentive fee, and the risks pass through to the investors. They will be the ones to make the final decision which to trade, and you do not need to take risks managing a book on your own. That being said, we will rank all strategies, investigate different combinations and guide our investors to make the most informed decision in asset allocation. The investor's interest is always our utmost priority.

And even if you just point out an interesting direction to explore without giving away too much detail, we might still reference your paper and share a cut with you if you keep updating positions and P&L. Your contribution will be decided by both transparency and performance. You could request not to publish certain parts of your article if needed, we will follow your suggestion and honor all information you supply. Still, we expect a decent disclosure or introduction of the trading methodology if you aim for a cut with a publication being referenced.

We share up to 50% incentive fee with internal researchers and portfolio managers contingent on your performance, involvement and dedication. If you follow the independent portfolio manager's track as outlined in Section 3.3 and your strategy is deemed worthy of the risk, we will decide a fee structure best suited, and share the incentive fee with the portfolio managers all the way up to 100%. Please rest assured that your efforts will be rewarded with a generous cut from us. The cut will be decided based on the length and credibility of your performance history initially, and increase further if you prove it in live trading. Please note you can elect to receive either the management fee or the incentive fee as the cut, not both. If you wish and the P&L with AUM is strong enough to afford all fees, we will incubate, seed and help you establish your own fund.

The terms are the same for all participating crypto funds. We will help you raise investments if you join us and provide auditable or verifiable track record. Otherwise, we will need to observe your performance out-of-sample for some time. When your strategy passes the test, we will open a voting and locking system for your fund as one of our subsidiaries on the Website. When the number of locked COMMs passes a threshold with enough capital deposited, you would COMMence live trading on your own book, and start cumulating P&L attribution for due profit sharing toward the end of the year.

4.5 The charity program

Two things fill the mind with ever new and increasing admiration and awe, the oftener and more steadily we reflect on them: the starry heavens above me and the moral law within me.

- Immanuel Kant, Critique of Practical Reason

The earth is but a tiny planet in the universe, and private wealth accumulation is but a drop in the civilization's ocean of negative entropy. The asset management industry has for long a reputation to widen the gap between the rich and the poor. To the contrary, Crypto Commonwealth is an ecosystem that endeavors to unite all people undifferentiated and build a maximal consensus, disregarding their nationality, race, ideology or financial status, in the promotion of the Ecosystem, the digital asset under our professional management and the philanthropic endeavors we pursue to repay our COMMunity and society. Proposed by Friedrich Hayek and ultimately realized by the cryptos, the free competition of currencies enables consensus-based, bottom-up, progressive, peaceful and sustained wealth redistributions, which, upon the execution of righteous monetary policy, can fundamentally increase fairness in the distribution of social achievements and foster the continuing growth of civilization.

An overlook on tiptoe is no match for a distant view from ascended heights. As the cornerstone of social progress, scientific research generates value by following the law of large numbers and the neutral theory of evolution. With every scholar striving to push the boundaries of knowledge, more will definitely stand on the shoulders of the giants, as well as accomplish great academic achievements.

The Commonwealth Foundation is dedicated to endowing all explorations of new knowledge with economic value and returns. We endeavor to advance the frontiers of multiple disciplines, to sponsor various types of research and projects, and to improve public welfare. As the Ecosystem grows, we will contribute the majority of ongoing profits after fees and operational costs to expand and promote the nonprofit ecosystem, to advance research in multiple frontiers, including natural and social sciences, and to build a safe, just and open-source digital world on Blockchain.

5 The roadmap

We are planning on the following stages along the path, some of which well overlap:

- E-publisher and asset managing platform with 2 or more partner funds; partner with external funds for strategy generation, execution and NAV report.
- Crypto strategy backtesting platform available for internal backtests, submission and production.
- Web development to enable COMM locking, data marketplace and article / strategy voting.
- Web development to host e-prints, Latex editing and promote academic social networking.
- Mature investing platform covering multiple distinct strategies and financial products.
- Main net launch and ecosystem expansion as a generic payment network.
- E-print hosting site and journal inception, operation and self-sustainable non-profit scientific publisher available for subscription.

We will proceed step by step and move on when we are readily prepared. We design the token economics carefully to make sure the COMM token has solid use cases in every phase, which moderately minimizes the overall risks of the project. Had we cease in any stage indefinitely for any reason, we have backup plans and feel confident and comfortable to focus solely in the existing businesses, keep growing our ecosystem as well as the use cases for COMM.

Note a strategy cannot be both in the data marketplace and live-trading in the meantime for regulatory reasons. Once we COMMence trading, we will stop public data sale on that strategy (if any) and there is no way back. The subscription service to the source publication (if applicable), including methodology updates or out-of-sample performance will however continue and remain an important use case for COMMs.

5.1 The timeline

We made great progress in building and expanding our ecosystem so far, and will continue to deliver good performance in both the Publisher and quant research.

2017: preparations. We developed and improved our quantitative investment philosophies on digital assets.

Q1-Q2 2018: publication and investing platform preparations. We set up the first version of the [Website](#), published our insights in quantitative crypto investing, assembled the team, collected feedback and reached consensus in the Commonwealth tokenomics and roadmap.

Q3 2018: logo design. We ordered multiple temporary designs and picked a final version after consulting the COMMunity.

Q2 2019: partner fund search. We collaborate with partner hedge and venture funds in investing.

Q4 2019:

Foundation launch. We register Commonwealth Foundation Ltd. in Singapore as the issuing entity for COMM.

Web development. Develop a scalable, user friendly backtesting platform for internal quantitative strategy research and submission. We have a dedicated developer team on it. Develop the e-print hosting website. Also a voting system to lock COMMs and a data marketplace. These may extend well into 2020 or beyond.

Private sale. We have gathered and will consolidate a number of investment COMMITments for the private sale(s).

Social media campaigns. We initiated social media campaigns and built a COMMunity.

2020 onward:

Alpha mining. When the backtesting platform is online, we will invite internal quantitative researchers to participate and seek alphas, and in the future possibly initiate several nationwide competitions for best alpha modeling. We will offer exceptional researchers contractual positions, and actively engage all interested and qualified parties in alpha exploration, portfolio construction and fund management. All endeavors will be recognized, and promotions will be offered for exceptional quants.

Q2-Q3 2020: the e-print website starts operating. We advertise and invite scholars to post pre-prints on our site. After some time and as we cumulate traffic and active users, we COMMence peer-reviewed journal operation.

Q4 2021: main net launch and ecosystem expansion as a generic payment network. We will design a system that features major advantages of best crypto projects, in particular good TPS and build on top of that. New tokens under the COMM ecosystem will be issued on a dedicated main net, which all rely on COMM for fundraising and infrastructure support. If issued early, these subprojects will be based on ERC tokens initially, and migrated to the main net later. The COMM ecosystem will support issuance of new tokens, and incubate the best of them for the next round of fundraising and COMMercialization. We will construct several stock market strategies on it, invite professional portfolio managers to tokenize their strategies, as well as authors to crowd sale a percentage of their future royalties on chain. COMM may change the publishing and asset management sectors in many ways, and at the very least, remove all middlemen and enable crowd funding for strategy incubation or publication. Well designed tokenomics is a powerful tool and just calls for moderate regulations and more good, honest people.



Figure 5. The evolution of bitcoin cap and price. Source: Coinmarketcap.

Q1 2022: journal launch. We generalize the publisher tokenomics and support a comprehensive academic journal in all disciplines. This may happen earlier if we make good progress. In the long run, we hope all scholars get token compensation in proportion to their academic contributions from our tokenomics. That’s our dream and ultimate goal. We will support the ecosystem with our performance and lay a solid foundation for the plan first.

5.2 The past, present and future of the crypto as an asset under management

Satoshi Nakamoto published in 2008 the whitepaper for bitcoin - ‘a purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution.’ Since then, bitcoin gradually proved its worthiness as an independent, inexpensive and reliable payment system in a wide variety of use cases. The bitcoin price soared to over 10,000 US dollars at its peak in 2017, with the market cap of all cryptos roughly doubled that of bitcoin. The total transaction volume in cryptos once matched the volume of NYSE, followed by a strong correction since December 2017. See Fig. 5 for the cap and price evolution of bitcoin.

The bitcoin dominance, or the percentage of bitcoin cap out of the entire crypto market has been mostly declining since bitcoin’s inception. The altcoins (cryptos other than bitcoin) are innovative in minor ways but fundamentally based upon similar cryptographic algorithms. They present a landscape of various ways a cryptocurrency could possibly be formed. Some were ill-designed with no solid use cases and slowly faded away, yet many proved worthy and kept appreciating in value along with bitcoin. Fig. 6 shows the price evolution of 100 coins with top market caps, and the bitcoin dominance in decline since 2013 as a result of the rise of other cryptos. We discussed in Appendix C at length how the historical top cap cryptos performed after they hit and dropped out the top cap list, and in

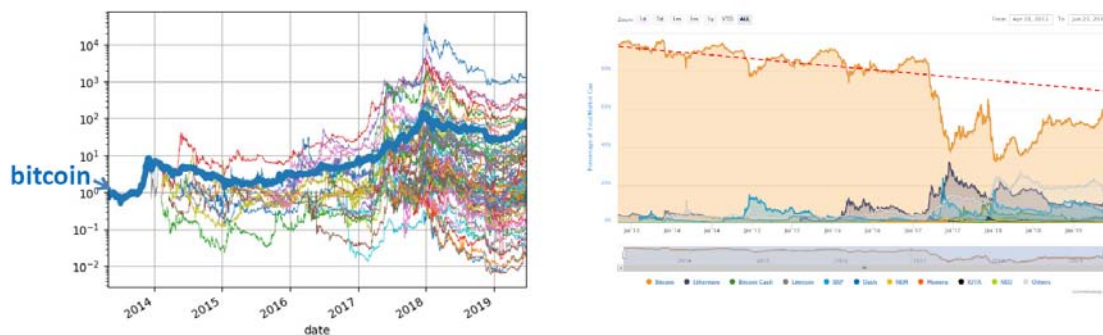


Figure 6. Left: price evolution of top 100 cryptos in cap. Right: bitcoin dominance on the decline. Source: Coinmarketcap.

particular the evolution of the bitcoin dominance in Appendix C.3. The crypto market cap has been on the rise exponentially, as is shown in Fig. 26. The bitcoin cap alone amounted to 3.8% of USD M1 money supply, and 1.0% of USD M2 supply, two numbers not to be easily ignored by any serious economists and keen observers.

Though decentralized in mining and bookkeeping, bitcoin holdings are highly centralized as most other assets. The top 30% addresses possess 99% bitcoins, see Table 4 for details. There are 30 million bitcoin users now, amounting to about 4‰ of the world’s population, a percentage similar to all internet users as of the year 199. Out of all bitcoin users, 39% are between 25-34 years old, 23.9% have annual incomes between \$500-1000, over 43% of users have full time jobs. 96.6% of users are male, 56% of users are married, and 53% of users come from North or South America. According to Blockchain.com’s wallet user statistics, the number of bitcoin users doubles every 1-2 years. If the trend continues, we are only 10-20 years away from a digital world that accepts bitcoin as a major universal equivalent for value store and transfer.

\$1	\$100	\$1,000	\$10,000	\$100,000	\$1,000,000	\$10,000,000
19,790,176	6,608,083	2,447,969	589,695	125,472	11,812	1,280

Table 4. Bitcoin distribution by addresses richer than the specified amount. Source: Bitinfocharts.

Bitcoin and cryptos in general feature almost zero correlations with traditional investment vehicles, whereas typical safe havens such as bonds, gold, Japanese Yen and Swiss Franc usually carry positive and low correlations. Fig. 7 shows their correlations. Bitcoin and all cryptos have ultra-low correlation against all other asset classes. However, all cryptos tend to correlate with one another and move together. Also see Fig. 8 for a comparison of returns (y-axis) and risks (x-axis) across a variety of assets including the cryptos in 2017-2018. Notably, the crypto class offers high return and bears high risks, among which bitcoin and stable coins are already the lowest in volatility.

The total supply of bitcoin is fixed at 21 million, out of which about 12% is estimated to have been lost permanently, 74% has entered circulation, and 14% remains unmined. The limited supply induces deflation and offers an effective hedge against inflation in all major currencies, the very reason bitcoin is considered digital gold. On the other hand, currency issuance is highly centralized and not always properly restrained, especially in a world where quantitative easing is becoming the norm to lower interest rates and increase the money supply. Note FED, ECB, Bank of England and Bank of Japan have overloaded their balance sheets to historical highs. One may argue that deflating universal equivalents like gold are unfit for economic growth if widely adopted. However, more cryptos like Litecoin, Bitcoin Cash, Cardano, Dash, IOTA, Monero and ZCash were issued later on, and more are anticipated to come. They serve as supplementary means in the overall crypto payment system. As a result, the payment oriented crypto market cap standalone has a tendency to inflate too, in the sense that bitcoin would have appreciated or deflate much more without these auxiliaries. And note smart contract oriented cryptos like Ethereum and EOS enable healthy inflation by moderate annual and continuous issuance.

Bitcoin has public and private keys. The private key is a unique and indisputable proof that one owns all bitcoins in a specific address labeled by the public key. Therefore, the private keys are never revealed unless one is ready to transfer or share the ownership of an address and the asset within. A private address can have many public keys, but a public key only maps to one single private key. The public key is needed for all deposits from the public or any sender, hence the name.

The launch of ethereum signifies the dawn of the smart contract economy. Everybody can create smart contracts with autonomous and enforceable financial obligations on chain. Once created, the contracts cannot be altered or stopped, and do not need any third party intervention. Complex operations can be coded and implemented on chain for all ethereum (or any other smart contract compatible chains like NEO, Qtum, EOS, etc.) based tokens, such as flight delay insurance claims, automatic bill payments, fair and transparent lottery issuance and drawing, medical record preservation / tracking and many more. Loosely speaking, the cryptos based on any public chains, i.e. those relying on miners therein to handle transactions are called tokens, whereas those with their own main nets, miners, ledgers and clearing services are referred to as coins.

As most major cryptos are highly volatile and have a tendency to deflate, a complete crypto ensemble calls for bridges to enable their valuation with existing financial systems. Stable coins serve as the crypto counterparts of fiat currencies. They are represented by the lowest two dots (below bitcoin) in the bottom right of Fig.8. These peculiar cryptos are endorsed by centralized companies and bound to fiats like USD, Euro or RMB at 1:1 rate, with added advantages of being transparent (arguably sometimes), trackable and easy / inexpensive to transfer. The most famous stable coin is USDT, issued by a centralized company (Tether) in June 1 2014 and with a circulating supply at 2.6 billion USD by the time of writing. It is based upon multiple public chains including but not limited to bitcoin, ethereum, EOS, Tron, and backed by available balances in company assets, but Tether does



Figure 7. The correlations of multiple asset classes: crypto, currency, commodity, equity and bond. Source: Bloomberg.

not disclose audited company financials, which provoked doubts among keen observers for long. Rivals of USDT include but are not limited to USDC, TUSD, bitUSD, DAI (USD based), bitEUR (Euro based), and bitCNY, CYNT (RMB based). Many crypto exchanges also issue their own stable coins to facilitate trading. Latest stable coins usually support smart contracts and feature certain margin addition / liquidation mechanisms to anchor the forex rate dynamically. These coins from an ensemble of DEFI (Decentralized Finance) ecosystem and has soared to over a billion USD in total cap as of late 2019. However, none is as stable as the real fiat currencies. We foresee a big, upcoming wave of crypto issuance by sovereign nations and largest corporations. Venezuela issued its own, centralized coin ('Petro') in Feb. 2018, backed by domestic natural resources like petroleum, natural gas, gold and diamond. China has been planning on centralized crypto issuance too, so do Facebook and Walmart. Since cryptocurrencies feature multiple additional advantages over either traditional fiat currencies or securities (in many cases effectively a hybrid of

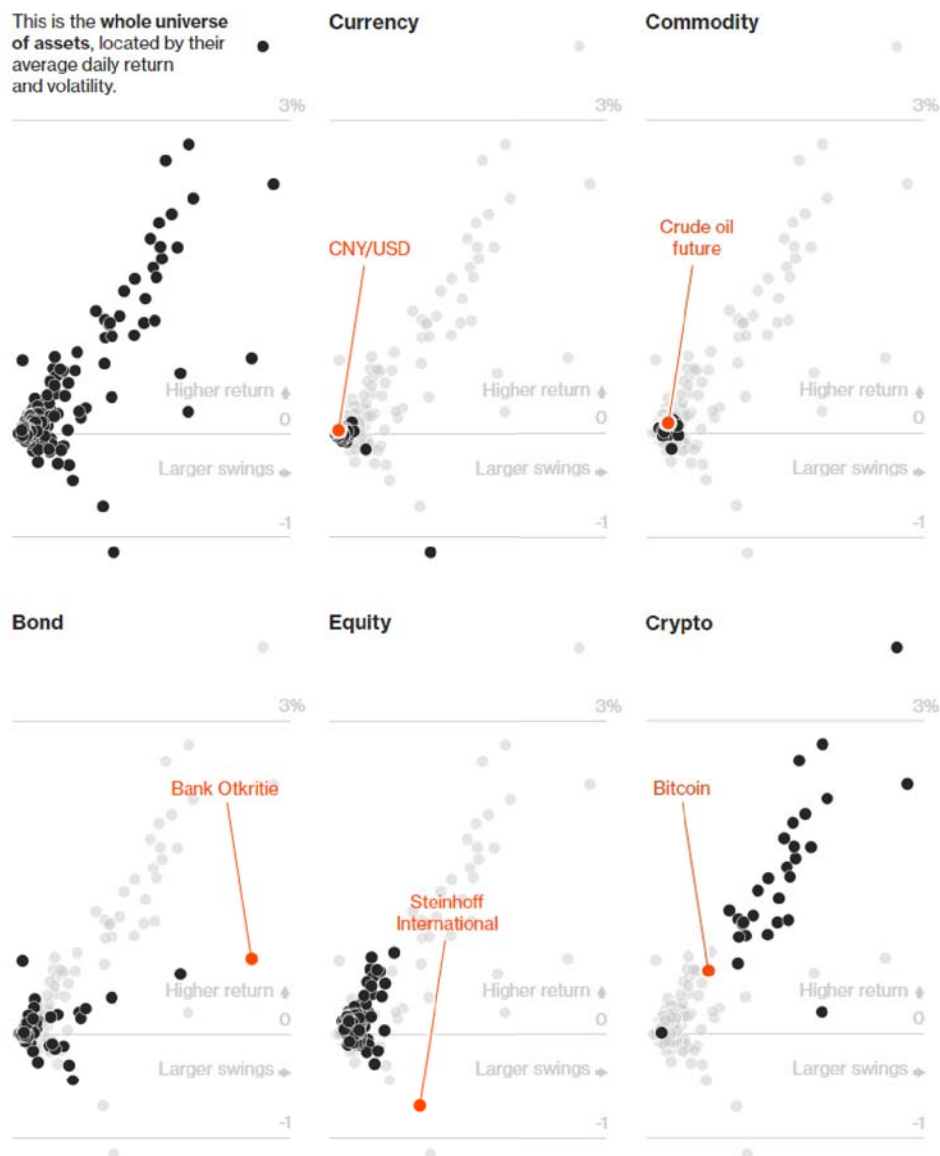


Figure 8. The returns (x-axis) and volatility (y-axis) of multiple asset classes in 2017-2018. From left to right and top to bottom: inclusive, currency, commodity, bond, equity and crypto. The lowest two dots (below bitcoin) in the crypto plot (bottom right) are stable coins, the crypto counterparts of fiat currencies. Source: Bloomberg.

both), more and more countries and entities will join, and we expect stable coins to play an increasingly important role in international trade and supply chain finance moving forward.

ICO as a novel way of fundraising becomes one of the most popular financing tools among start-up projects and small businesses. Conventional IPOs offer stakes or ownerships of the company itself. ICOs have the same options too (in which case they would become 'security tokens'), but usually issue materialized rights (quantified in tokens) to enable participation in the ecosystem and access potential benefits ('utility token'), such as the right to use of

services or to store / transfer value within the system. The right to use or lease is becoming more popular than the ownership of the firm in the context of sharing economy nowadays, as it is financially and directly bound to the fundamentals and earnings of a company. The token appreciates in value naturally as the right of use consolidates, whereas stocks appreciate when enterprise rises (or is expected to rise) in value. Some crypto projects pay out dividends to token holders like stocks, and some promise and execute periodic repurchase plans to further appreciate the tokens, which is usually bound to a certain percentage of business revenue. In both scenarios, tokens can be sold for profits and cashed out from listed exchanges. In general, IPO is effectively a peculiar form of ICO, and the crypto market as a whole is expected to represent the productivity and property value of the civilization more faithfully upon honest operation and proper regulation.

There are two major categories of ICOs, readily applicable to even common underlyings like stocks, commodities, futures: utility and security. In general, all public and consortium Blockchains are fully or partially decentralized and anticipated to serve as utility tokens, whilst many private chains essentially fall into the security or equity category and are partially or fully centralized, private company backed tokens in particular. The utility tokens authorize users to employ digital services or products on their chains with their tokens. Broadly speaking, commodities and futures represented by electronic contracts are forms of utility tokens too. On the other hand, the security token is a broad classification for all tradable assets that aim for profit and appreciation upon investment. In the United States, SEC v. Howey established guidelines in 1946 for whether a financial arrangement involves an investment contract and is subject to security regulations, allowing jurisdictions on whether any token is essentially a security. Among the security tokens are the equity tokens, where the tokens represent the ownership of an asset or liability, such as company bond or stocks. The issuer usually promises a percentage of revenue or profit for all security token holders. In particular, the stock (including shares issued in IPOs) is a typical equity tokens - well regulated, but constrained to the arena of conventional underlyings and largely only circulate in the stock exchanges; on the other hand, once consensus is reached, all cryptocurrencies have the potential to serve as universal equivalents, acquire varied use cases and circulate in our daily lives. Bitcoin and ethereum were both ruled as utility tokens. Every other crypto is considered and traded as utility tokens by default, but CFTC and SEC are actively working on a more detailed guidance to classify them properly and systematically.

The cryptos are fit for value store and transfer. A wallet address with some initial balance is required to initiate any transfer. When one enters the target address, amount and sends over the coins, the miners pick it up, package, validate and transmit the encrypted message over. It takes only seconds for the recipient to receive an announcement on the transfer, and a series of confirmations (e.g. 6 for bitcoin) until the amount hits the target address and becomes available to spend or withdraw. A Blockchain explorer is deployed for all independent chains (including bitcoin, ethereum and many others) to query the balance or transaction history of any public address. However, the owner of the address, i.e. the holder of its private key remains hidden.

Most custody services fall into two categories: centralized custody that keeps private keys and takes full responsibility for any loss of assets, and decentralized custody that preserves no private key and charges a fee for the banking service. In the case of decentralized custody, multisignature wallets are utilized for multiple parties to manage bitcoin or ethereum in the same address, in which case a total of M private keys are created, and any coin transfer requires consent from N private key holders ($N < M$). This enables reliable custody services, where a custody trust owns one private key and N (usually $N=2$) stakeholders each owns a private key; a successful transfer requires all N stakeholders' consent, or $N-1$ consents plus custody institution's assistance. Typical custody providers include Coinbase, Northern Trust and Mitsubishi UFJ Trust.

Over 10,000 merchants support bitcoin payments now, and the number has been constantly climbing at the time of writing. Bitcoin ATMs are usually available near these shops. Arizona has passed legislations to enable bitcoin taxation, followed by Georgia and Illinois. The Swiss town of Zug in central Switzerland has been accepting bitcoin as payment for government fees. Furthermore, crypto debit cards from BitPay, Vaultbank, Bankera, Cryptopay, etc. enable users to convert bitcoins real-time into currencies of the merchants' choice and make payments either online or off-line. Balance and transaction history inquiries have been made as easy as conventional debit cards. Many large crypto transactions have been made successfully in the year 2017, including real-estate, land and luxury car sales involving tens to hundreds of bitcoins. It is becoming a favorable way for large bitcoin holders to consolidate their cryptos into tangible asset classes, and crypto fans to acquire bitcoins inexpensively and off the crypto exchanges.

The crypto auditing services are on the rise. Although applicable for now on several top cap cryptos only, Northern Trust and PwC have collaborated and offered tools for auditors to access data on their private chains real-time before the periodic NAV reports from the fund managers. Libra and PwC released together an enterprise auditing product that enables funds, fund administrators, exchanges, trading operations and crypto enterprises to automate and optimize middle and back office processes and reporting. The 'big four' accounting firms all released evaluation reports on the important roles Blockchain auditing is to play in the future.

Some insurance companies have begun to offer products for bitcoin insurances, such as XL Catlin, Chubb and Mitsui Sumitomo Insurance. The premium is high (1.5%) but expected to drop gradually as bitcoin becomes more popular. BitFlyer and Mitsui Sumitomo Insurance are working on an insurance product that covers retailer's losses if a customer fails to place an order due to technical issues. Coincheck is initiating a similar service with Tokio Marine & Nichido Fire Insurance. Moreover, Mitsubishi UFJ Trust is initiating a service that recovers all losses if a crypto exchange closes down or gets hacked. The service is expected to cover all bitcoin traders first.

Typical, relatively low-risk investment vehicles for cryptos include certificate of deposits (CD), arbitrages and cloud mining contracts. CD or loan accounts of major cryptos have

become available with multiple crypto exchanges. They offer a leverage for margin accounts, and enable borrowing cash or cryptos from those willing to lend. The deals are matched accordingly with transparent interest rates, amount and repayment periods. Margin addition and closeout mechanisms ensure the lenders earn pretty much risk-free interest rates as was agreed upon. Meanwhile, arbitrages on price inefficiencies across multiple crypto exchanges have been increasingly active. Varied local policies, supply and demand result in price differences in many exchanges, notably those in Korean and the rest of world in 2016 and 2017. The arbitrage between futures and spots are also popular, in which the trader buys one and sells the other, hoping that their prices eventually converge and bring about profit in relative movements. Exchanges like Huobi Global, Binance, OKEx, Bitfinex, BitMex and Bittrex support crypto futures at the time of writing, and more are to come. The cloud mining contract is another form of crypto derivatives. The users purchase the services and the right to use remote hardware and in a cloud mining contract, and leave everything else for the contract issuer to manage. A periodic payout is to be expected in these contracts, predefined per terms and conditions.

Multiple financial products on cryptos were also made available by professional funds. XBT Provider was the world's first institution that enables US dollar and Euro investments on cryptos via ETNs (Exchange Traded Note) without actually holding bitcoin or ethereum. Coinbase, one of the largest crypto wallet providers with auxiliary crypto exchange, offers a crypto index with a weighted portfolio of available cryptos in service, which is to be adjusted upon any new coin additions. Grayscale, a crypto fund in Wall Street that acquired the crypto trading license in New York State, has launched Digital Large Cap Fund, Bitcoin Investment Trust, Ethereum Classic Investment Trust and ZCash Investment Trust. Swissquote issued a bitcoin-USD based ETP (Exchange Traded Product) with 3 years of maturity, which went public in Six Swiss (the largest security exchange in Switzerland) and has been actively traded since.

Smart routing services for crypto transactions like Changelly, ShapeShift and Flypme are rising. Based on the order books of multiple crypto exchanges, the service providers split big orders into small quantities, and route them to several markets accordingly for best execution speed and concatenated price. The next generation of smart routing will be based on atomic swaps, which enables fast P2P transfers across different chains. It is effectively on-chain OTC foreign exchange at volume weighted, consolidated crypto prices across crypto exchanges.

We are at the dawn of the consensus era, a paradise for ambitious adventurers, in particular primary market investors. This is still the wild wild west - early investors suffer from huge volatility, but with great risk comes great return. As time goes by, a moderately regulated crypto market will become one of the most vibrant emerging markets with excellent profits and increasing institutional interests. Faster transactions, higher TPS, larger volume and safer value store / transfer are to be expected in the near future. Ultra-low correlation with conventional assets enables cryptos as a premium underlying and an effective means to hedge against risks in any diversified portfolios. Many crypto based financial products

and derivatives have been made available, with more diversified additions on the way as the market becomes more efficient and the liquidity picks up. New investing strategies and paradigms will emerge in the chorus of upcoming crypto projects and ICOs. As more and more users reach consensus, bitcoin will eventually stabilize atop a price plateau with much lower volatility, and become a widely accepted currency in most payment systems and sovereign forex reserves. The road has twists and turns for sure, but the prospect is undoubtedly bright.

6 The team

We are a group of portfolio managers, quantitative researchers, senior IT/data engineers, scholars and crypto experts with varied backgrounds. Most of the core team members are quantitative Ph.D.s from renowned tech companies, hedge funds and academic institutions including Google, Cadence, Worldquant, Harvard, MIT, and Fermilab. Moreover, several top advisors are dedicated to assisting our publishing and financing endeavors. Among them are doctoral supervisor in top university, senior derivative quant in investment banking, and #1 ranked experts on reputed ICO rating sites including ICO Bench and ICO Holder. We saw abundant opportunities in the highly volatile yet rapidly growing crypto industry, and decided to set up a semi-decentralized digital ecosystem intended for the benefit of the most. See Fig. 9 and Fig. 10 for our core team members and a simplified overview on their background.

The founder and author of the Whitepaper, [Dr. Wayne Yee](#) is a quantitative Ph.D. and has many years of quantitative alpha research experience in hedge funds. He is familiar with asset management in stocks and cryptos, tokenomics, philosophy, and managed / researched market neutral equity portfolios and strategies in renowned quantitative hedge funds with good performance. He participated in the search of Higgs boson in [Fermilab](#). The work and the ongoing research conducted at European Organization for Nuclear Research (Conseil Européen pour la Recherche Nucléaire in French), [CERN](#)'s Large Hadron Collider ([LHC](#)) led to the discovery of the Higgs boson, the Nobel prize winner in physics 2013. He earned a B.S. degree in Physics, University of Science and Technology of China (USTC), and a Ph.D. degree in Physics, Stony Brook University.

Dr. Yee attended multiple online AMAs ([Japan](#), [Korea](#), [COMMunity Europe, 1st](#), [COMMunity Europe, 2nd](#)) lately and elaborated a plethora of details about the COMM project - the incentive, core values, timeline, progress, and exciting plans ahead. And [here](#) is his recently featured interview on Irish Tech News.

Our core team members include:

[John Gan, PhD](#): Dr. Gan obtained his Ph.D. from Harvard University with a solid background in applying machine learning algorithms and statistical inference to solve big data challenges. He then joined Harvard Business School as a researcher, focusing on asset pricing in emerging financial sectors including cryptos. At Harvard, John designed and implemented a course on financial technologies, linking AI and big data to financial services with real world cases. He has tutored over 1,000 students world wide, most of whom are industrial leaders with senior positions including C-level executives. See [this interview](#) to learn more about him and his role with COMM.

[Simon Cocking](#): Simon is Chief Editor of the Commonwealth Publisher, together with a few other influential crypto news medias with over 1.5 million constantly growing and unique monthly views. He is a top 3 ranked expert among [People of Blockchain on ICO Bench](#), also a [top 3 ranked advisor on ICO Holder](#). He is a business mentor and advisor

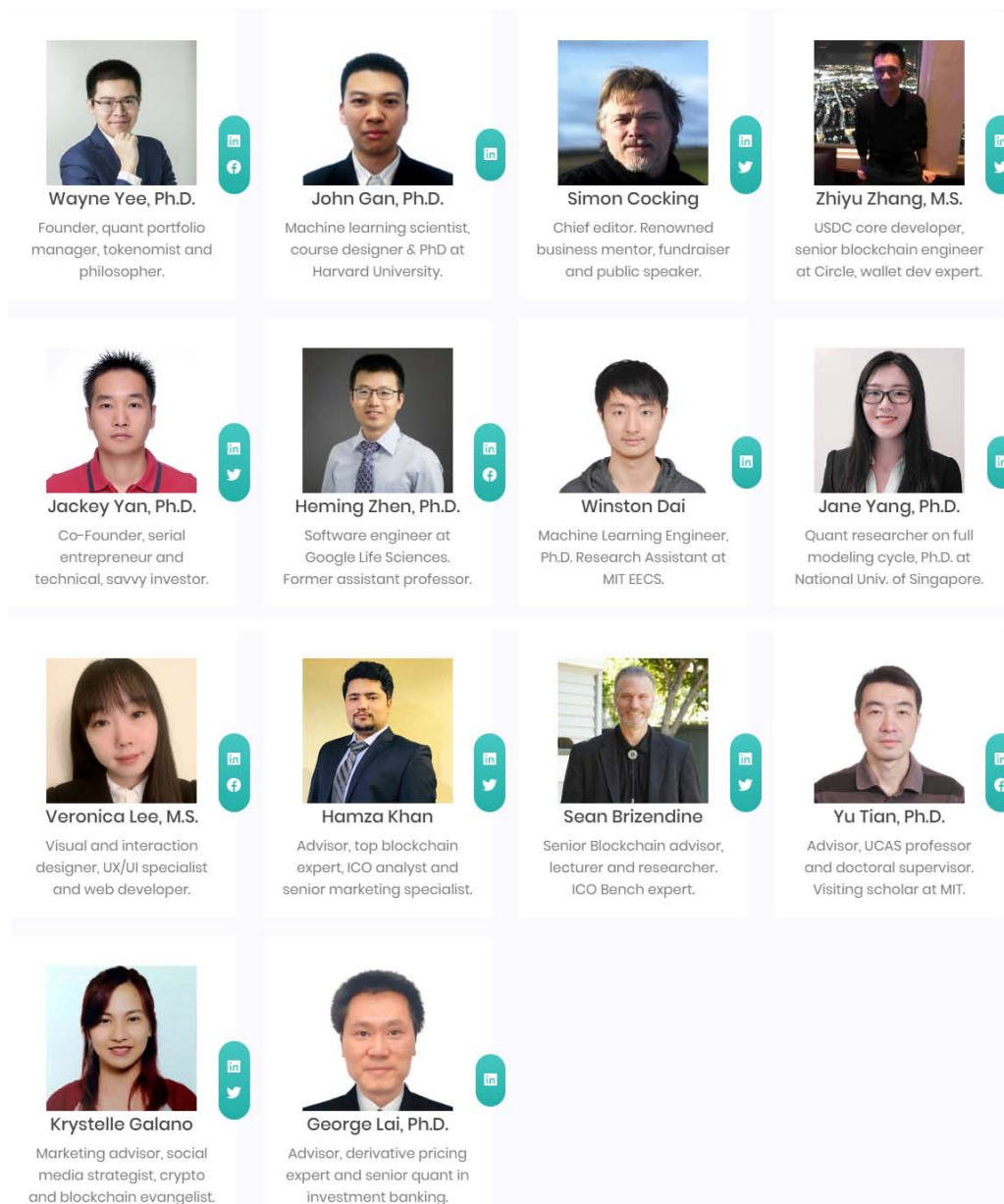


Figure 9. COMM’s core team. Source: cryptocommonwealth.co.

working with over 200 successful companies to date, and has been named on many global Twitter influencer lists. Meanwhile, he is an accomplished public speaker at events including TEDx, Web Summit, and overseas in Monte Carlo, Pyeonchang, Amsterdam, Dubai, Delhi, Kiev, Singapore, Moscow, Tel Aviv, Madrid, Tbilisi, Riga, Porto, Dublin and Helsinki in the last 12 months. He has been based in Ireland for over 22 years and has cofounded or founded seven successful companies.

Zhiyu Zhang, M.S.: Zhiyu is a core developer for [USDC](#), and senior Blockchain engineer in [Circle Internet Financial](#). He oversees the wallet development and server structuring in

Team Background			
			
			
			

Figure 10. An overview of COMM’s team background. Source: cryptocommonwealth.co.

[Poloniex Exchange](#) (acquired by Circle), and is familiar with the order matching system among trading pairs. A Blockchain evangelist, he is also an open-source contributor of the Ethereum and Bitcoin communities. He received a master’s degree in Computer science.

Jackey Yan, PhD: Dr. Yan is a cofounder of the COMM Project, a savvy investor and successful, serial entrepreneur with a strong technical background. He is a senior principal software engineer at [Cadence Design Systems](#), focusing on scalable and efficient algorithm design, data structure, optimization, distributed system, and large-scale software development. Meanwhile, he invested in multiple startup businesses and operates his own with good cash flow. He is a Ph.D. in Computer Engineering. See [this interview](#) to learn more about him and his COMMENTS on the COMM project.

Heming Zhen, PhD: Dr. Zhen is a quantitative researcher, and a software engineer at Verily - Google Life Sciences. He is a former program director in Data Engineering, Insight Data Science. Before that, he served as an assistant professor at [Rush University Medical Center](#) and [Boston University Medical Center](#). He received his B.S. degree in Physics, University of Science and Technology of China, and Ph.D. degree in Medical Physics, University of Wisconsin at Madison.

Winston Dai: Winston is currently a PhD student and research assistant with a full scholarship at MIT Department of Electrical Engineering and Computer Science. His research focuses on machine learning and its applications in industrial TB-level big data, including risk stratification, deep generative modeling and causal inference. He has published multiple papers and given talks at top AI conferences. At MIT, he has been a teaching assistant for several graduate level machine learning classes, and a research mentor for many undergraduate students.

Jane Yang, PhD: Dr. Yang focuses on quantitative research on conventional and new data sets in the crypto domain, as well as trading in the crypto market. She participates in the full cycle of simulator construction, data analysis and portfolio construction. She has

a B.S. degree in Biosciences, University of Science and Technology of China, and a Ph.D. degree in Cell Biology and Genetics, National University of Singapore.

Veronica Lee, M.S.: Veronica is a versed visual designer and web developer. She has a multidisciplinary background in Information Systems & Information Management, Human-Computer Interaction (HCI) and Japanese. She has designed concept arts for a variety of industries including Blockchain, filmmaking, medical care and logistics. She is enthusiastic in discovering the wonders of life and creating rich visual experience through professional design. Skilled in wireframing and prototyping, Veronica is also familiar with front-end development. She has a M.S. degree in Information Systems.

Our advisors include:

Hamza Khan: Hamza is a top 3 Blockchain expert among [People of Blockchain on ICO Bench](#), a senior ICO analyst with 5-year experience in the crypto world, and an expert in Ethereum and Stellar Blockchain. He worked with many ICOs and helped them reach successful positions in the market. He also helped many non-ICO projects to get their communities and become well-known among the Stellar platforms. Moreover, he is in contact with many renowned exchanges for listing the projects after their successful ICOs.

Sean Brizendine: Sean has over 8 years of experience researching bitcoin and Blockchain technology. He was rated 5+ POD (Proof of Developer) by CryptoAsian in 2014 and is a Certified IIB Council Blockchain Professional and Advisor, plus a lecturer of EC Council University in his Blockchain Cyber Talk Series. As an ICO Bench expert, he participated in over 40 Blockchain related projects over the years, some of which were among the most successful token sales in history. In August 2018, former Bloomberg Anchor Jane King interviewed Sean live at the NASDAQ in Times Square, New York regarding Blockchain applications and real world use cases.

Yu Tian, PhD: Dr. Tian is a professor and doctoral supervisor at the University of Chinese Academy of Sciences (UCAS). He is currently a visiting scholar at the [Center for Theoretical Physics](#), Massachusetts Institute of Technology. He has a B.S. degree in Physics, Zhejiang University, and a Ph.D. degree in Physics, Peking University. Before his tenure, he worked as a postdoctoral researcher in [Institute of Theoretical Physics](#), Chinese Academy of Science.

Krystelle Galano: Krystelle is a social networking expert and has more than 5 years of social media management experience such as in Facebook and Twitter marketing. She has been a public relations manager that plans and protects projects' images. She has strong connections with top-tier crypto exchanges for direct listing, and renowned publishers like Corporate Investment Times Magazine for prompt press releases. She also has years of experience in crypto and Blockchain areas as a marketing advisor for various ICOs. Her strategy brought them to the right tracks and gave them a successful head start.

George Lai: George has more than five years experience working in the financial field, in particular quantitative research and derivative pricing. Currently he works in the investment banking division of TD Bank as a senior quant, and mainly focuses on the derivative products pricing. He formulates a large number of mathematical models for the front trading desks in strategy construction, optimization, arbitraging and hedging. Prior to the current position, George was a quant researcher in a fintech company that develops applications of financial analytics with quantitative pricing solutions. He received his Ph.D. degree from the State University of New York at Stony Brook in biophysics. See [this interview](#) to learn more about him and his advisory assistance to COMM.

Our developer team include several senior developers, architects and UI designers. We have been actively working together to bring the backtesting platform and e-print website online as scheduled. Furthermore, Zhiyu, a senior Blockchain engineer from the USDC core development team advises, designs and reviews our codebase. He brought forth the token and vesting smart contracts to CertiK for a successful official audit.

We are actively looking for more collaborators! [Let us know](#) if you are interested.

7 Conclusion

Consensus is highly valuable. It has paramount power to promote massive collaboration. Backed by reliable cryptography at the algorithmic level, digital currencies securely store and transfer the value of consensus. This is the technical and fundamental support for their value.

Financial democracy among the global payment network comes only from free competition outside the system. The taming of centralized currency issuers, and the realization of a shared dream to put them in cages can be only achieved by free competition. Digital currencies successfully lock all central currency issuers behind the cage, and return the power and privilege to people globally. The rise of their market capitalization over the years is proof. It is only behind bars where the issuers shall stay both tractable and unarmful. COMM stands firmly in support of financial democracy and liberty digital currencies offer.

In the Whitepaper we introduced Crypto Commonwealth - a Blockchain based scientific publisher and asset managing platform that endeavor to offer good compensation among all COMMunity contributors in both publishing and investment industries by careful tokenomics design. We are a pioneer of tokenomics in the investment industry with strong research and good transparency. Moreover, the Commonwealth tokenomics boasts multiple innovative features, including applications of the tokens as investing rights, compensation to alpha and content mining, macroeconomic control overseen by the Commonwealth Open Market Committee (COMC) and many more.

A scientific publisher and asset manager on Blockchain, COMM's issuer - Commonwealth Foundation is a nonprofit Singapore CLG that offers good compensation to all COMMunity contributors in both publishing and investment branches of the consortium. It is COMMitted to building an ecosystem that endows value upon exploration of new knowledge, and promotes it into productivity. It harnesses the power of knowledge produced by leading thinkers of our era, and compensates them with considerable token payments. This enables crowd based publisher operations and the offering of transparent, research-based investment strategies.

Both scientific publishing and asset management industries are highly centralized, globalized and homogeneous among different regions, where decentralized tokenomics and Blockchain technology can play an important role, with the assistance of a just currency policy and well-designed economic model. Crypto Commonwealth believes that a strong crypto project should be open-minded and willing to benefit the welfare of society. That spirit is the best nourishment for the ecosystem under a healthy token distribution structure, where the team and the COMMunity's interests fully align. We are hereby forging a crypto ecosystem for the common good, hence the name 'Commonwealth'.

We are a professional, quantitative and diverse team in publishing and investment. Most of us have many years of experience in the asset management industry, tech companies, academia or the crypto domain, including Harvard, MIT, Fermilab, Google, Cadence,

Worldquant, TD Bank, ICO Bench, and ICO Holder. Many hold advanced degrees in quantitative disciplines from renowned universities. We have strong confidence in the future of the Blockchain, witnessed abundant opportunities in the digital industry, and are together dedicated to building and maintaining a cryptocurrency ecosystem that aims for the welfare of the most under the cherished Blockchain spirit - safer, faster and fairer. This is the way all crypto projects really should be.

Make love, not war. Destroy power, not people. Decentralize in value and technology, and centralize further in collaboration as a united civilization. This is how we humans differ from other species on earth and stand out. As the undoubted leader of planet earth's biosphere, our civilization can, should and is obligated to achieve much more.

8 Appendices

Note: all backtest results, figures and plots were updated until early 2018, the time of writing.

A Passive crypto investing: introducing the crypto ETFs and small cap premium

A.1 Introduction

Who benefit most from the crypto market growth? The early investors and long-term holders. Their persistence falls into two categories: active and passive. The active holders have strong faith on bitcoin and the entire crypto market. They chose to invest a significant portion, if not all of their assets into the cryptos, and hold on for dear life (HODL) disregarding extreme volatility. Their rewards come with high prices, which requires strong will, persevered execution, great foresight or ridiculous blind luck - most certainly not the cup of tea for everybody. The most aggressive of them sold their houses and went all-in back in 2014. Investors with this level of insight and guts can be counted easily.

On the other hand, the passive holders never have much faith in the market. They have always been skeptical, and only invest with capital they can afford to lose. Most of them stay in a low profile and are quite reluctant to admit they ever invested until they feel comfortably sure, since their expectations on their crypto asset returns are not much better than none. Nevertheless, most of them have accessed ten-fold or hundred-fold profit. This is achievable by an average crowd, and it is never too late to invest - remember a pizza used to sell for 10,000 whopping bitcoins?

Passive investing is an investment strategy that aims to maximize returns over the long run by keeping the amount of buying and selling to a minimum, traditionally referred to as 'buy and hold'. Typical passive investing is to hold a cap-weighted basket of underlying instruments in the portfolio, such as the ETFs and index investing, commonly exercised by mutual funds. It features low or zero management fee, ultra-low turnover, and better returns over a majority of actively managed funds. In 2007, Warren Buffett bet a million dollars that an index fund would outperform a collection of hedge funds in the long run like 10 years. Over the course of the bet the S&P 500 index fund returned 7.1% compounded annually, significantly more than the basket of funds selected by his counterparty, an asset manager at Proégé Partners. That active basket only returned an average of 2.2% annually.

What happens if we practice passive investing in the crypto domain? We constructed and studied in this paper typical crypto ETF constructions and performances. Section [A.2](#) introduces conventional cap weighted ETF and potential improvements, Section [A.3](#) discusses the equal weighted construction, where small cap premium plays an important role, as well as the performance with more breath when we generalize top 20 to top 50 cap underlyings. Conclusions follow in Section [A.4](#).

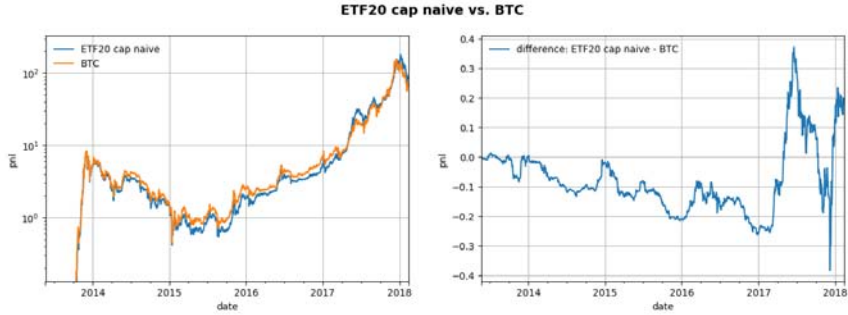


Figure 11. The performances of top 20 cap cryptos, cap weighted (ETF20 cap naive) and bitcoin (BTC). Left: performances in logarithm scale. Right: their cumulative P&L difference (ETF20 cap naive less BTC).

A.2 Crypto ETFs

Though decentralized and distributed technologies are widely deployed, all cryptocurrencies are effectively managed and maintained by centralized organizations or companies, and the token value is but a representation of the network value. As Metcalfe’s law states, the value of a telecommunications network is proportional to the square of the number of connected users of the system (n^2). The more useful and widely applicable the network, the more valuable the ecosystem and hence the token. This is the de-facto fundamental support to all token prices.

A.2.1 The top 20 cap weighted ETF

Note most cryptos other than bitcoin carried poor liquidity before 2013, some only available over the OTC market. We construct a cap weighted ETF on top 20 cryptos from mid 2013 with monthly turnover, which we call ‘ETF20 cap naive’. The universe was ranked and picked point-in-time. Since bitcoin took over 80% dominance before 2017, the performance would be almost identical to bitcoin, as is demonstrated in Fig. 11. The left shows the ETF and bitcoin performances, where we normalized the initial positions and set the y-axis on a logarithmic scale for ease of comparison. The plot on the right is the cumulative P&L difference between the two (ETF20 cap naive less bitcoin). The information ratio (IR) for bitcoin is 1.5, return 130%, volatility 86%, max drawdown 82%, all numbers annualized except drawdown (annualization applies to all numbers in this paper unless otherwise noted). The naive ETF gives IR 1.6, return 130%, volatility 84%, max drawdown 85%.

A.2.2 Improvements

The naive cap weighted strategy offers limited insight on passive crypto investing. It is quite similar to holding bitcoin alone, and a small mix of low-cap cryptos seems to pull performance slightly down before 2017, until ethereum joined the gang in 2017 and brought more volatility to the game. Most other cryptos carry negligible weights throughout the period.



Figure 12. The performances of top 20 cap cryptos, cap weighted (ETF20 cap) and bitcoin (BTC). Left: performances in logarithm scale. Right: their cumulative P&L difference (ETF20 cap less BTC).

A natural next step is to enforce 10% threshold on any cryptos, i.e. if the underlying crypto passes 10% in weight, we set it to 10% as long as it is possible. We call this strategy 'ETF20 cap', whose performance is displayed in Fig. 12. ETF20 cap gives IR 1.7, return 180%, volatility 100%, max drawdown 90%, a good improvement over holding bitcoin alone. From the right plot we confirmed that ETF20 cap outperforms bitcoin, except saw-sawed between 2014 and 2017. The max relative rise occurred toward the end of 2013 - the turbulence in Venezuela triggered a strong demand in bitcoins, and an overwhelming number of ICOs without solid use cases added fuel to the flames. This was the first crypto bubble and triggered large-scale regulation particularly in China, followed by a long bear market for the next year and half. This is an extraordinary length considering crypto's short market cycles - the longest bear market recorded in its brief history. Also note there were two major surges in 2017. The first was led by the rise of ethereum - a revolutionary crypto featuring smart contract deployment, the very first of its kind. The second happened when bitcoin regressed to its fair value alone and slowly after another surge during a new North Korea nuclear crisis, while the rest of cryptos caught up. No wonder the year 2017 was generally considered the genesis of the upcoming Blockchain era - it is almost surely the first year cryptos drew massive public concern.

Fig. 12 gives the first indication of small cap premium in the crypto market. This is a popular and famous (if not the most) risk premium in quantitative finance domain - stocks with small caps enjoy better growth statistically, as with great risk comes great return. The small cap premium is one of the earliest factors discovered in the stock market, and applicable almost across the globe. We are not surprised to witness the same phenomenon in the crypto market - investing in riskier small cap cryptos offers better returns. This premium clearly goes beyond simple leveraging effect.

A.3 Small cap premium on cryptos

What if we give higher weights to smaller caps? This could be the first smart beta discovered on cryptos.

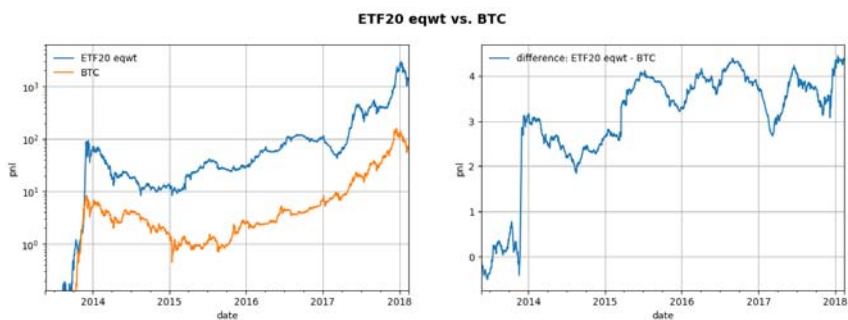


Figure 13. The performances of top 20 cap cryptos, equal weighted (ETF20 eqwt) and bitcoin (BTC). Left: performances in logarithm scale. Right: their cumulative P&L difference (ETF20 eqwt less BTC).

A.3.1 Top 20 caps equal weighted

Let's construct a simple strategy - an equally weighted portfolio on the same top 20 cap universe, which effectively increases the weights on cryptos of smaller sizes. We call it 'ETF20 eqwt'. The performance is shown in Fig. 13. The new strategy offers annual IR 1.8, return 220%, volatility 120%, max drawdown 90%, somewhat better than its predecessor. From the plot on the right we see a more consistent premium from small cap cryptos over bitcoin. We also observed annual cyclicality in this premium. In a live-trading environment we must consider transaction costs, but the analysis above is based on monthly turnover over top cap cryptos, the same conclusion almost surely applies. However, over 100% annual volatility and 80% max drawdown are way beyond the psychological threshold of average investors. We strongly suggest all investors to exercise your highest level of caution, and think twice how much capital you are literally willing to HODL and lose before any serious investment decisions.

A.3.2 Generalizing to top 50 caps

We then generalized the equal weighted portfolio to top 50 cap cryptos ('ETF50 eqwt') for more breadth, see Fig. 14. The new portfolio offers annual IR 2.7, return 310%, volatility 120%, max drawdown 82%, a significant improvement over ETF20 equal weighted. Small-cap premium is clearly stronger and more consistent in cryptos with lower caps. We include performance numbers for all three scenarios in Table. 5. Generalization as such is trivial and can be done on higher universes if needed, and the premium continues to grow as the cap reduces.

A.4 Conclusion

In summary, if we practiced passive investing consistently, assigned predefined weights and held on to a basket of cryptos with monthly turnover for a couple of years with expendable capital, we would benefit from small cap premium and earn higher and more stable returns than simply holding bitcoin. This is a typical phenomenon for most emerging markets, and the first and strong proof cryptos have qualified in the arena of security-like

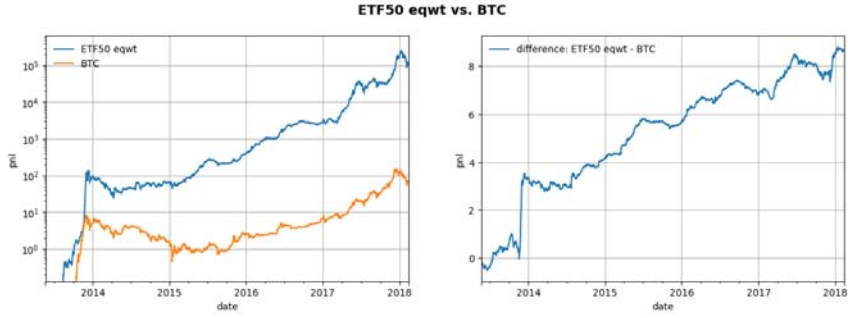


Figure 14. The performances of top 50 cap cryptos, equal weighted (ETF50 eqwt) and bitcoin (BTC). Left: performances in logarithm scale. Right: their cumulative P&L difference (ETF50 eqwt less BTC).

strategy	IR	return	volatility	max drawdown
BTC	1.5	130%	86%	82%
ETF20 cap naive	1.6	130%	84%	85%
ETF20 cap	1.7	180%	100%	88%
ETF20 eqwt	1.8	220%	120%	90%
ETF50 eqwt	2.7	310%	120%	82%

Table 5. Performance summary for BTC, ETF20 cap (naive, improved, equal weighted) and ETF50 equal weighted.

financial instruments. The more vibrant the new market, the stronger the small cap premium. As long as the fundamentals of the crypto market remain unchanged, excellent new projects and ecosystems backed by centralized organizations or companies will keep growing, and the premium will continue to persist.

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

B.1 Introduction

Multi-factor analysis has been popular in the stock market and expected to stay as such in the foreseeable 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 representative of company fundamentals and usually used to describe the risks or returns of a portfolio or asset. Much like the stocks, the return-generating process for cryptos is also largely 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 [B.2](#) presents and explains a number of crypto factors observed, including universe selection, factor construction and performance analysis. Section [B.3](#) discusses the tradability and performances of the long components of these factors, followed by conclusions in Section [B.4](#).

B.2 Crypto factors

The crypto market has been 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 - 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 characteristic 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 portfolios 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 stable cryptocurrencies or commodities like USDT and XAURUM, since they are merely cryptolized fiat or commodity of quite different nature 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 cannot happen too often in a sane and moderately regulated market. This

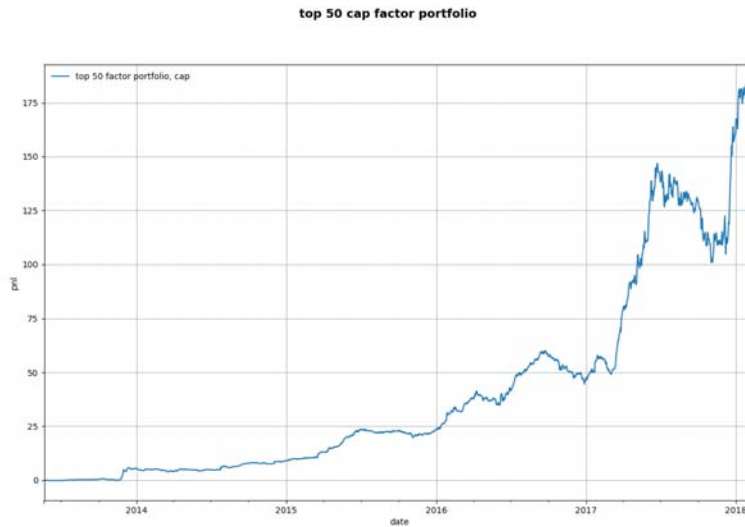


Figure 15. The size factor portfolio performance on top 50 cap cryptos.

treatment gave us a better picture for quantitative analysis purposes, but may affect live performance in extreme market conditions. Note all removed exotic price movements went upwards, so one can circumvent losses easily by taking long-only positions, which is to be discussed in Section [B.3](#).

B.2.1 Size

The size factor 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. [15](#), with annual information ratio (IR) 2.3, return 120%, volatility 52%, max drawdown 48%. The factor underwent three long drawdowns in the second half of 2015, 4th quarter 2016 and 3rd quarter 2017 - 16%, 25% and 31% peak to trough, respectively. The drawdowns are defined the same way as Ref. [\[4\]](#).

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 this aggressively expanding realm in many years to come. The bitcoin dominance declined for a good reason.

B.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. [16](#). We got annual IR 2.2, return 110%, volatility 49%, max drawdown 49%. The P&L is very similar to the size factor in Fig. [15](#), as the price and cap in the crypto world are highly correlated. Note new coins or tokens are usually mined at a fixed or exponentially decayed rate, and some of them feature repurchase and destruction mechanisms, which compromise the predictive power of the price factor to some degree and result in a return drift over all.



Figure 16. The price factor portfolio performance on top 50 cap cryptos.

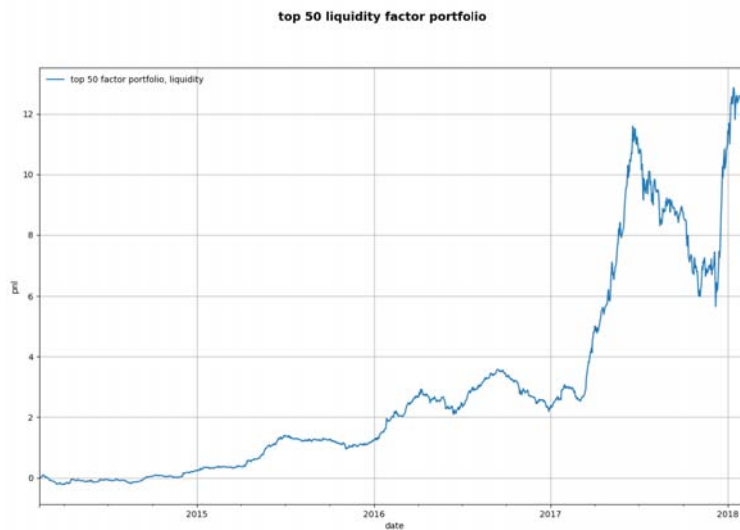


Figure 17. The liquidity factor portfolio performance on top 50 cap cryptos.

B.2.3 Liquidity

We took liquidity as the product of price and volume series, calculated the rolling simple mean over the previous month, inverted and constructed a factor portfolio following the same procedures. Much like the size 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 the cap factor. The performance is shown in Fig. 17. We got annual IR 2.0, return 70%, volatility 34%, max drawdown 47%. Not surprisingly, the liquidity factor performance highly resembles the size factor again.

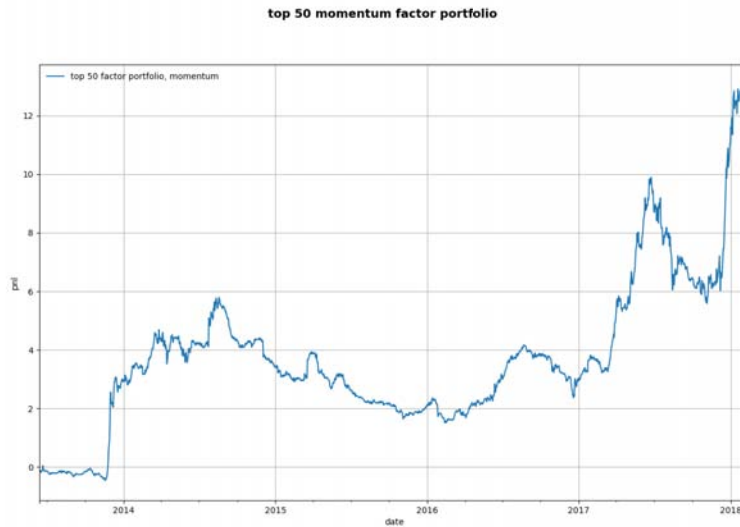


Figure 18. The momentum factor portfolio performance on top 50 cap cryptos.

B.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 one 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 much 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 a few years historically.

The factor performance is shown in Fig. 18. We observed some premium in inverse momentum, with annual IR 1.3, return 70%, volatility 55%, max drawdown 63%. There were strong surges (reversion) before mid 2014 and after 2016 with a long decline (momentum) in between. Two other notable drawdowns were recorded in the second halves of 2016 and 2017. During these periods, 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 could not stay hidden forever, and their price kept falling as investors gradually found out about their ill nature. One way to subdue underlyings of this kind would be to remove all cryptos on the fall last month (set momentum 0) and reconstruct the factor portfolio, but this breaks universe symmetry and fails to constitute an accurate factor portfolio. We leave the discussion on the long component of this treatment to Section B.3.2. Note most of the premium raised 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 cannot be too far behind.

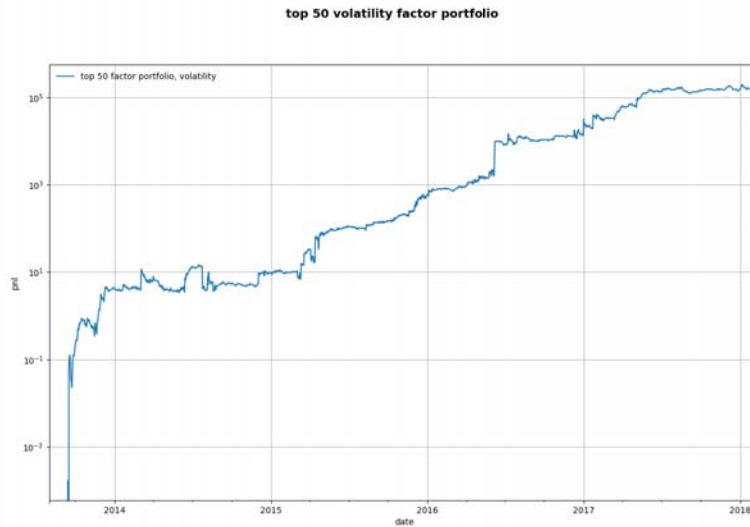


Figure 19. The volatility factor portfolio performance on top 50 cap cryptos, with the y-axis set to logarithmic scale.

B.2.5 Volatility

We calculated monthly volatility on daily rate of return series, constructed 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. Here volatility serves a similar yet complementary dimension, as many of these cryptos carry higher volatility too, and with great risk comes great return. The performance is as shown in Fig. 19, with the y-axis set to logarithmic scale for better readability. One may expect the performance similar to that of the size 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, the 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.

B.2.6 Drawdown

The drawdown factor is in general neither widely applicable nor acclaimed in the market neutral front of a mature 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 do not 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 no alphas exist as they claimed whatsoever, and they are all deemed to lose at some point, which is but simply a matter of time.

Does the drawdown factor work for strong emerging markets like the 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. 20, we have annual IR 0.32, return 30%, volatility 96%, max drawdown 90%. It seems to work in an 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 build the portfolio on both good and bad 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. 20.

At this point one may wonder if it is worthy at all to look into the drawdown factor. 0.32 is the lowest IR recorded among all factors indeed, however, it was largely compromised by a few weird price data points in 2013 and 2014, which we think are faithful but not to recur 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 B.3 and present another proof. The nature of this factor is however pending further observations out-of-sample.

B.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. 21, with annual IR 1.4, return 94%, volatility 70%, max drawdown 73%. The performance was strong between 2014 and 2016 but has decayed since. One may like to consider a higher frequency or expanded universe for stronger signals.

We include performance numbers for all factor portfolios in Table. 6.

B.3 Tradability and the long-only construction

B.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, as many premiums (as they appear) in the stock market effectively arise from limited executability. Indeed, the crypto market is at its infant phase after all. Unlike the stock market, there have not

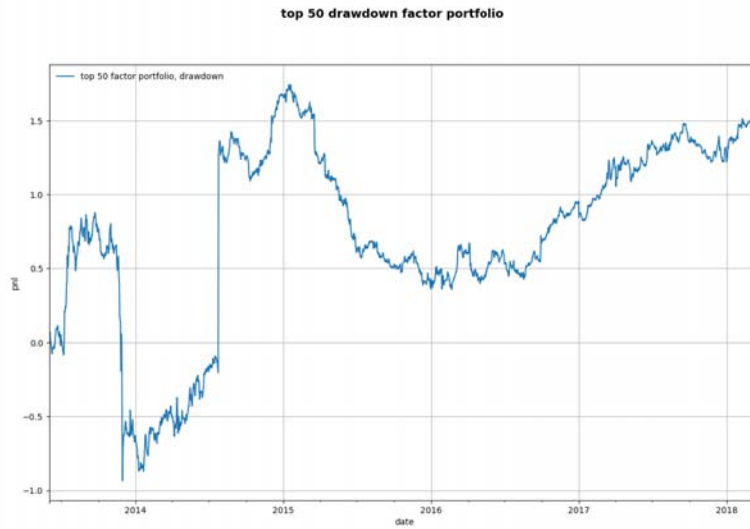


Figure 20. The drawdown factor portfolio performance on top 50 cap cryptos.



Figure 21. The beta factor portfolio performance on top 50 cap cryptos.

been a single crypto prime broker to offer large-scale comprehensive hedging or shorting service at a relatively low cost, mostly due to limited liquidity, popularity, and as a result, lack of institutional interests. The typical shorting interest in a crypto exchange 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. To make things worse, most cryptos in the top 50 cap are not shortable at all. Typical hedging service covers top 25 cap at most, Bitfinex for instance covers 23 cryptos in shorting as of October 2019.

factor	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 6. Performance summary for all factor portfolios.

Transaction costs, including the bid-ask spread and impact cost is another concern in live trading. Though picking up quickly, the crypto liquidity is still too poor to accommodate large hedge funds or mutual funds. Whales cannot swim in a small pool. One could however achieve higher capacity with lower frequency at the cost of some performance. Since the turnover assumed in our analysis is only monthly, as long as the size is not overwhelming, liquidity would not pose a big problem for small to midsize sharks to take a bite or two. On the other hand, better performance with higher frequency is possible but comes 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.

B.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 main goal of these long-only portfolios would be to beat the benchmark, bitcoin.

The performance of these long-only factor portfolios are shown in Fig. 22. For ease of comparison, we calculated the excess returns of these portfolios over bitcoin and showed them in Fig. 23. Admittedly, profits in these long components were mostly induced from the small cap premium and somewhat correlated, since a good number of low cap cryptos were involved in any case. However, orthogonal ingredients from individual factors persisted and resulted in some uncorrelated differences in P&L. Their performances are given Table. 7.

We mentioned in Section B.2.4 that troubled projects could be identified by consistently falling momentum to some extent. 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 is shown in Fig. 22-23 and summarized in Table. 7.

Another curious observation is that the long component of the drawdown factor did well in the anticipated max down dates (Nov. 2013) from Fig. 20. This is because the max drawdown happened to stem from the short component in those days and got evaded.

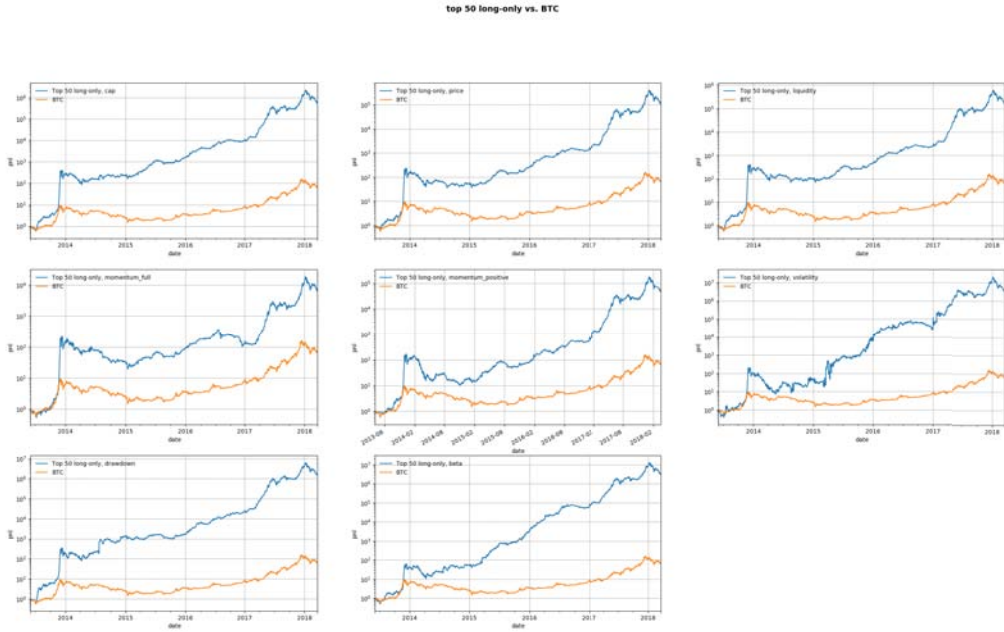


Figure 22. Performances of the long-only components for factor portfolios on top 50 cap cryptos: size, price, liquidity, momentum (full), momentum (positive), volatility, drawdown and beta. Blue: factor performance, orange: BTC performance.

However, even with the down in place, most profit still came from the small cap premium materialized, which would have covered up the loss easily.

These crypto factors are as applicable on the long exposures as their market neutral counterparts, if not more. They are simple and straightforward, yet highly explanatory and effective historically. We noticed recently that a large wave of crypto data vendors, social media and news agencies are on the rise, so are various kinds of ranking services, most of which endeavor to become the crypto industry equivalents of Bloomberg, Facebook, Google, S&P, Wikipedia, etc. Many of them would 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.

B.4 Conclusion

Factor models can be used to evaluate how much of a crypto portfolio 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 risk premiums or smart betas observed and

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

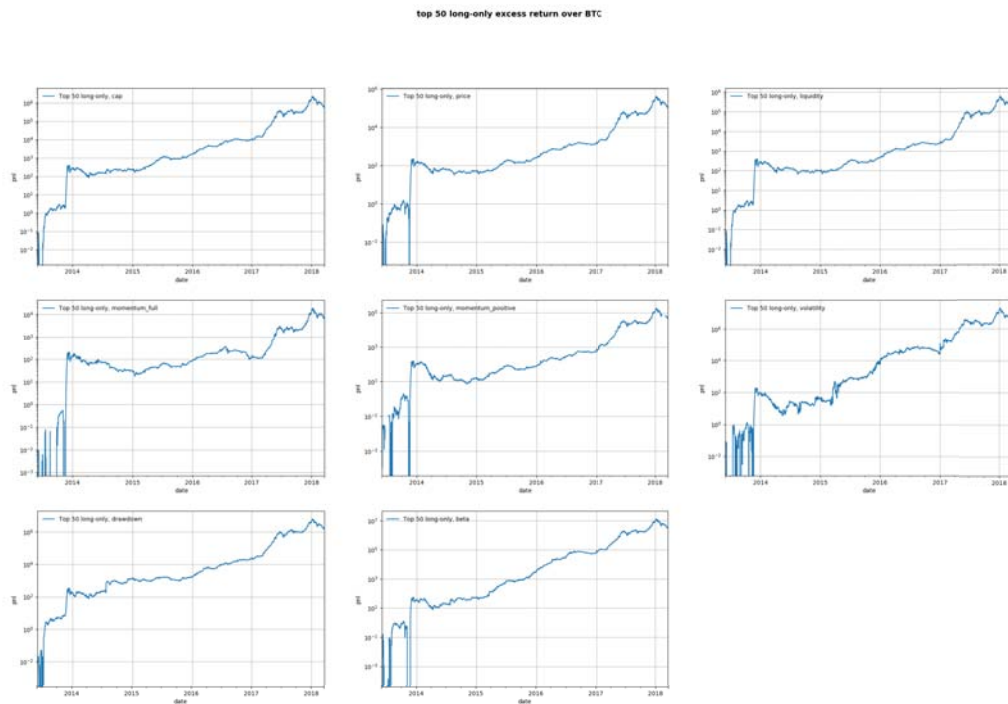


Figure 23. The excess P&L over bitcoin in the long-only components of factor portfolios on top 50 cap cryptos: cap, price, liquidity, momentum (full), momentum (positive), volatility, drawdown and beta.

reported in the crypto market, pending 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.

We will pay close attention to the evolution of these factors while the crypto market keeps growing and developing. We encourage interested scholars to join us and explore

more exciting quantitative dimensions of cryptos in depth, and are happy to offer assistance in our reach.

C The decline and fall of angels: where did the historical top cap cryptos go?

C.1 Introduction

Despite the fact that the crypto market grows exponentially over the last few years, most top cap cryptos faded away. Fig. 24 shows the top 10 cryptos in 2013 ranked in cap. Apparently every dog has its day, but how many of them have you heard of nowadays? Did you ever wonder where they went and how they performed in cap or price later? Did they burst out ultimately, or perish in silence instead?

Historical Snapshot - May 05, 2013

USD -

← Previous Week Next Week → View All

#	Name	Symbol	Market Cap	Price	Available Supply	% 1h	% 24h	% 7d
1	Bitcoin	BTC	\$ 1,261,032,079	\$ 113.46	11,114,672	-0.07 %	15.32 %	?
2	Litecoin	LTC	\$ 61,100,880	\$ 3.53	17,331,692	-0.05 %	13.91 %	?
3	Namecoin	NMC	\$ 5,710,685	\$ 1.05	5,459,714	-0.17 %	10.38 %	?
4	Peercoin	PPC	\$ 5,596,144	\$ 0.297292	18,823,710	-0.09 %	12.82 %	?
5	Feathercoin	FTC	\$ 2,532,299	\$ 0.400646	6,320,547	-1.35 %	-3.51 %	?
6	Freicoin	FRC	\$ 2,109,841	\$ 0.107150	19,690,469	-0.55 %	-13.68 %	?
7	Terracoin	TRC	\$ 1,349,993	\$ 0.562622	2,399,467	-0.69 %	-1.19 %	?
8	Devcoin	DVC	\$ 1,208,631	\$ 0.000275	4,401,638,196	-0.12 %	18.85 %	?
9	Novacoin	NVC	\$ 971,890	\$ 3.53	275,218	-0.00 %	15.49 %	?
10	Mincoin	MNC	\$ 170,594	\$ 0.168895	1,022,167	-8.43 %	-23.36 %	?

* Not Mined
** Significantly Premined

← Previous Week Next Week → View All

Total Market Cap: \$ 1,341,783,035

Figure 24. The top cryptos in cap according to CoinMarketCap, May 2013.

The paper is structured as follows. Section C.2 follows up the performances of historical top 50 cryptos that dropped out, calculates their returns against the US dollars and offers statistics in histograms. Section C.3 addresses a curious question arising from Section C.2 - does it make sense that most cryptos outperformed the US dollars yet fell out of top 50 cap? Section C.4 and C.5 discuss the performances of these dropouts on the bitcoin basis and ethereum basis, respectively, followed by conclusions in Section C.6.

C.2 Historical top 50 cap cryptos on the dollar basis

Starting from mid 2013, we kept selecting the top 50 cap cryptos consistently, and followed up the caps and prices for those dropped out of the list. In order to evaluate the true value of the projects, we removed the price movements during the first month upon inception, as volatility in this period is irrational due to frequent pump-and-dump. Projects with less than half a year history (up to February 2018) were still accumulating strength, it is unfair to judge their returns based on a short period as such, so we moved all these cryptos out of the picture too. Anchor currencies like USDT are removed too as they are bonded to fiats and lack research value. We collected over 200 cryptos in total, and the final list changes frequently over the last few years.

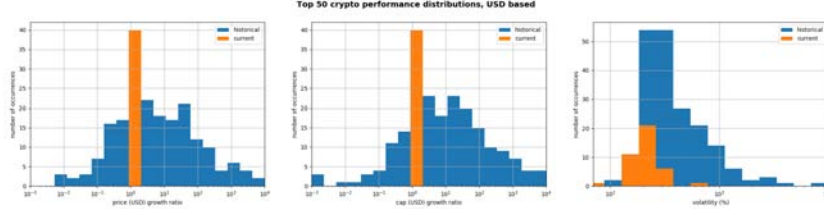


Figure 25. The price growth, cap growth and annual volatility distributions of top 50 cap crypto dropouts, US dollar based. The price and cap growths are compounded annually. The x-axes are set on a logarithmic scale.

Most of these cryptos remained anonymous in their afterlife, only limited few are remembered. Note their lengths of price history varied a lot. Old cryptos like bitcoin span the full period, but most new ones have merely one or two years of available data. We defined the initial price as the price before each of them fell out of the top 50 cap, and final price as today’s price as of February 2018. The ratios of final and initial prices were then computed and compounded annually for comparison. All prices and caps are based on the US dollars.

Fig. 25 shows the results in histograms, in annual price growth, cap growth and volatility from left to right, respectively. Different cryptos varied in issuance and destruction mechanisms (if any). The issuance rate could be fixed or dynamic, and in some cases depends on mining difficulties, as a result the cap and price are not necessarily in proportion. We therefore offered the statistics on both price and cap ratios. The x-axes are price, cap growth rates compounded annually (left and middle) and annual volatility (right), and the y-axes are the numbers of cryptos found in corresponding ranges. Since small cap cryptos differed significantly in prices and caps, we took x-axes in logarithmic scale for better readability. The orange bars are in the current top 50 list and provided as a reference, while the blue bars correspond to the dropouts. If a token failed to update its price in the last two months, we returned its value to zero.

Two distinct categories manifest in Fig. 25: old, robust cryptos like Bitcoin, Ripple, and fledglings launched over the course of the last few years and yet to prove their worthiness. We calculated their annual volatility earlier in Ref. [3], which corresponds to the orange area in the volatility plot on the right. Not surprisingly, the dropouts (blue area) carry much higher volatility than the survivors (orange area). And from the price and cap growth plots (left and middle), we see the survivors (current top 50 cap) have the ratio equaling 1. This validates our calculation: since they haven’t fallen out of the list, their initial and final prices or caps are equal by definition.

Now we are ready to check what happened to the dropouts. From left and middle of Fig. 25, we see 1/6 of them gradually diminished or even returned to zero (blue area to the left of orange bar), and 5/6 of them kept growing and managed to stay to the right of orange. Note the prices and caps are based on US dollars, i.e. 5/6 cryptos still outperformed the dollar, most of which carried small caps, and some even appreciated hundreds of times.

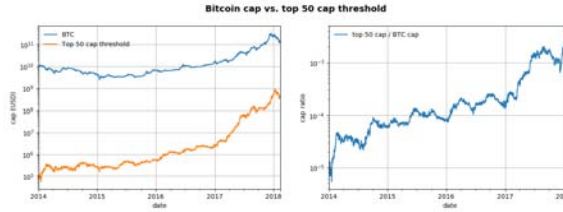


Figure 26. The evolutions of bitcoin cap and the cap threshold to top 50 cryptos since 2014. The y-axes are set on a logarithmic scale. Left: bitcoin (blue) and top 50 cap threshold (orange), respectively. Right: The cap ratio between the threshold and bitcoin.

This seems highly counter-intuitive, as rumor has it that most of crypto projects are scams and regressed to doom eventually.

C.3 Top 50 cap threshold on the rise

We noticed most anonymous cryptos actually outperformed the dollar, and some even beat bitcoin. Why didn't they stay in the top 50 cap list but dropped out instead?

Let's investigate the qualification to enter and stay in the list. Fig. 26 shows the evolution of bitcoin cap (blue) and the cap threshold required to stay in top 50 (orange) over time (left), and the ratio of threshold and bitcoin caps (right). The y-axes are both on a logarithmic scale. The left plot indicates the cap requirement in early 2014 was low. There were not many cryptos available after all, one sneaked in easily if it passed hundreds of thousands US dollars in cap. But as time went by, the threshold rose exponentially and reached hundreds of millions dollars in early 2018. This can be seen more clearly on the right plot - their ratio increases exponentially over time, and the threshold climbs much faster than bitcoin. In other words, if a new crypto intended to reserve a spot in the most wanted list, its growth rate must pass not only bitcoin, but also this top 50 cap threshold, or it would have lost the competition against other small cap cryptos and dropped out. Note the overall growth rate of this threshold amounts to 5,000 times over the last 4 years, and hundreds of times in 2017 alone, whereas bitcoin grew merely tens of times at its peak the same year. This is some truly remarkable caliber required of any new cryptos. We see once again the small cap premium prevails and dominates the crypto caps on the rise. Consequently, the bitcoin dominance fell significantly. This is the first risk premium or smart beta reported on cryptos, as was pointed out in Ref. [1]-[2]. Passive investing in the whole crypto market would be more profitable than investing in bitcoins alone.

C.4 Top 50 dropouts on the bitcoin basis

How many of these anonymous cryptos outperformed bitcoin? Why were they largely forgotten after all? We reran the statistics on the bitcoin basis instead of US dollars in Fig. 27. The plots on the left and right are the compounded annual price and cap growths on bitcoin. We see only 1/3 of the dropouts beat bitcoin (blue areas to the right of orange bar), and 2/3 of them lost the race (blue areas to the left). From Fig. 25 we know 1/4 of

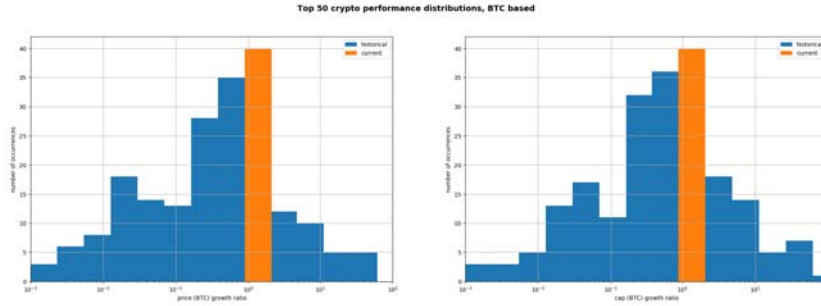


Figure 27. The price growth, cap growth and annual volatility distributions of top 50 cap crypto dropouts, bitcoin basis. The price and cap growths are compounded annually. The x-axes are set on a logarithmic scale.

the losers even failed to beat the dollar, while the rest of them appreciated over the dollar at least.

C.5 Top 50 dropouts on the ethereum basis

Ethereum was only two years old as of early 2018. It was a small cap paradigm itself in 2017 and served as the basic currency in an abundance of ICOs, leading to its strong and bubbled surge. It is expected to be harder for a new crypto to outperform ethereum statistically. The results on the ethereum basis is shown in Fig. 28. Sadly, it turned out that only 10% of the dropouts beat ethereum afterwards. This is the first evidence that most ethereum based projects had their best days upon a successful top 50 rush, after which most gradually faded away. This observation is critical for primary market investors, as most ICOs raised funds in ethereums lately. One probably ends up better swapping all crypto holdings back to ethereum after a march to the top list, unless he knows very clearly what he is doing.

More importantly, this is a strong reason many ICOs should be regulated at the security level, as it is hard to judge if the project sponsors anticipated this disturbing process, or even worse, got involved in it. Is their interest truly aligned with the investors, or instead against it, which effectively turns them into counter parties? All investors should seek an appropriate answer to this question from as many channels as possible before any asset allocation. A healthy emerging market only arises and thrives upon moderate regulations, as has been the case in stocks and IPOs.

C.6 Conclusion

It is challenging enough for a crypto to ascend to the top 50 cap from scratch. Even if it turned out as a flash in the pan, 1/3 of them kept outperforming bitcoin, and the reason they still dropped out was that they failed to beat the top 50 cap threshold on an exponential rise over bitcoin, which is a totally different story. The chance they lived and beat the US dollar is still as high as 5/6. This is because all cryptos have potential to serve as media to store and transfer value upon consensus, and Satoshi's ingenious cryptographic

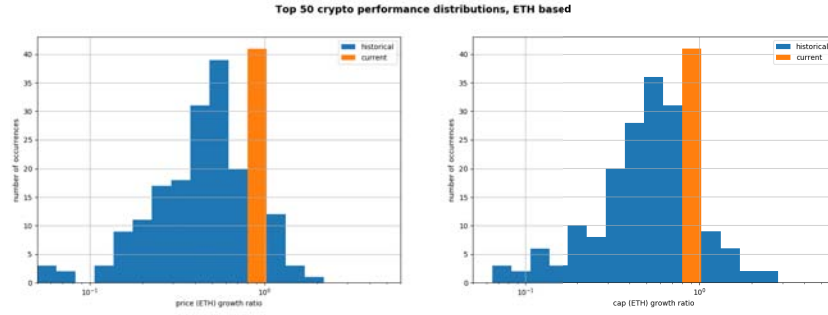


Figure 28. The price growth, cap growth and annual volatility distributions of top 50 cap crypto dropouts, ethereum basis. The price and cap growths are compounded annually. The x-axes are set on a logarithmic scale.

design offers them fundamental support. It is harder than most people think for a crypto to return zero. From another perspective, those that remain in the top cap list consistently almost surely have their strengths, as beating the top 50 threshold is a difficult mission on an exponential scale if at all possible.

However, if one has converted his wealth to bitcoin or ethereum basis and invests with crypto assets, e.g. participates in private or public token sales with bitcoin or ethereum and holds on to the tokens for a while, it is another story. He must tread carefully on the next move. If unable to decide, it is never a bad idea to sell away for the base crypto. After all, most cryptos declined and fell after ascension to the top 50 cap, and the dropouts have a low probability (1/3) to beat bitcoin, and only 10% chance to outperform ethereum. In particular, if one invests in a small number of cryptos and does not get to make the head returns out of a large project pool like a private crypto capital, his chance to make the right bets would be rather slim.

D The art of blade grasp: historical drawdown statistics on common cryptos

D.1 Introduction

Blade grasp, also known as Shirahadori, is a legendary defense technique to catch falling blades with bare hands, at least in cartoons. The real life technique of this name, however, does not involve blocking a sword but rather preventing the opponent from drawing his sword. More importantly, we would like to point out that your feet are much more trustworthy against any armed opponents than your bare hands in almost all scenarios. In case it is really too late to run, a wiser move is to dodge, rush in and seize your opponent's sword or hand while he stops at the end of swing or draws back, instead of catching the flat of a blade at 40 mph. This is however NOT to offer a fencing advice, you are responsible for your defense decisions at your own risk.



The crypto market has been growing rapidly for a few years, as the world is getting to know the value and profound influence of the Blockchain technology. What are the rules of thumb in crypto investments, if any? We constructed a few passive investing strategies in Ref. [1] and discussed the importance to invest with spare cash passively. This is the only way to profit for most investors.

On the other hand, much like 'catching a falling knife', bottom-copying is widely regarded as a risky investment approach. It is however strongly favored by value investors and reversion speculators under certain circumstances, who buy good stocks in the plunge and hold on until recovery or hitting new highs. From a more quantitative point of view, market or strategy declines are always watched over closely in all trading groups as one of the most important indicators for strategy assessment out-of-sample or even a regime change. Both require knowledge of historical drawdowns. An extraordinary drawdown in magnitude, length or multiple downs in higher frequency raises red flags and might require prompt measures in risk management.

We present in this article the historical drawdown statistics for top 50 cap cryptos since mid 2013. Section D.2 breaks down the drawdown occurrences in magnitude ranges. Section D.3 defines and gives crypto stability scores on period length, down magnitude and frequency, followed by conclusions in Section D.4.

D.2 Historical drawdown statistics

If $X = X(t)$, $t \geq 0$ is the cumulative return with $X(0) = 0$, the max drawdown at time T , $MDD(T)$ is the measure of decline in percentage from historical peak to trough as in Eq. D.1, and a drawdown is the max drawdown percentage between any two nonadjacent new highs at t_1 and t_2 , see Eq. D.2. Note the cycle containing a new high, drawdown and the next new high only has one drawdown by this definition, and we do not include any internal cycles in between, e.g. bitcoin movement between the end of 2013 and early 2017 is counted only as one single drawdown.

$$MDD(T) = \max_{\tau \in (0, T)} \left[\frac{\max_{t \in (0, \tau)} X(t) - X(\tau)}{\max_{t \in (0, \tau)} X(t)} \right] \quad (\text{D.1})$$

$$MDD(t_1, t_2) = \max_{\tau \in (t_1, t_2)} \left[\frac{\max_{t \in (t_1, \tau)} X(t) - X(\tau)}{\max_{t \in (t_1, \tau)} X(t)} \right] \quad (\text{D.2})$$

We picked the cryptos among the top 50 cap as of February 2018, removed stable currencies like USDT and any cryptos with a history less than half a year for fairer and more relevant assessments, and collected statistics on their drawdown magnitudes and frequencies starting mid 2013. Since newly launched cryptos are highly volatile and not of statistical significance, we removed the first month of price movements upon inception. We also disregard all drawdowns below 5%, as they are commonly observed and do not offer much insight in crypto stability.

crypto	5-10%	10-15%	15-20%	20-30%	30-40%	40-50%	50%+
Bitcoin	8	1	6	3	3	0	3
Ethereum	6	3	4	3	1	1	5
Ripple	1	4	4	1	1	0	6
BCH	2	0	0	1	1	0	3
Litecoin	4	6	0	4	2	0	3
Stellar	4	1	1	5	3	2	6
NEO	3	3	1	5	1	1	4
EOS	2	0	1	1	2	0	1
IOTA	2	0	2	1	0	0	2
Dash	6	6	4	4	5	3	6
NEM	9	10	5	6	2	1	4
Monero	8	8	4	3	1	3	4
ETC	1	4	1	5	3	0	3
Lisk	4	2	1	8	4	2	6
Qtum	3	0	0	4	0	0	3
Vechain	2	2	0	2	1	0	2
ZCash	1	0	0	2	0	0	2
OmiseGo	1	2	1	5	1	0	2
Raiblocks	4	4	1	5	0	2	4
Steem	1	1	1	2	2	2	4
BNB	1	2	1	4	0	1	2
Populous	4	2	1	4	1	0	2
Bytecoin	11	6	3	15	4	3	7
Stratis	8	9	3	3	1	1	4
Verge	5	9	7	11	20	12	16
Siacoin	5	4	8	7	2	1	4
Status	0	0	1	0	3	0	3
Dogecoin	2	2	4	1	2	1	5
BitShares	5	2	2	4	0	1	3
Waves	5	1	2	2	0	1	3
WTC	1	3	0	1	2	3	2
Aeternity	3	0	1	2	2	2	2
Augur	5	4	7	5	1	2	5
Veritaseum	1	3	2	0	0	2	2
HShare	2	0	0	1	1	0	2
0x	2	2	0	0	0	0	2
Decred	12	6	4	4	2	3	4
Ardor	4	8	2	2	1	1	2
DigixDao	4	2	5	5	1	2	4
Komodo	0	4	3	5	1	0	3

Table 8. Drawdown statistics on top 50 cap cryptos.

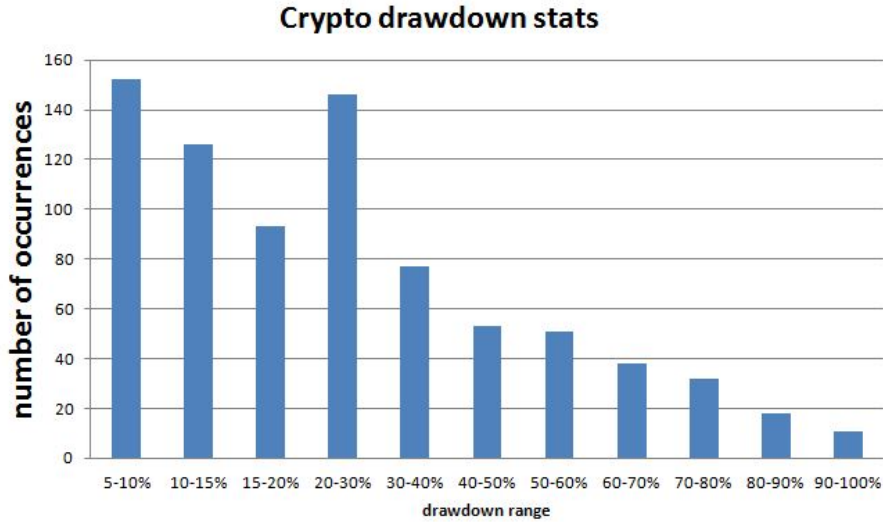


Figure 29. Drawdown frequencies break-down on top 50 cap cryptos. The x-axis is the magnitude and y-axis the number of occurrences.

The statistics are shown in Table 8, where we present the number of downs in corresponding magnitude ranges for all cryptos in consideration. Focusing on the plunges over 50%, we see Verge headed down in this magnitude for 16 times, way beyond the second tier in line. The next tier includes: Bytecoin, 7 times; Ripple, Stellar, Dash, Lisk: 6 times, Ethereum, Dogecoin, Augur: 5 times. Most of them are small cap cryptos at the time of declines, which underlined the risks involved betting on smaller caps. Bitcoin sits at the stabler end of the spectrum with only 3 downs over 50%: December 2013, 2014-15 and the ongoing bear market starting end of 2017. As the first crypto with longest history, bitcoins are relatively held more diversely, and whales are usually rational, firm believers in crypto prospects, resulting in fewer liquidations at times of turmoil.

In view of the strong correlation among all crypto prices much like the stock market, we concatenated all statistics from these cryptos and summarized the down distribution in magnitudes in Fig. 29. The x-axis is the down magnitude ranges, and the y-axis the number of observations accordingly. We see the frequencies of crypto downs roughly follow an exponential decay as the magnitude increases, as is expected of typical financial instruments, but with a fatter tail above 50%. This implies the bottoms in crypto market cycles tend to be lower than expected. Note the intervals below 20% are in 5% increments, and those above 20% are in 10% increments.

D.3 Stability scoring

Based on the drawdown statistics in Table 8, it is possible to evaluate the stability of these cryptos. We define the stability score (S) as the weighted average on a crypto's down occurrences O_i at interval i , with the mid value of each magnitude range as weight, see Eq. D.3. Ranges below 20% are in increments of 5%, and above 20% in increments of 10%. All downs less than 5% are again not counted for consistency. Note these cryptos have

varied history in lengths, and a fair ranking must take into account the number of days upon inception - older cryptos naturally decline more than the new ones and deserve certain compensation. We take the final weight as the mid value in range (mid_i) divided by the number of days (N) since launched, multiplied by 100 for better readability. The stability scores are shown in Table 9.

$$S = \sum_{i \in 5\% - 10\%, \dots, 90\% - 100\%} O_i * \left(\frac{mid_i}{N} * 100 \right) \quad (D.3)$$

crypto	stability	crypto	stability
Litecoin	28	NEO	98
Bitcoin	32	Bytecoin	101
Ripple	37	Augur	105
BitShares	38	Decred	106
Dogecoin	42	Stratis	118
ZCash	46	Veritaseum	120
Monero	55	Komodo	122
Stellar	61	BCH	126
Waves	67	Qtum	127
Ethereum	68	HShare	132
Dash	69	Lisk	133
NEM	78	Vechain	134
EOS	80	Status	142
Steem	81	OmiseGo	153
IOTA	87	Populous	156
ETC	88	Aeternity	159
Ardor	90	BNB	164
0x	93	Raiblocks	177
Siacoin	95	WTC	231
DigixDao	96	Verge	233

Table 9. Stability scores for top 50 cap cryptos.

Note lower scores indicate better stability, i.e. fewer weighted drawdowns. We see old cryptos like Bitcoin, Litecoin, Ripple and BitShares passed the most volatile cycles upon inception and are hence relatively stable, whereas new participants like WTC, BNB, Verge, Vechain, or cyptos with unclear future like Raiblocks, HShare tend to soar and slump dramatically. Some may wonder how Dogecoin sneaks in the top 5 list, that is because its historical price features strong cyclically, and according to our definition in Section D.2, this crypto did not really go down very often - the stability score does imply certain predictability or cyclically especially for old cryptos. Once again, we would like to remind our readers that the stability score here is solely based on drawdown statistics, and carries no direct

information from crypto volatility. It is but one dimension to understand the market risk from a quantitative point of view.

D.4 Conclusion

We collected the drawdowns in frequency and magnitude for top 50 cap cryptos, presented the concatenated occurrence break-down in magnitude ranges and calculated their stability score based on the drawdown statistics. We hope this analysis serves a complementary dimension for value investors, short-term speculators and portfolio risk managers in the crypto domain.

E Buckle up and enjoy the ride - volatility analysis on common cryptos

E.1 Introduction

An emerging market usually features high volatility. It is not uncommon that large price movements up to ten or hundred folds are observed in the crypto market, for it is still an infant and highly immature with ambiguous future in most people's eyes. The public has not reached consensus for the prospects of consensus based and cryptography backed universal equivalents.

Nevertheless, that does not compromise the importance of quantitative volatility analysis in any way, as it is a must for experienced quants to understand the market trend, control various sources of risk exposures and assess loss limits. Long story short, if the consolidation and concussion interval is within the volatility range of the last few years, there is not too much to worry about.

This article is intended for generic readers and crypto investors without a financial background. Section E.2 introduces volatility as a popular tool for risk analysis. Section E.3 presents the daily and annual volatility for the top 50 cryptos in cap as of February 2018, and briefly analyzed the implications for common investors, followed by conclusions in Section E.4.

E.2 Defining daily and annual volatility

We presented and analyzed the drawdown frequencies and magnitudes for top 50 cap cryptos in Ref. [4], designed a stability score and ranked them as appropriate. Let's look further into volatility, another major dimension in risk management and portfolio optimization. Define the rate of return (RoR_t) on the daily close prices ($Close_t$ as of day t) as Eq. E.1 and take the standard deviation on the time series, we obtain the volatility of the crypto over the course of the period involved. Note the length of the period (degrees of freedom) affects the value, a common treatment is to calculate the annual volatility for ease of comparison. A year for the crypto market is 365 days, and our last calculation was based on daily returns, so all we need along annualization is to multiply by $\sqrt{365}$.

$$RoR_t = (Close_t - Close_{t-1})/Close_{t-1} \tag{E.1}$$

Why is the volatility important? Statistically, we would know how probable the crypto price movements stay in a certain range. That is because the time series of the rate of return loosely follow a normal distribution, though with fatter tails or more black swan events. Fig. 30 shows the probability density function (PDF) of a standard normal distribution. The x-axis is the rate of return, each segment is one standard deviation (σ) or volatility in width, and y-axis the density distribution. The shaded area is the integral of probability density over the return range, which amounts to the probability any return shows up in corresponding ranges. For instance, the chance an annual return sits between 0 and 1σ (or annual volatility) is 34.1%, in other words there is 68.2% chance the return amplitude lies

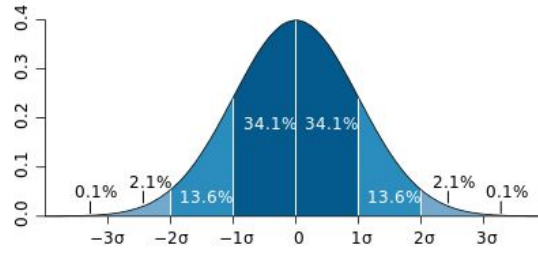


Figure 30. Probability density function for the standard normal distribution.

crypto	volatility	crypto	volatility	crypto	volatility
USDT	11.6%	OmiseGo	177%	Siacoin	233%
Dai	30.0%	Decred	184%	Qtum	237%
Bitcoin	86.1%	Stellar	185%	Binance coin	242%
Ethereum	138%	Augur	193%	Lisk	252%
Litecoin	147%	0x	195%	NEO	254%
Dogecoin	148%	Veritaseum	200%	Status	269%
Monero	149%	Ardor	203%	WTC	280%
Waves	151%	Stratis	204%	Steem	284%
Dash	157%	Populous	208%	Vechain	286%
ZCash	157%	NEM	209%	Aeternity	298%
ETC	158%	EOS	209%	Bytecoin	308%
Digixdao	163%	Bitcoin Cash	214%	Raiblocks	320%
Bitshares	165%	HShare	217%	Verge	508%
Ripple	174%	IOTA	219%	Komodo	629%

Table 10. Annual volatilities on top 50 cap cryptos.

within $(-\sigma, \sigma)$, as the PDF is symmetric about the y-axis and the probability of a price rise or fall is equal.

E.3 Volatilities on top 50 cap cryptos and implications

Now we are ready to assess the volatilities of top 50 cap cryptos as of February 2018. Starting mid 2013, we removed the prices for the first month upon inception, picked the cryptos with histories over half a year, and added one more stable cryptocurrency DAI for analysis. The annual volatilities are shown in Table 10. Some readers may find it somewhat counter-intuitive as most cryptos carry a volatility greater than 100%, so we present the daily volatilities too in Table 11 for better interpretability. They are ranked and aligned from highest to lowest.

These percentages are the annual volatilities when you start investing with 100% capital from mid 2013 to February 2018. They can be greater than 100%, since your asset may appreciate multi-fold and fluctuate drastically onward. Not surprisingly, US dollar based stable currencies USDT and DAI ranked in top two. DAI features a stable and decentralized

crypto	volatility	crypto	volatility	crypto	volatility
USDT	0.607%	OmiseGo	9.26%	Siacoin	12.2%
Dai	1.57%	Decred	9.63%	Qtum	12.4%
Bitcoin	4.51%	Stellar	9.68%	Binance coin	12.7%
Ethereum	7.22%	Augur	10.1%	Lisk	13.2%
Litecoin	7.69%	0x	10.2%	NEO	13.3%
Dogecoin	7.75%	Veritaseum	10.5%	Status	14.1%
Monero	7.80%	Ardor	10.6%	WTC	14.7%
Waves	7.90%	Stratis	10.7%	Steem	14.9%
Dash	8.22%	Populous	10.9%	Vechain	15.0%
ZCash	8.22%	NEM	10.9%	Aeternity	15.6%
ETC	8.27%	EOS	10.9%	Bytecoin	16.1%
Digixdao	8.53%	Bitcoin Cash	11.2%	Raiblocks	16.7%
Bitshares	8.64%	HShare	11.4%	Verge	26.6%
Ripple	9.11%	IOTA	11.5%	Komodo	32.9%

Table 11. Daily volatilities on top 50 cap cryptos.

margin system, whereas USDT has long been criticized as an overly centralized crypto in lack of transparent issuance mechanism. However, DAI launched just a month ago at the time of writing and lack degrees of freedom. It is yet to see if it really boasts the potential to outperform USDT in stability. DigixDao, a crypto gold hybrid is the stable cryptocurrency for gold, whose price is expected to be highly correlated with gold in the long run. It is not really a typical crypto project.

Aside from the stable currencies, tokens aimed for transfer and store of value (e.g. the public chains) tend to carry lower volatility, including Bitcoin, Litecoin, Ethereum, Monero and Ripple. In particular, bitcoin carries only half or less volatility of any other cryptos and ranked high in our stability analysis [4] as well, since it is the origin and the most senior in the market. Older exchange coins serve as the base currencies for large trade volume and tend to be stabler too, such as Bitshares, Waves, whereas 0x, BNB (Binance coin) are newer and more volatile. Among the public chains, Bitcoin Cash, NEO, Qtum, EOS, Vechain, Lisk, AE (Aeternity) are still rapidly growing and quite volatile. In the zero-transaction fee sector, IOTA turns out stabler than Raiblocks (Nano). As for the private payment coins, Monero, Dash, ZCash, Verge, Komodo rank in that order of stability. The former three are similarly volatile, but the last two are newer and much more so. Verge showed up again and took the last spot, and we knew it has a reputation of being unstable from the drawdown perspective [4], indicating drastic turnover and high risks over all. Note the volatility ranking is quite correlated with the stability ranking in general, yet somewhat different and complementary. Both of them serve as appropriate metrics for evaluations of portfolio risks.

E.4 Conclusion

In summary, the top 50 cap cryptos, the best representatives of the entire market mostly carry annual volatility greater than 150% or daily volatility greater than 7.9%. In other words, your crypto assets in these underlyings have a 31.8% probability to fluctuate beyond $\pm 150\%$ per year or $\pm 7.9\%$ daily, north or south. This is the risk level crypto investors must all endure - your initial capital could indeed regress to 0 before hitting a new high, and this is fully expected within the volatility range! We see again the importance to invest with spare cash, as with great return comes higher risk, which was discussed at length in Ref. [1]. Never, ever invest the capital you cannot afford to lose, or you would not hold on to it comfortably and long enough until the tail wind blows.

F Blue pill or red pill? Common myths in quantitative strategy research

F.1 Introduction

In the world depicted in the critically acclaimed movie 'The Matrix', you take the blue pill and the story ends, you wake up in your bed and believe whatever you want to believe - falsehood, security, happiness and the blissful ignorance of illusion. However, if you take the red pill, you will be offered knowledge, freedom, adversity, with the brutal truth of reality.



Do you get a funny feeling that the entire market is moving against you all the time? Why does it always move in the opposite direction against my bets? Why doesn't the whales just let go of my tiny thousand-dollar position? Why does everybody else claim to make a hell of profit, and I always seem to be the compromised?

First of all, this is largely a psychological effect in consequence of evolution - humans are born to be risk averse. You are actually doing better than you think, and just happen to magnify the result from bad bets instinctively. You are not alone, all portfolio managers and traders are facing the same conundrum - market drawdowns bring us far more negative feelings and memories than rallies. They affect your trading decisions if you don't keep them under control. This is an important reason many individual investors buy high and sell low at the wrong times. The best way to fight against it is to persevere in a systematic, working strategy and keep improving it year after year.

However, it would have been too easy if that's the full story. Aside from psychology, the construction of trading strategies are easily swamped in a few common myths. These are hazardous zones even experienced and successful fund managers must tread carefully. We discuss in this article the typical mistakes researchers make in developing new strategies, and ways to cope with them properly. Section [F.2-F.7](#) discuss the symptoms, reasons and solutions to overfitting, forward-looking bias, selection bias, reliability in consolidated prices, issues in intraday candlesticks and transaction costs, respectively, followed by concluding remarks and open brainstorm in Section [F.8](#).

This article is intended for generic readers with all backgrounds, and the scope goes beyond just cryptos.

F.2 Overfitting

You took a crypto and analyzed it with a few common indicators, conducted fine-tuning in a large, multi-dimensional parameter space and determined the best set. But when you applied this set on simulated or live trading, the signal vanished or diminished significantly.

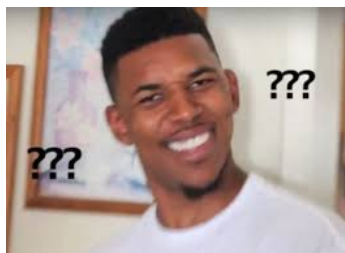


Thus Spoke Katula: Simple predictors like technical indicators are usually limited in predictive power. When you optimize them along backtests, a default assumption is made: these indicators are informative and valuable. This is however not always true and should be examined closely and proactively. Moreover, even if the indicator offers guidance for market signals, one must avoid overfitting, as it brings overly optimistic results far from the truth.

Solution: Select appropriate indicators with systematic rules. Good strategies are usually based on a straightforward and reasonable vision neither too complex nor too simple. It is usually difficult to find good strategies out of publicly available data such as price and volume. Fit the data conservatively, or look for signals with artificial intelligence or machine learning techniques. These advanced methodologies are better means to search for needles in the big data haystack. We noticed a trend lately that top IT talents joined renowned high frequency shops or hedge funds. As AI technology progresses, the financial markets become more and more efficient, and professionals have been setting and pushing a bar on alpha research beyond the reach of most enthusiasts outside quantitative or coding backgrounds. If you are interested to develop your skills toward machine learning in your spare time, the testbase on Kaggle is a good entry point to get started.

F.3 Forward looking bias

You found the top cap underlyings, checked their historical performances and discovered a few nice patterns. Perfect! And you started to construct your trading strategies. But the signals with great historical performances behaved quite differently in live trading.



Thus Spoke Katula: Do your historical data contain information from the future? Any quantitative research requires or favors point-in-time data. We can't emphasize more about its importance. This means all data used in backtests should be available or readily attainable upon every timestamp. When you select today's top cap underlyings for historical backtests, an implicit assumption is made that you knew about their future success, but that wasn't necessarily true back then. According to our previous statistics in Ref. [5], most top cap crypto dropouts failed to beat bitcoin. If you select the universe point-in-time, the results would be quite different.

Another type of implicit forward looking bias has to do with data vendor's backfill methodology. For instance, a vendor established their business in 2015 and provides data from 2011. It is critical to find out how they obtained data between 2011 and 2015: did they collect them real-time, purchase them elsewhere, or simply backfill by certain rules? Simple price-volume and cap data are likely fine, but complex ones such as news, sentiments, rankings, company fundamentals must be collected and posted point-in-time to be trustworthy, as they are easily modified ex post to meet certain expectations, intentionally or not. Smart and experienced vendors collect and package their point-in-time data for a higher price. The backfilled data usually carry some hindsight, which compromises their reliability to a good extent.

Solution: Document all information and data collections with accurate timestamps. Construct your strategy on real-time data readily obtainable on each timestamp. Backfill with conservative estimates, and avoid capturing any information from the future at any point of time.

F.4 Selection bias

After careful preparation over a while and lots of trials and errors, you identified 100 systematic strategies. Some of them were based on single names, some multiple. They all varied in research methodologies, but all made sense in some ways and performed well in backtests. You ran them in simulated trading and combined them as appropriate, but were shocked after some period of time - their out-of-sample behaviors turned out very different from historical performance, and the combined strategy seemed almost flat!

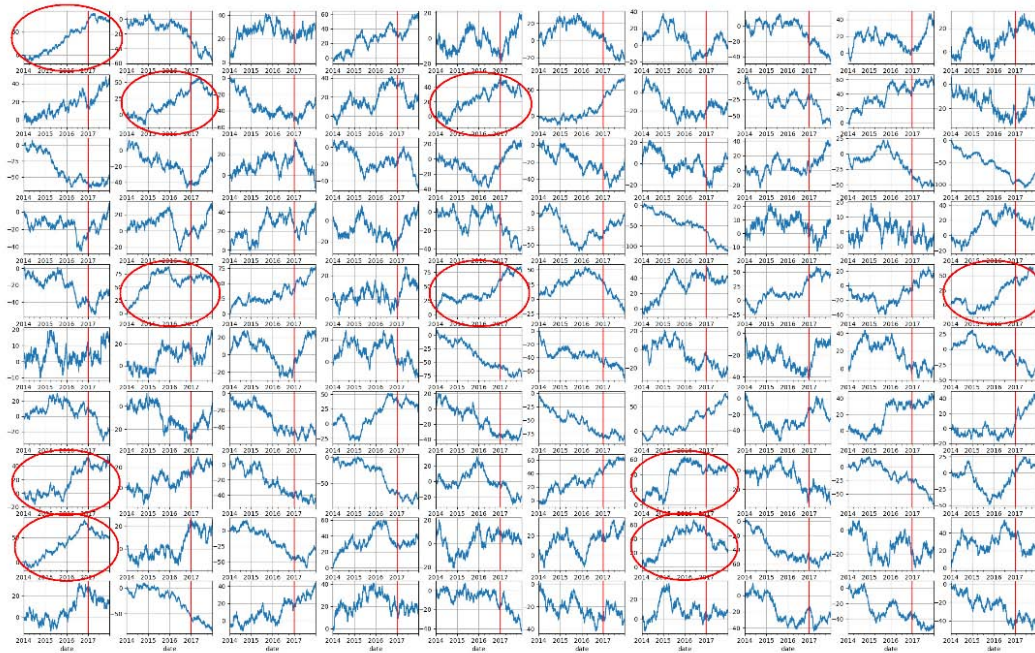


Figure 31. The cumulative P&L out of 100 time series of random daily rates of return, generated from a standard normal distribution. The in-sample and out-of-sample stay to the left and right of vertical lines, respectively. The circled are top 10 performers over in-sample returns.



Thus Spoke Katula: How many times did you trial for a tradable strategy? The issue raised from the number of trials you conducted and errors you disposed of. If you tried 100 times, found half of them profitable and picked the best 10, be warned. Strategy research is a cruel domain. Unlike the realm of scientific discoveries and inventions where single and repeatable experiment proves or disproves everything, if you don't do it right, your result is mostly likely a statistical fluctuation. We present a straightforward example here. Let's generate 100 time series for daily rates of return out of a standard normal distribution. Their cumulative P&L over the last 4 years are shown in Fig. 31.

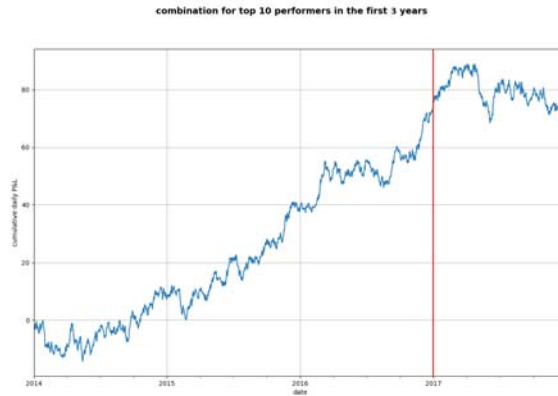


Figure 32. The cumulative P&L of the equal weight combination on the top 10 in-sample performers in returns.

Intuition and commonsense from statistics tell us, the final returns of these 100 'strategies' follow the standard normal distribution too. We take the first 3 years as in-sample, and the last year as out-of-sample, corresponding to the left and right areas beside the vertical splitters. Now we pick the top 10 in-sample performers in returns (circled in red) and combine them with equal weights. Fig. 32 shows the combined portfolio performance. We see the strategy performs well in the first 3 years as selected and expected (in-sample, left of vertical red line), but poorly in the last year (out-of-sample, right of vertical red line). The reason is straightforward. We generated these time series out of random numbers, and the simulated trading in out-of-sample is but the mean of 100 random series as well. By the law of large numbers, the more 'strategies' involved as such, the more horizontal and straight the cumulative P&L would be out-of-sample. It is also easy to verify this directly from Fig. 31, that the chance to profit is about 50% in the full ensemble, either in-sample or out-of-sample, and also about 50% out-of-sample for the top 10 in-sample picks circled in red. Now you see how easy it is to pick ambiguous strategies among a large number of time series out of trial-and-error. Many of them are inevitably statistical fluctuations and not really applicable, let alone those appear to make sense, but actually do not for reasons one isn't aware of due to limited understanding or resources.

When your research advances to a certain stage, you would realize that the effective distinction of true strategies and random series is the divide between excellent fund managers and the crowd, either in strategy picking or talent hiring. An independent trading team in a quantitative fund relies heavily on the portfolio managers (PM) and quant researchers. The PMs decide final positions based on multiple quant models, and take responsibilities on the P&L. The researchers are responsible in proposing alpha or beta models without taking capital risks. Their ratio is typically 1:3 to 1:10, and the de facto divide between them is the ability and experience to select and invest tradable strategies. This is a challenging task all hedge funds pay dear resources to accomplish, and quite likely tougher than most people think.

Solution: Develop strategies backed by economical, financial or value-investing principles and avoid overly complex research methods. Lower your expectations. Admit and assume that all new strategies could perform differently in and out-of-sample. Paper trade for some time before any massive capital allocation. Size up prudently and gradually. The time it requires to paper trade is contingent on the out-of-sample performance - shorter if pretty good and vice versa.

F.5 Executability of consolidated prices

You analyzed data on Coinmarketcap, found some interesting patterns, developed some strategies and paper traded them for several months. The out-of-sample looked good and cleared, no problem! But when you started live trading, the P&L achieved ended up quite different.



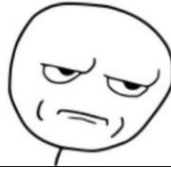
Thus Spoke Katula: If your strategy is somewhat sensitive to the prices, that's usually because a relatively high trading frequency results in higher turnover. It is perfectly fine, but did you ever wonder if the data you backtested upon might not be as reliable as you thought? Coinmarketcap and most websites offer consolidated prices, i.e. a weighted mean price across multiple exchanges, usually by liquidity but sometimes other factors weigh in too. However, the consolidated price isn't necessarily tradable in specific exchanges especially if your volume is high.

Solution: Trade less if you can, and use the actual data from the exchange for backtests. The length of such data is usually not long, and consolidated prices are still needed beyond a certain point, but one can at least try to confirm the recent performances with available data from the exchange. The result is usually worse than your backtest, intraday trading in particular.

F.6 Reliability of interval prices

An expert in big data analysis, you found the volatility in cryptos much stronger than the stock market and feature distinctive patterns. You went ahead and built a machine learning based strategy on 5-minute prices. The performance was strong historically and out-of-sample, but diminished a great deal, flattened out or went south in live trading.

ARE YOU [REDACTED] KIDDING ME



Thus Spoke Katula: The shorter the candlesticks the less reliability, even a different exchange could give you distinct results. As all roads lead to Rome, there are 5 ways to define a 5-minute interval, one can start from the first, second, third, fourth and fifth minute. If your strategy works on one of them and performs poorly on some others, there could be implicit overfitting. Moreover, the longer it takes to compute signals, the more uncertainty in live trading. Since the order book depth and slippage vary across different exchanges, the backtested and executed prices could be quite different.

Solution: Use different ways to construct your candlesticks, and test performances separately for intraday strategies in particular. Beware and stay alert if you can't profit in the worst scenario.

F.7 Transaction costs

Your historical backtest soared straight up! Exhilarated and motivated, you tested the strategy live for a couple of days and the performance went straight down?



Thus Spoke Katula: You may or may not include the transaction costs in massive backtests, but the bottom line is to keep your eyes wide open on the turnover. There is a big difference in costs between monthly and daily rebalancing, for which reason most alphas or signals seem to exist before cost but evaporate after. Also, the total cap and volume in the crypto market aren't big enough for now, and lack of liquidity means the bid and ask spread is insufficient to estimate the transaction costs. One must calculate the executable prices with an in-depth order book on your capital size, or equivalently, estimate the capacity of your strategy based on the average liquidity of cryptos involved.

Solution: Trade less often and trade small. Estimate the transaction costs as accurately as possible. A conservative methodology and defensive mindset go a long way.

F.8 Conclusion and brainstorm

We reviewed the common myths, possible reasons and potential solutions in quantitative strategy research. This is however a lightweight overview intended mainly for readers without a financial background in the buy side.

Now that you have a better idea in quant research, let's work on a few interesting open questions and brainteasers. Don't be surprised if you ran into some of these in a quant interview, crypto or not!

1. All bubbled market participants are enthusiastic about the hunt for the next hundred-fold underlyings, crypto markets in particular. What are the potential myths in those predictions? What if one attempts to predict tens of cryptos separately over the course of weeks? Assuming faithful without further modification, are those historical snapshots or analysis on single-name predictions trustworthy? What is it to gain if one keeps doing so?
2. If you make predictions often, and many readers referenced your suggestions to trade (not necessarily a strict copy), what happens? Will they believe you if you are an ordinary predictor? And can you come up with predictive methods with almost 100% success rate under certain circumstances? No cheating of course. Hint: what if you offer an entry point without an exit point in a highly volatile (even better, growing) market like the cryptos?
3. Why is auditable or verifiable track record so important? Why do professional hedge funds always emphasize 'past performance is not indicative of future results'? Why do they accept capital from accredited investors only?
4. Does it help if a fund issues decentralized tokens? Any pros and cons? What use cases can you imagine? How would you price the tokens? Would it be higher than the redemption price the fund offers (if applicable)? Why? Should a crypto fund raise fiat or cryptocurrencies? What standard(s) should they be based upon in P&L reports and settlements? Does it differ between a mutual fund and a hedge fund?
5. How would you pick a competent fund manager to invest with? In other words, if you are the CEO, how would you pick adequate and qualified portfolio managers and quants to work for you?

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