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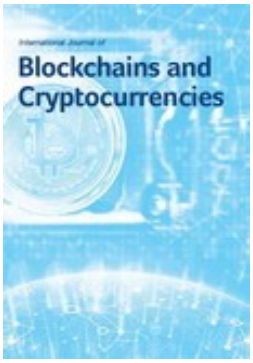

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How to obtain the fair value for cryptocurrency and digital assets

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How to obtain the fair value for cryptocurrency and digital assets

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Abstract: Digital asset prices have been highly volatile, and it is hard to understand their fair value as you would with traditional assets. There has been some research to consider how cryptocurrencies and digital assets can be valued. However, there are no mainstream valuation theories that have still been developed. This paper undertakes a survey of some of the methods utilised to perform this valuation in practice at present. Though, as cryptocurrencies have a significant technology component, as a result, the existing valuation models being used in the industry are different to the traditional valuation models. This paper intends to review traditional asset valuation models like the CAPM and APT. When reviewing industry-based models that are used to value digital assets, we notice that neither of these models provides a simplistic way of analysing the fair value of digital assets. Therefore, this paper develops the volatility-based digital asset model to show how traditional and digital assets can be valued using a standard model.

Keywords: cryptocurrency; digital assets; bitcoin; valuation; fair value; volatility; valuation models; blockchain; capital asset pricing model; CAPM; arbitrage pricing theory; APT.

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Biographical notes: Nipun Agarwal holds a PhD in Computer Science and Behavioural Economics. He has a passion for valuation models, cryptocurrencies and blockchain. He has previously published papers in financial technology and economics fields. He is currently working as a Management Consultant in Technology Risk for the KPMG in Sydney, Australia.

1 Introduction

Cryptocurrencies have had a significant impact on the global economy over the past decade. However, these currencies have had significant volatility since they have been introduced. It is unclear if they can be classified as currencies, property, commodities, or stocks. Different organisations across the globe have a different perspective on their classification and as there is no specific regulation of these cryptocurrencies or digital assets. There is no consensus on how these cryptocurrencies can be valued. Some market participants consider them as currencies and utilise the quantity theory of money (QTM)

model to value them. While others utilise asset pricing models like capital asset pricing model (CAPM) or arbitrage pricing theory (APT) to value these currencies as if they were stocks. Often these cryptocurrencies might also be considered as commodities like gold or a safe haven asset, i.e., cryptocurrencies being valued as digital gold.

Though, based on recent research it is starting to become clear that cryptocurrencies are not typical currencies, as they do not meet the requirements for a traditional currency. Also, holders of these cryptocurrencies seem to be trading them like assets rather than purchasing goods and services. Therefore, that would move the definition of these cryptocurrencies to a form of investment (i.e., stock, property or commodity). As a result, these cryptocurrencies and digital assets seem to reflect a non-dividend paying asset with high volatility. But, due to their speculative nature it has become difficult to find the fair value of these cryptocurrencies using traditional models. The question to ask in this instance is – how do we value these cryptocurrencies and digital assets?

The key contribution of this paper to the field of cryptocurrency and digital asset valuation is that cryptocurrencies are seen to be valued based on different basis than traditional asset. While there are specific cryptocurrency and digital asset valuation methods in practice, there aren't any mainstream valuation methods that the industry has settled on at present. Most of the cryptocurrency and digital asset valuation methods are quite specific to the technology related to that asset. In order to simplify this process of coming up with a mainstream fair value model.

This paper has reviewed the key traditional valuation models that relate to traditional assets and also of cryptocurrency and digital asset valuation models used in the industry. This allows us to understand at a high level the types of models that can be applied to this valuation exercise. This paper also develops a volatility-based digital asset valuation model. The reason for developing this model is that it seems that there is no simplistic model that covers the valuation of cryptocurrencies and digital assets. As, this will be required if a mainstream valuation model is required for all cryptocurrencies and digital assets, rather than having a multitude of valuation models.

2 Existing cryptocurrency valuation methods

It is hard to value cryptocurrencies as it is not clear if asset, currency, or property valuation methods should be applied to them. Traditional finance methods that would be utilised to value currencies are the QTM and stocks can be valued using the discount cash flow, dividend discount model, CAPM and APT. Understandably only crypto assets that have a future dividend or cash flow can be valued using the discount cash flow and dividend discount model. However, CAPM and APT can still be used for stocks not paying dividends.

Though, all these models have their shortcomings, it is also important to state that while the CAPM have been the most commonly used model for asset pricing. It has a key shortcoming, where the price of the stock is potentially a self-fulfilling prophecy. The price of the stock is based on the systemic risk it has to the market portfolio. So, if the return on the market portfolio increases it will increase the stock price and vice versa. For example, if the price of Amazon, Facebook (Meta), Alphabet, Netflix and Google (otherwise called the FAANG) goes up then the market portfolio will increase.

This will inadvertently increase the valuation of any other stock that shares the same portfolio as these FAANG stocks. While, it is not as simplistic, using an equation that directly links the stock value to the portfolio value will create a cycle that will not keep the individual stock value independent of other stocks. This will specifically be highlighted at times when the stock valuation of leading stocks climbs or drop rapidly. It will have an artificial impact of increasing the stock price of directly unrelated stocks, which is concerning as the fundamentals of these unrelated stock are not clearly reflected in their valuation using the CAPM.

Further, it is also hard to calculate the inputs to the CAPM equation accurately.

$$E(r_i) = R_f + \beta_i \left(E(r_m) - R_f \right)$$

where

$E(r_i)$ return on the financial asset i

R_f risk free rate of return

β_i beta or systemic risk of the stock to the market portfolio

$E(r_m)$ expected rate of return on the market portfolio.

The APT is an extension of the CAPM, where it analyses the expected return on the stock based on multiple factors that impact the asset. The APT has the difficulty of accurately assessing the factors that impact an asset's price and the value of that factor. This equation can be written as:

$$E(r_i) = R_f + \beta_i * RP_1 + \beta_2 * RP_2 + \ldots \beta_{kn} * RP_n$$

where

$E(r_i)$ return on the financial asset i

R_f risk free rate of return

β_n beta or systemic risk related to factors $(1 \ldots n)$

RP_n risk premium associated to the specified factor for factors $(1 \ldots n)$.

Ernst & Young (2019) study on cryptocurrency valuation has viewed it from four different perspectives. Table 1 provides a summary of the approaches reviewed by this study, which states that the valuation model depends on the possibility of receiving future cash flows. Therefore, this study classifies these crypto assets into three classes security tokens, utility tokens and cryptocurrencies. The market and income approaches can be applied to the security tokens as they provide future cash flows compared to the cost approach that is applied to utility tokens. However, the study finds that the income approach is preferred over the market approach, unless the is highly liquid and at a higher stage of development. Utility tokens do not provide a future cash flow, but they provide the right to utilise the invention to utility token holders from the blockchain technology. Finally, the crypto assets that can be mined for example Bitcoin (BTC), can classified as a cryptocurrency. This study states that the lower bound for the price of a cryptocurrency in effect can be the cost of mining as the miners will not mine this cryptocurrency at a loss. Ernst & Young (2019) also states that the QTM is another method to obtain the fair value of these crypto assets. However, they state that there is significant judgment in

assessing the inputs to the QTM equation, which can impact the value of these assets. Further the QTM equation provides a fair value of this crypto asset at a future date. Therefore, an appropriate discount rate is required to obtain the current fair value.

Table 1 The valuation of crypto assets EY summary

Valuation approach	*Security tokens*	*Utility tokens and cryptocurrencies*
Market approach	• Quoted prices	• Quoted prices
	• Comparable tokens	• Comparable tokens
Income approach	• Possible	• Not applicable
	• Key considerations	
	• Forecasts	
	• Discount rates	
Cost approach	• Not applicable	• Opportunity cost of utility
		• Cost of generation (e.g., mining)
QTM	• Not applicable	• Possible
		• Practical aspects
		• Estimation of equation terms
		• Time value of money

Source: Ernst & Young (2019, p.16)

An alternate model for valuing cryptocurrencies has been provided by SEBA Bank (2021) based on the acceptance of the crypto asset:

$$P_t C_t = U_t^n H(d_t)^i \left(\frac{C_t}{C}\right)^s \left(\frac{C_t}{T_t}\right)^g$$

where

P_t Dollar price of the cryptocurrency.

C_t Number cryptocurrencies in circulation.

P_tC_t Market capitalisation.

U_t Number of users and n is the network parameter that captures the positive externalities associated with the users. The number of users indicates the magnitude of adoption.

$H(d_t)$ Calibrated network hash rate (defined as $d.2^{32}$ with d being the difficulty. As $1/H(d_t)$ is the probability the next hash mines a block, the larger $H(d_t)$, the higher the security of the blockchain).

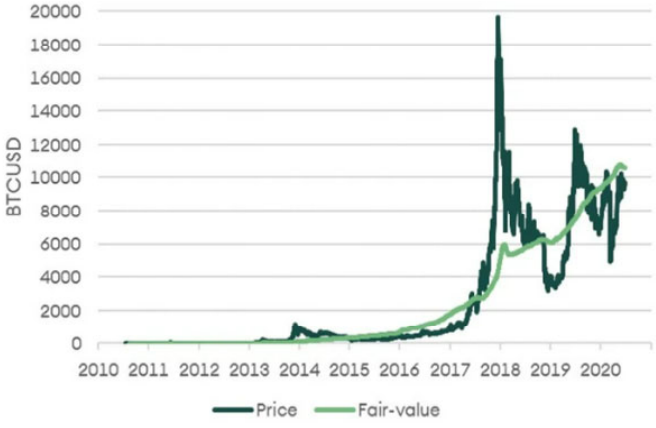
i Immutability parameter; the second term measures network security. The higher i, the more important are immutability as a characteristic and the higher the value associated with it. The immutability parameter i measures the price elasticity of security.

C_t/C Is an index measuring the proportion of circulating supply $C(t)$ to total supply C, and s is the scarcity parameter.

C_t/T_t Measures the proportion of transaction $T(t)$ to the current supply $C(t)$, and g is the Gresham's law parameter.

This model primarily explains the price of the cryptocurrency depends on the circulation of the currency. The results simulated in USD are provided against the actual price of BTC between 2010 to 2021, as seen in Figure 1. The fair value for BTC does not accurately align with the historical price and significant volatility can be noticed in the BTC price.

Figure 1 Historical evaluation of BTC price and fair value provided by the SEBA model (see online version for colours)



Source: https://www.seba.swiss/research/A-new-fair-value-model-for-Bitcoin/#valuation

Lielacher (2021) provides additional valuation models for cryptocurrencies, these include: store of value, token velocity, Metcalf's law, NVT ratio, INET model, daily active addresses and crypto networks for small economies model. The store of value model is rather arbitrary and assumes that if we consider that BTC will replace gold as a safe-haven asset in the future. Then, we can align the fair value of BTC to that of gold.

The token velocity model is a bit more sophisticated and can be defined as: token velocity (V) = total transaction volume / average network value and this can be substituted into the QTM equation (MV = PQ). Metcalf's law is another method to value cryptocurrencies that has been introduced in a paper by Alabi (2017). This equation can be stated as MET ratio = market cap / (daily active address)^2. Where Alabi (2017) states that he believes that Metcalf's law models the fair value of cryptocurrencies well, as the square of the number of end users is proportional to the value of the network.

Woo (2017) provides an alternate valuation method called NVT ratio (network value to transaction ratio) that can be stated as NVT ratio = market cap / transaction volumes. In effect, Woo (2017) that it is like the price earnings ratio for an asset, where the value to the network depends on the number of transactions made through the network. The NVT ratio seems to be quite similar to Alabi's (2017) MET ratio. Compared to these models, another model called the INET model provided by Chris Burniske. This model

utilises the QTM and treats cryptocurrency as a currency. It has a similar basis as the token velocity model.

However, it differentiates itself by providing two values of the cryptocurrencies represented by current utility value (CUV) and the discounted expected utility value (DEUV). CUV represents the present value of the token, while DEUV represents value of a token when it is used as a speculative asset. In comparison, the daily active addresses model is like the Metcalf's law and NVT ratio and crypto networks for small economies replicates as if the cryptocurrency is the national currency of a small economy. There seem to be numerous valuation models that exist; however, most models are specific to the type of cryptocurrency in existence. It will be useful to obtain a more generic model that will assist in valuing all types of crypto assets, regardless if they provide future cash flows or not.

If we look back at this discussion, some researchers like Humphrey (1993, 1997) has reviewed cryptocurrency valuation from a quantity theory of money perspective. Assuming that cryptocurrencies should be considered a form of money. While, other researchers like Gounder et al. (2021a, 2021b, 2012c) state that there are numerous applications of cryptocurrencies. That explains that cryptocurrencies should be valued in other ways than just as a currency. Supporting this concept, Lielacher (2021) provides a different perspective on cryptocurrency valuation.

However, the main question still exists – how to value cryptocurrencies and digital assets and are they overvalued? Woo (2017) states that cryptocurrencies maybe overvalued. This creates a discussion on how we need to value cryptocurrencies and digital assets and what are the most appropriate valuation models to do that valuation?

3 Digital asset volatility model – volatility model-based to value digital assets

This section will attempt to develop a valuation method that is independent of the type of crypto asset in existence. This volatility model intends to assess the risk – return pay-off for this crypto asset and as a result, it equates the current price of the asset to the last price and the change in volatility in comparison to the risk-free asset over the last period. This equation can be states as:

$$Price(t1) = Price(t0)x\frac{1+Volatility\ of\ crypto\ (t1)}{1+Votality\ of\ risk\ \ free\ asset\ (t1)}$$

Provided in Figure 2 is the change in BTC price in relation to its 30-day volatility to the USD that can often be considered as a safe haven asset. This model can potentially also be used to value traditional assets like equities and bonds, if we replace the cryptocurrency volatility by the volatility of the respect asset class. Similarly, if we replace the volatility of any type of digital asset with the volatility of the cryptocurrency in the equation above, then we should be able to calculate the fair value of this digital asset.

In this equation, we consider the price of the crypto asset at the last period ($t0$) and consider the price volatility of this asset to a risk-free asset since the last price. This will allow us to obtain the current price based on the deviation in price over the past period

due to its relative volatility. While this equation can be applied to a crypto asset, however as it is generic in nature, it can potentially be applied to other assets like stocks.

Figure 2 Chart for BTC price and volatility compared to USD (see online version for colours)

Source: http://www.highcharts.com

4 Conclusions

In conclusion, the intent of this paper has been to provide a survey of the valuation models that are being used to value cryptocurrencies at present. The volatility model that has been developed in this paper as another possible option compared to existing models. The intent of this paper however has been to highlight that numerous models are being developed in this research area and that it is ripe for further research to be undertaken as this research field is in its early stage.

The key contribution of this paper to the field of cryptocurrency valuation is that cryptocurrencies are seen to be valued based on different basis than traditional asset. While these digital assets (i.e., cryptocurrencies) are new compared to traditional assets. In order to undertake this alignment, this paper has developed a volatility-based model to value digital assets.

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