Real Digital Asset Index: A Fundamentally-Weighted Index for the Crypto Asset Class

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Abstract

Speculative trading accounts for the vast majority of cryptoasset usage. This has resulted in a volatile asset class that creates risk for investors at all levels. To address these risks, we develop a fundamentally weighted index (Real Digital Asset Index) for the asset class.

We start our analysis with the Friedman conjecture which states that users of cryptoassets fundamentally value peer-to-peer, trustless, decentralised and censorship resistant transactions. From the Friedman value drivers, we derive several other factors, demand-side and supply-side, that give fundamental value to cryptoassets: Grouped into four categories, we refer to these factors as RDA Attributes. We then model the Intrinsic Value (IV) of cryptoassets as a function of their RDA Attributes. This unique RDA Attributes-weighted methodology is combined with modern portfolio theory (Markowitz optimisation) to derive five data sets, namely; RDA IV Ranking, RDA IV Rating, RDA Pricing, RDA Exchange Rates and RDA 10 Index.

In the last part of the paper, we discuss the various uses of RDA data sets to address investment risks and summarise the backtesting undertaken on the RDA Price and RDA 10 Index in order to assess its reliability and potential use as trading benchmarks.

Keywords:
Cryptoasset, Intrinsic Value, Fundamental Analysis, Backtesting

1 Introduction

There are over 10,000 cryptoassets traded across 40,000 markets by nearly 250 million active users. As at the time of writing, £950 billion had migrated from traditional asset class such as commodities and stocks into cryptoassets. With the fear of great market crashes that is consistent with cryptoassets, investors seek clarity on asset valuation beyond market-capitalisation weightings and price series. Four main problems inhibit intrinsic valuation of cryptoassets:

1. A lack of information on the fundamental drivers of the cryptoasset market,
2. The complex nature of an asset class is not captured by traditional financial markets analytical frameworks,
3. Excessive speculative trading leading to high market volatility,
4. Regulatory uncertainty resulting in a weak compliance regime.

These challenges disincentivise new entrants into the market and constrained mass adoption of cryptoassets across industries and economies. Real Digital Asset Index (RDAi) address the four problems of valuation, asset complexity, volatility and regulatory compliance through multi-factor analysis to establish an instrinsic value (IV) benchmark for the asset class. RDAi is conceived to bring a quantitative approach to fundamental analysis of cryptoassets.

In this paper, first we present the RDA Points System for cryptoassets and the methodology used to construct it. Second, we use the RDA Points System to generate five data products:

- RDA IV Ranking: Cryptoasset ranking by intrinsic value
- RDA IV Rating: Cryptoasset rating by investability
- RDA Pricing: Pricing of cryptoassets based on their underlying intrinsic value
- RDA Exchange Rates: Intrinsic exchange rates between cryptoassets
- RDA 10 Index: A fundamentally-weighted index of 10 cryptoassets from the top 500 by marketcap

Third, we describe the ongoing backtesting analysis to demonstrate the reliability of RDA Pricing and returns of RDA 10 Index. Finally, we summarise our conclusions and state the limitations of the RDA Index Data Suite.

2 The RDA Points System

In the style of Emiliano Pagnota and Andrea Buraschi [2], we cite the Friedman conjecture as the foundation of our work:

> "I think the internet is going to be one of the major forces for reducing the role of government. The one thing that's missing but that will soon be developed, is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B without A knowing B or B knowing A." Milton Friedman, 1991

We take for granted that users of cryptoassets value the ability to engage in trustless, decentralised, censorship resistant peer-to-peer financial transactions. These factors are intrinsic to most of the cryyptoasset networks available today. From these factors we derive several other qualities, demand-side and supply-side, that a cryptoasset must have in order to be of value. These qualities include community participation, decentralisation, voting rights, computational nodes, token velocity, and so on. We aggregate these qualities into to four distinct groups and refer to them as Real Digital Asset (RDA) Attribute Groups. Detailed analysis of the RDA Attributes is outside the scope of this paper: We present a broad view of the attributes as follows:

2.1 Real Digital Asset Index Attributes

The four groups of RDA Attributes consist of Business Ecosystem Stability (E), Digital Utility (U), Technology Efficiency (T), and Sentiments (S) on the three core (E), (U) and (T) attributes. RDA attributes are found more in some cryptoassets than in others which enable those cryptocurrencies to attract and retain value.

2.1.1 Business Ecosystem Stability (E)

The Business Ecosystem Stability component represents resilience and the capability to maintain a stable state of socio-economic equilibrium that keeps the cryptoasset alive and valuable. This group of attributes reflects the value brought to the token by the strength of the team, community, investors and the influence of competitors and regulators.

2.1.2 Digital Utility (U)

Much of the speculation around the value of digital assets stems from their promise as investment vehicles, and this area is subject to intense regulatory scrutiny from securities agencies. However, for other tokens, at least a proportion of their value is intrinsic to their actual use case within a payment or software application ecosystem. A pure utility token may still rise in value if the ecosystem for which it is developed undergoes growth and demand increases, however under this group of attributes we examine the extent to which the token has inherent value due to its use cases both on-chain and off-chain.

2.1.3 Technology Efficiency (T)

All cryptocurrencies may be regarded as innovative technologies, however with a 13 year history now to draw upon, different technologies may be regarded as having distinguishable track records of effectiveness. As a range of different consensus mechanisms and mainnets proliferate at this time, we compare a diverse range of factors to yield evaluations of how efficient and secure are the specific technologies in use.

2.1.4 Sentiments (S)

The Sentiments attributes seeks to measure the level of sentiments that persists in favour of the asset's fundamentals i.e. ecosystem stability, utility, and the underlying technology. In an era when hype has had far too much influence on cryptoasset valuation and pricing, RDAi is keen to ensure sentiment is viewed with the appropriate lenses as another important factor alongside the preceding groups of core RDA attributes. The role of sentiment on the intrinsic value of cryptoassets cannot be downplayed particularly in the social endorsement of an asset's intrinsic worth.

2.2 Calculating RDA Points

From the above, we argue that the existence of RDA Attributes in a cryptoasset determines its reliability as a store of value and consequently its bonafide use as a value-based currency.

To model the intrinsic value of a cryptoasset, A, we specify a mapping $(E, U, T, S) \rightarrow r(A)$ that quantifies the intrinsic value of the asset as a function of its attributes. A measure of the intrinsic value of an extant cryptoasset A is hence defined by the RDA Points function :

$$r(A) = \sum_{i=1}^{I_Q} \left(\omega_i \left(1 + \alpha SQ_i\right) Q_i\right) \tag{1}$$

Where I_Q is the number of RDA (E, U, T, S) attributes, ω_q is the weight associated with an attribute Q, SQ is the IV sentiment expressed on an attribute Q, and α is the additional scaling factor assigned to the entire group of Sentiment attributes.

3 Reference Portfolio Construction

Despite their inherent usecase for borderless, permissionless and decentralised peer-to-peer transactions, behaviour consistent with speculative trading accounts for the majority of cryptoasset uses. A portfolio of cryptoassets can be constructed to reduce volatility such that its market price infer its fair price at a specific point in time. By definition, this portfolio's value should not vary uncontrollably with time. The Modern Portfolio Theory (MPT) allows us to define this (reference) portfolio to have the lowest possible volatility whereby its market price reflects the lowest level of speculation.

The use of MPT to construct the reference portfolio enables us to minimises the covariance of asset returns in general, upside and downside and derive the optimal weights of assets within the portfolio from a risk perspective.

3.1 Assets Selection for the Reference Portfolio

We select assets constituting the reference portfolio from the top five assets by market capitalisation across five major categories of cryptoassets as at June 30, 2020. The five categories used to construct the reference portfolio include (1) Unbacked payment cryptoassets (2) Gold-backed cryptoassets (3) Exchange-backed cryptoassets (4) Fiat-backed cryptoassets and (5) Smart contract platform-backed cryptoassets.

We start by creating for each of the 5 categories of cryptoassets a sub-portfolio with minimal volatility. Then, in order to obtain the global portfolio, we proceed to obtain the optimal combination of these sub-portfolios that again minimises the total volatility.

3.2 Calculating the Reference Price

Let A_h^i denote a cryptoasset of type h. There are I_h unique cryptoassets of type h. The price of an asset A at time t is denoted P_A^t. Hence, the return of an asset A_h^i between t_1 and t_2 is given by:

$$R_{A_h^i}^{t_1,t_2} = \frac{P_{A_h^i}^{t_2} - P_{A_h^i}^{t_1}}{P_{A_h^i}^{t_1}} \tag{2}$$

The covariance matrix between the I_h daily returns $R_{A_h^i}$ of the assets of type h is denoted by Cov_h. It is a symmetric definite positive matrix of size $I_h \times I_h$

Each cryptoasset belongs to a unique asset class h. For each asset class consisting of I_h digital assets, we find the optimal combination of portfolios that minimises the total volatility as follows :

$$\min_{\omega_{A_h}} \quad \sum_{i=1}^{I_h} \sum_{j=1}^{I_h} \omega_{A_h^i} \omega_{A_h^j} Cov_h^{ij} \tag{3}$$

$$\text{subject to:} \quad \sum_{i=1}^{I_h} \omega_{A_h^i} = 1 \tag{4}$$

where ω_{A_h} is the vector of weights applied on assets in portfolio h.

The solution of this problem will generate an optimal portfolio Pt_h^* whose price at any time t is given by :

$$Pt_h^{*t} = \sum_{i=0}^{I_h} \omega_{A_h^i}^* P_{A_h^i}^t . \tag{5}$$

$\omega_{A_h^i}^*$ is the solution to the previous optimization problem within every asset class. The procedure for generating the reference portfolio Pt_{ref} is a repeat of the previous procedure but now applied on the H portfolios Pt_h^*, whose covariance matrix is denoted by Cov_*. Hence :

$$Pt_{ref} = \sum_{h=0}^{H} \omega_{Pt_h^*}^{h*} Pt_h^* \tag{6}$$

$\omega_{Pt_h^*}^{h*}$ is the solution to the optimization problem along asset classes. Or in other words,

$$Pt_{ref} = \sum_{h=0}^{H} \omega_{Pt_h^*}^{h*} \sum_{i=0}^{I_h} \omega_{A_h^i}^* P_{A_h^i}^t \tag{7}$$

Thus we derived the optimal weight and price that minimizes the covariance of asset returns.

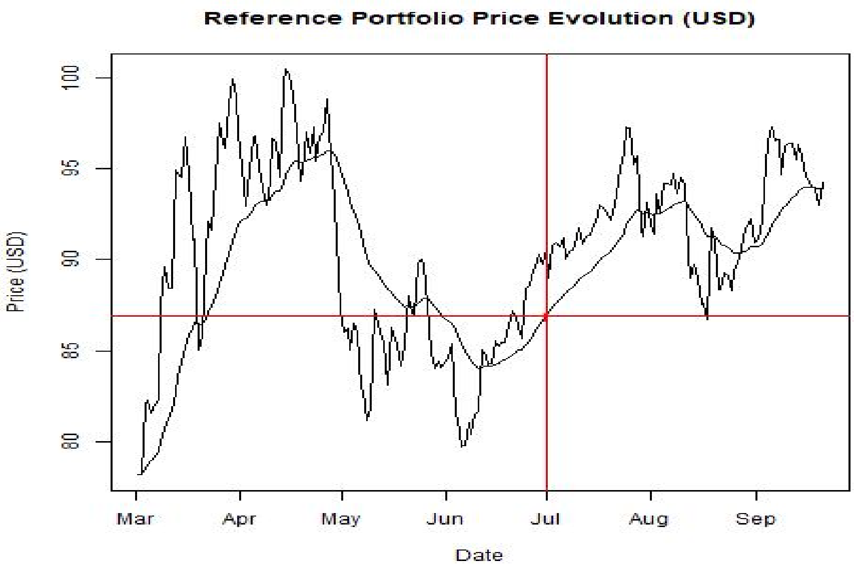

Figure 1:

3.3 Fundamental Price of the Reference Portfolio at March 31^{st} 2021

By definition of the reference portfolio, it is built to extract the portfolio whose fundamental price can be derived from its market price at March 31^{st} 2021 using a 14-day Exponentially Weighted Moving Average initialized at November 1^{st} 2020.

$$Pt_{ref} = EWMA(\sum_{h=0}^{H} \omega^{h*}_{Pt^*_h} \sum_{i=0}^{I_h} \omega^*_{A^i_h} P^t_{A^i_h}) \tag{8}$$

3.4 Practical Considerations

While Bitcoin was the only cryptoasset in 2007, as at the time of writing this paper, there are more than 10,000 cryptoassets traded and grouped under numerous classification. We select the most popular assets within each of the aforementioned asset categories or types. Also, the current level of maturity is assumed to have been attained starting November 1^{st} 2020, which is the date we consider to be the starting point of our analysis. Finally, the reference price at March 31^{st} 2021 is inferred from the reference portfolio by taking an 14-day Exponentially Weighted Moving Average (EWMA) of its market price initialised on November 1^{st} 2020. This is motivated by the fact that applying EWMA on a process generates a signal that includes information from the whole history of the process and hence provides a price accounting for the whole period. The 14-day time decay factor is derived to insure maximum accuracy is reached by March 31^{st} 2021.

4 RDA Index Data Suite and Use Cases

4.1 RDA IV Ranking

Two of the most common questions that are often asked about cryptoassets are 'what is the intrinsic value (IV) of a cryptoasset?', and 'what makes one crypto asset more valuable that another asset?'. In a complex market with literally thousands of instruments, RDA IV Ranking clarifies the intrinsic value of cryptoassets. RDA IV Ranking uses a proprietary algorithm to analyse asset attributes and compute their intrinsic value on 0 to N point scale - where 0 indicates no intrinsic value and N is the highest intrinsic value for a given asset. The Market IV Level at time t is defined as the maximum RDA points across all assets at any given point in time t. The Market IV Level serves as a reference for the evolution of fundamental drivers of the cryptoasset industry. By definition, it is the higher frontier of intrinsic value of cryptoassets in the market.

$$MarketIVLevel_t = \max r_t(A) \tag{9}$$

4.2 RDA IV Rating

RDA IV Rating is a star rating system designed to simplify the comparative assessment of the investability of cryptoassets. The calculation of the IV Rating stars is based on the Cross Attributes Group Average (CAGA) Score of an asset. The CAGA score is the percentage average score of an asset across the four RDA attribute groups. The CAGA score is further analysed within a 5 tiier star system in order to assign a rating per CAGA score per asset. This approach enables the assessment of the assets across the RDA attribute groups and provides a more comprehensive assessment of their relative systemic integrity and investability. It enables crypto users and investor to identify risks related to asset integrity and systemic issues. When used in conjunction with RDA IV Rankings, RDA IV Ratings empower investors to move from speculative trading to a knowledge-based portfolio construction and investment strategies.

4.3 RDA Pricing

Despite their libertarian use cases to enable peer-to-peer, trustless, decentralised peer- to-peer transactions, behaviour consistent with speculative trading accounts for the majority of cryptoasset use-cases. The FCA cryptoasset consumer research 2020 concluded that 47% of people considered buying cryptoassets as a gamble that could make or lose money, 25% see it as part of their wider investment portfolio, 22% do not want to miss out on a money making opportunity, 17% classifies it as part of their long term savings plan (e.g. pension), and 7% invest in it because they don't trust the current financial system. The majority of people buy them on the expectation that the asset will appreciate in value over time due to speculative buying which subsequently creates risks for investors at all levels of the pyramid. The RDA Price data stands in contrast with the market price to reveal the impact of speculation on each asset. The RDA-Market price ratio (RMr) is a key data point in the RDA Index Data Suite: RMr enables crypto users and investors to determine over or under pricing and to manage risks upside and downside.

The Fundamental Price P_f of a cryptoasset at any point in time is defined as its RDA Points at that particular point in time multiplied by the fundamental price of the reference portfolio at March 31^{st} 2021. This price is normalised by the ratio of its Circulating Supply to the Circulating Supply of the reference portfolio for all assets except those of particular types (i.e. stablecoins, commodity-backed, etc...) whom we replace this normalising factor by special provisions that are beyond the scope of this paper.

$$P_f = R_A \times Pt_{ref} \frac{CirculatingSupply_A}{CirculatingSupply_{ref}} \tag{10}$$

4.3.1 The RDA-Market Price Ratio

Using the RDA Price, we define the RDA-Market Price Ratio for an asset as the ratio of its calculated fundamental price over its market price. This ratio gives an indicator on the level of speculation price in the market. An RM ratio close to 1 reflects minimal speculative noise in the asset, while further values of RMr indicate higher levels of mispricing. When combined with the rating of the considered asset, we derive a tradability indicator as follows:

			FMr = Fundamental Price / Market Price		
			FMr<0.9	0.9<=FMr <=1.1	1.1<=FMr
IV Score	High	IVScore>=0.85	**Hold**	**Buy**	**Strong Buy**
		0.7<= IVScore <0.85	**Hold**	**Hold**	**Buy**
	Average	0.4<= IVScore <0.7	**Sell**	**Hold**	**Buy**
	Low	0.2<= IVScore <0.4	**Sell**	**Hold**	**Hold**
		IVScore <0.2	**Strong Sell**	**Sell**	**Hold**

4.4 RDA Exchange Rates

The RDA Exchange Rate (ER) clarifies the intrinsic exchange rates between cryptoassets based on their underlying attributes. Similar to RDA pricing data, the RDA exchange rates enable consumers to identify the level of speculation in market rates for each currency pair. RDA exchange rates serve as a useful reference for over-the-counter trading and payment use cases.

$$ER^F_{A/A'} = \frac{r(A)}{r(A')} \tag{11}$$

4.4.1 The Fundamental Exchange Rate as a Price Oracle for Liquidity Pools

The above mentioned fundamental exchange rate allows traders to characterise the relative value of token pairs upon which liquidity pools rely. Using the fundamental exchange rate, a trader is able to adequately assess the liquidity pools returns and make the adequate decisions depending on his aimed trading horizon.

4.5 The RDA 10 Index

In a volatile and complex market with thousands of instruments, RDA Index provides a dynamic portfolio of cryptoassets with minimum risk and projected higher returns. With a starting value of 100, the RDA Index Level is the current performance of the weighted asset allocation. The RDA Index Level reflects the evolution of investment returns based on the fundamental drivers of the cryptoasset industry. The index constituents are first selected based on the top 500 assets by market capitalisation, then filtered by top 100 by iv ranking, and further filtered by top 50 by iv rating and finally filtered by RM ratio (the ratio of RDA price to market price) to arrive at the RDA 10 Index. The weight of each asset within this fundamental portfolio is determined by their relative RM ratio.

5 Special Considerations

5.1 Attributes Weighting, Re-Balancing and Portfolio Reconstitution

The cryptoasset industry is in constant evolution. New asset features are announced daily in this field. This entails the RDA attributes taken into account be periodically reviewed through their relevance and the weights applied to them in the definition of the RDA Points. This is done through sentiment analysis of the RDA attributes. Moreover, the reference portfolio is also updated at the same pace to ensure the index continuously represents the evolution of a reference portfolio with the least level of speculation on it.

5.2 Validating the Reliability of the Fundamental Price

The fundamental price concept of a cryptoasset is conceived to reflect its intrinsic value deprived of speculative noise. As this price should mirror the real worth of the asset, we derive a standard methodology that evaluates each asset while taking into account its specific characteristics.

In order to measure the reliability of the fundamental price generated, we proceed to monitor how this price is positioned with respect to the market price. If the market price of an asset consistently maintains itself either below or above the fundamental price during the considered period then the fundamental price is dubbed to be reliable.

In practice, the typical observation period is three months. We also allow the prices to cross during two one-week buckets without retracting the reliability quality. This last assumption is made to further confirm the robustness of the fundamental price as being a correction level of the market price.

6 Backtesting

The reliability of the fundamental price is also to be measured by the performance of a mean-reversion trading strategy around this price. To summarise the strategy in brief, when the market price grows significantly greater (lower) than the fundamental price, we set the algorithm to construct a short (long) position. This position is closed progressively as the spread between the market price and the fundamental price narrows. Backtesting of the fundamental price is an ongoing exercise and the results will be published along with the relevant KPIs in due course.

7 Concluding Remarks

This paper detailed the steps in the process of the creation of the fundamentally-weighted Index for the crypto asset class. We used Modern Portfolio Theory techniques to derive the reference portfolio whose fundamental price is equal to its market price. This reference portfolio is built across all cryptoassets types and meets the requirements of consistency and robustness necessary to be adopted as a benchmark for the cryptoasset space. In the current circumstances where the lack of fair value valuation prevails, the RDA Index is set to become a corner stone and a reference benchmark for assessing digital assets.

The methodology adopted for construction of the index based on past returns has its limits, as in not taking into account future circumstances, which might not be present when historical data were considered but could play an important role in valuation if taken into account. Asset scarcity is also a limitation in this methodology, as it is assumed that any amounts of any assets can be accessed, irrespective of the market depth and costs. Furthermore, an implicit assumption that the returns are normally distributed without any skewness. This is asymptotically valid but not detected in practice at lower polling frequencies. Finally, the volatility of assets and the correlation between them may change over time, hence motivating periodical reconstitution of the portfolio.

8 References

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