Real
Digital Asset Index

RDA Index Methodology

Academic Paper

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

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Abstract

Speculative trading accounts for the 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 have developed a fundamentally weighted index—Real Digital Asset Index (RDAi)—for this asset class. We use multi-factor analysis to compute RDA Points as a measure of the intrinsic value of cryptoassets where the Index Level is the maximum RDA Points attained by an asset at any given point.

We start our analysis with the Friedman conjecture that users of cryptoassets fundamentally value peer-to-peer, trustless, decentralised and censorship resistant transactions. From these 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. To model the intrinsic value of cryptoassets, we then specify a mapping of RDA Attributes to RDA Points to quantify the intrinsic value of each asset as a function of its RDA attributes. This unique RDA Attributes-weighted methodology is combined with modern portfolio theory to compute and track the intrinsic value and associated fundamental price of cryptoassets over time. The reference portfolio definition relies on Markowitz optimisation.

In the last part of the paper we discuss the various uses of the index and summarise the backtesting undertaken on a fundamental price in order to assess its reliability and potential use as a trading benchmark.

Keywords: *cryptoasset, fundamental analysis, intrinsic value*

1 - Introduction

There are over 8,000 cryptoassets traded across 34,000 markets by nearly 250 million active users. As at the time of writing, £800 billion had migrated from traditional asset class such as commodities and stocks into cryptoassets. With the fear of market crash that often surrounds cryptoassets, investors seek clarity on asset valuation beyond market-capitalisation weightings and price series. Four main problems inhibit such intrisic valuation of cryptoassets:

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

These problems disincentivise new entrants into the market and constrain mass adoption of cryptoassets across industries and economies. Real Digital Asset Index (RDAi) addresses the four problems of valuation, asset complexity, volatility and regulatory compliance through multi-factor analysis to establish an instrinsic value benchmark for the asset class. RDAi brings 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 a fundamentally weighted index, an intrinsic value rating, and fundamental prices and exchange rates. Third, we present backtesting results to demonstrate the reliability of RDAi. Finally, we summarise our conclusions and state the limitations of RDAi.

2 - The RDA Points System

In the style of Emiliano Pagnota and Andrea Buraschi (2), we cite the Friedman conjecture:

> *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 cryptoasset 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, decentralisation, voting rights, computational nodes, token velocity, and so on. We aggregate these qualities into 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 cryptoassets to attract and retain value.

2.1.1 Business Ecosystem Stability (E)

The Business Ecosystem Stability component represents resilience and the ca- pability 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 a distinguishable track record 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 the specific technologies in use are.

2.1.4 Sentiments (S)

The Sentiments attributes seeks to measure the level of sentiment that exists in favour of an 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 through the appropriate lens 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 use as a 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:

$$r(A) = \sum_{q=1}^{I_Q} \omega_q Q_A$$

Where I_Q is the number of RDA attributes along (E, U, T, S), ω_q is the weight associated with an attribute Q.

3 - Reference Portfolio Construction

Despite their inherent usefulness to enable borderless, permissionless and decentralised peer-to-peer transactions, behaviour consistent with speculative trading accounts for the majority of cryptoasset uses. The majority of people buy and sell cryptoassets not because of their promise to deliver a libertarian financial system; rather, they are bought speculatively, held and eventually sold for profits—or in most cases a loss. The Financial Conduct Authority (FCA) has advised consumers to be cautious when buying cryptoassets and should ensure they understand and can bear the volatility and risks involved with assets that have as they put it no 'intrinsic value.'

A portfolio of cryptoassets can be constructed such that its market price infers its fair price at a specific point in time. By definition, this portfolio's value should not vary uncontrollably with time. 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 chose the assets constituting the reference portfolio from the top five assets by market capitalisation across five major categories of cryptoassets as at June 30th 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-currency backed stable 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, we find the optimal combination of these sub-portfolios that again minimises the total volatility.

3.2 Practical Considerations

While Bitcoin was the only cryptoasset in 2009, as at the time of writing this paper, there are more than 8,000 cryptoassets traded and grouped under numerous classifications. 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 March 1st 2020, which is the date we consider to be the starting point of our analysis. Finally, the reference price at June 30th 2020 is inferred from the reference portfolio by taking a 14-day Exponentially Weighted Moving Average (EWMA) of its market price initialised on March 1st 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 June 30th 2020.

3.3 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:

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

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:

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

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

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:

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

$\omega_{A_h^i}^*$ 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 although now applied on the H portfolios Pt_h^*, whose covariance matrix is denoted by Cov_*. Hence:

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

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

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

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

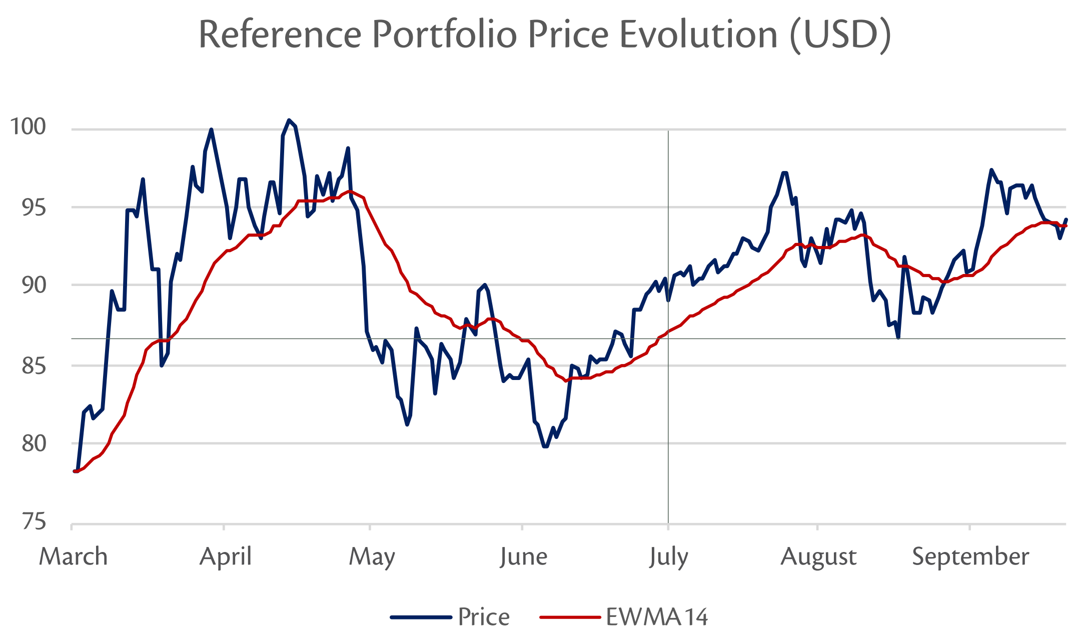

Figure 1

4 - RDAi Data and Usecases

4.1 Fundamental Price of the Reference Portfolio at June 30th 2020

By definition of the reference portfolio, it is built to extract the portfolio whose fundamental price can be derived from its market price at June 30th 2020 using a 14-day Exponentially Weighted Moving Average initialized at March 1st 2020.

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

4.2 Fundamental Price of a Cryptoasset at Any Period in Time

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 June 30th 2020.

$$P_f = R_A \times Pt_{ref}$$

4.3 Fundamental Price Index

Using the fundamental prices generated through the RDA Points, we generate fundamental prices for portfolios, which is essential for comparing and benchmarking the market price of these portfolios and decomposing the prices by RDA Attributes. That is, the Fundamental Price of an index I of n assets would be:

$$I^F = (\sum_{i=0}^{n} \omega_{A^i} R_{A^i}) * Pt_{ref}$$

4.4 Intrinsic Value Rating

By dividing the RDA Points of a cryptoasset by the RDA Index Level for the same time t, we obtain a score on a 0 and 1 scale that enables rating and ranking of cryptoassets.

$$r_A = \frac{R_A}{\max_A R_A}$$

The ranking is translated into a bucketed 5-star grading system. These buckets are not uniformly distributed; Instead, they divide the [0;1] segment into 5 uneven and separated clusters that reflect the distribution of the grades of the cryptoassets.

4.5 Fundamental Exchange Rate Index

Having established the fundamental prices of cryptoassets, we generate the fundamental exchange rates between cryptoassets serving as a useful reference for over-the-counter trading and crypto payment use cases.

$$ER_{A/B}^{F} = \frac{R_A}{R_B}$$

4.6 RDA Index Level

The RDAi Level is defined as the maximum value of the RDA Points of the largest 500 cryptoassets by market capitalization at any given point. It serves as a reference for the evolution of fundamental drivers of the crypoasset industry. By definition, it is the higher frontier of intrinsic value of cryptoassets.

$$RDAiLevel = \max_A R_A$$

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 that the RDA attributes taken into account be periodically reviewed as to their relevance and the weights applied to them in the RDA Points definition. 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 Reliablity of the Fundamental Price

The fundamental price concept of a cryptoasset is conceived to reflect its intrinsic value minus speculative interference. As this price should mirror the real worth of an 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 considered 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 a fundamentally-weighted Index for the crypto asset class. We used Modern Portfolio Theory techniques to derive a 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 that might not be present when historical data is considered but that 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 amount of any asset can be accessed, irrespective of the market depth and costs. Furthermore, an implicit assumption is 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.

6 - References

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